TECHNOLOGY IN ACTION

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Behind the Scenes: How the Internet Works

Inner Workings of the Internet

- Internet Management and Networking

- Internet Identity

Internet Management and Networking

Objectives

13.1 Describe the management of the Internet.

13.2 Explain how the Internet's networking components interact.

13.3 List and describe the Internet protocols used for data transmission.

Internet Identity

Objectives

13.4 Explain how each device connected to the Internet is assigned a unique address.

13.5 Discuss how a numeric IP address is changed into a readable name.

Internet Management and Networking

Management (Objective 13.1)

**Figure 13.1** Major Organizations in Internet Governance and Development

Organization	Purpose	Web Address
Internet Society	Professional membership society that provides leadership for the orderly growth and development of the Internet	internetsociety.org
Internet Engineering Task Force (IETF)	A subgroup of the Internet Society that researches new Internet technologies to improve its capabilities and keep the infrastructure functioning smoothly	ietf.org
Internet Architecture Board (IAB)	Technical advisory group to the Internet Society and an IETF committee; provides direction for the maintenance and development of Internet protocols	iab.org
Internet Corporation for Assigned Names and Numbers (ICANN)	Organization responsible for managing the Internet's domain name system and the allocation of IP addresses	icann.org
World Wide Web Consortium (W3C)	Consortium of organizations that sets standards and develops protocols for the web	w3.org

Internet Management and Networking
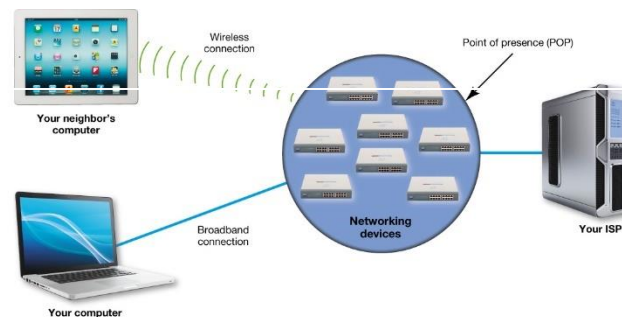## Networking Components (1 of 3)

- Internet backbone

  – Main paths of the Internet

  – Data travels the fastest

  – Collection of large national and international networks

  – Optical carrier line

    ▪ Fiber-optic
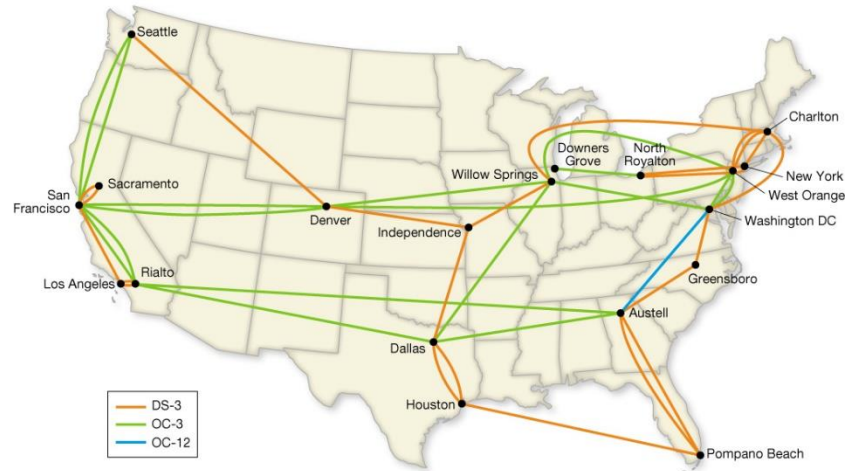
Internet Management and Networking
Networking Components (2 of 3) (Objective 13.2)

- Internet exchange point (IXP)
  - Used for connecting ISPs
  - One or more network switches
- Point of presence (POP)
  - Used for individuals
  - Bank of modems, servers, routers, and switches

Internet Management and Networking
Networking Components (3 of 3) (Objective 13.2)

- Client/server model is used for Internet

- Common servers

  – Web servers host web pages and provide information to clients

  – Commerce servers enables users to buy goods and services

  – File servers provide remote storage space

Internet Management and Networking
Data Transmission (1 of 4) (Objective 13.3)

- Network follows standard protocols to send information

- Protocol is a set of rules for exchanging electronic information

- They are the "rules of the road" for the information superhighway

- Open as apposed to proprietary system
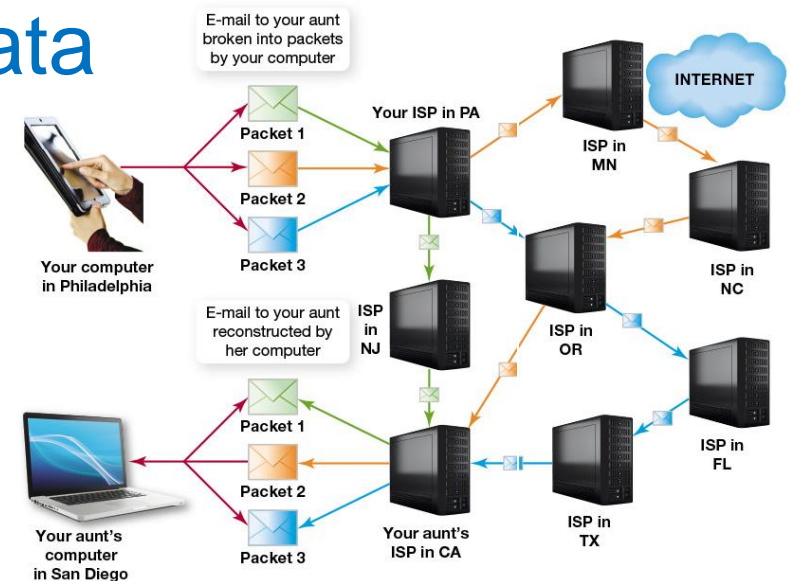
Internet Management and Networking
Data Transmission (2 of 4) (Objective 13.3)

- Circuit switching is not used to connect two computers
  - Inefficient when applied to computers
  - Computers transmit data in a group, or burst
  - Processor works on the next task and ceases to communicate until ready to transmit next burst
  - Circuit would have to remain open

Internet Management and Networking
Data Transmission (3 of 4) (Objective 13.3)

- Packet switching makes computer communication efficient

- Packets are chunks of data

  – Address to which the packet is being sent

  – Address from where the packet originates

  – Reassembly instructions

  – Data that is being transmitted

Internet Management and Networking
Data Transmission (4 of 4) (Objective 13.3)

- TCP/IP is the protocol the Internet uses for transmitting data
  - Consists of many interrelated protocols

Figure 13.5 TCP/IP Protocol Suite—Main Protocols	
Internet Protocol (IP)	Sends data between computers on the Internet
Transmission Control Protocol (TCP)	Prepares data for transmission and provides for error checking and resending of lost data
User Datagram Protocol (UDP)	Prepares data for transmission; lacks resending capabilities
File Transfer Protocol (FTP)	Enables files to be downloaded to a computer or uploaded to other computers
Telnet	Enables user to log in to a remote computer and work on it as if sitting in front of it
Hypertext Transfer Protocol (HTTP) and HTTP Secure (HTTPS)	Transfers Hypertext Markup Language (HTML) data from servers to browsers; HTTPS is an encrypted protocol for secure transmissions
Simple Mail Transfer Protocol (SMTP)	Used for transmission of e-mail messages across the Internet
Dynamic Host Configuration Protocol (DHCP)	Takes a pool of IP addresses and shares them with hosts on a network on an as-needed basis
Real-time Transport Protocol (RTP)	Network protocol for delivering audio and video over IP

Internet Identity
IP Addresses (1 of 2) (Objective 13.4)

- Each device connected to the Internet is required to have a unique number
  - Called the IP address

- Internet Corporation for Assigned Names and Numbers (ICANN) ensures IP addresses are unique

- Internet of Things (IoT) is the explosive growth of Internet-enabled devices

Internet Identity
IP Addresses (2 of 2) (Objective 13.4)

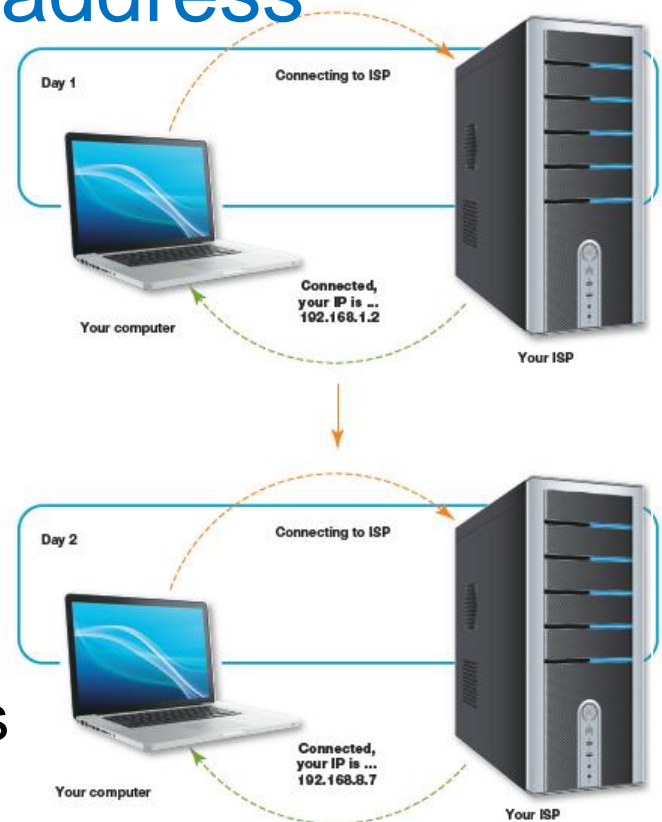- How a computer gets an IP address (either/or)
  - Static
    - IP address never changes
    - Assigned by network administrator or ISP
  - Dynamic
    - IP address is temporary
    - Assigned from pool of addresses
    - More common
  - DCHP shares IP addresses as needed

Day 1
Connecting to ISP
Your computer
Connected, your IP is ... 192.168.1.2
Your ISP

Day 2
Connecting to ISP
Your computer
Connected, your IP is ... 192.168.8.7
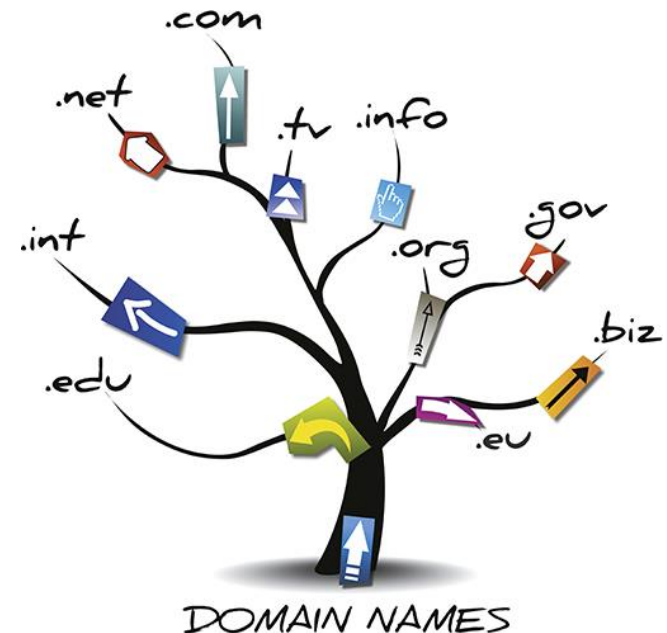Your ISP

Internet Identity
Domain Names (1 of 2) (Objective 13.5)

- Top level domains

  - Standardized pools such as .com and .org
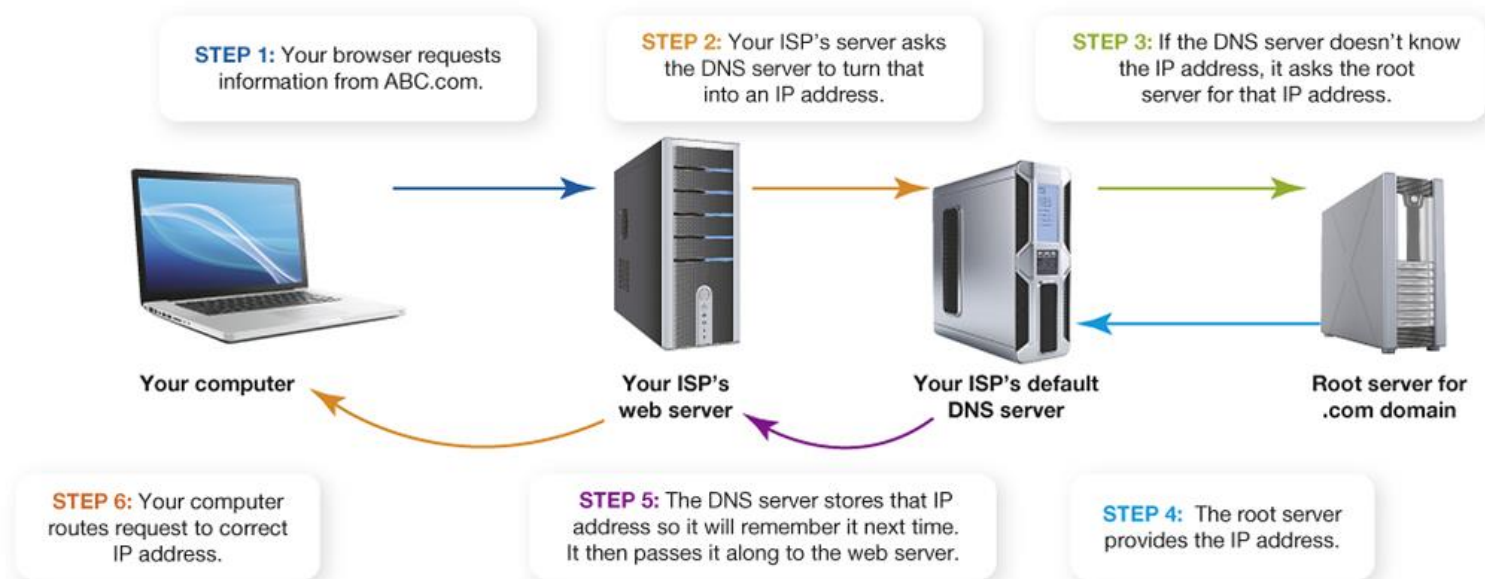
  - Established by ICANN

- Second-level domains

  - Directly below the top-level domain

  - Unique within its own TLD

  - Not necessarily unique to all top-level domains

DOMAIN NAMES

Internet Identity
Domain Names (2 of 2) (Objective 13.5)

- Computer converts URL to an IP address

- Domain name system (DNS) server functions like an Internet phone book

STEP 1: Your browser requests information from ABC.com.

STEP 2: Your ISP's server asks the DNS server to turn that into an IP address.

STEP 3: If the DNS server doesn't know the IP address, it asks the root server for that IP address.

Your computer

Your ISP's web server

Your ISP's default DNS server

Root server for .com domain

STEP 6: Your computer routes request to correct IP address.

STEP 5: The DNS server stores that IP address so it will remember it next time. It then passes it along to the web server.

STEP 4: The root server provides the IP address.

Coding and Communicating on the Internet

- Web Technologies

- Communications Over the Internet

Web Technologies

Objectives

13.6 Compare and contrast a variety of web development languages.

13.7 Compare and contrast server-side and client-side application software.

Communications Over the Internet

Objectives

13.8 Discuss the mechanisms for communicating via e-mail and instant messaging.

13.9 Explain how data encryption improves security.

Web Technologies
Web Development (1 of 4) (Objective 13.6)

- HTML
  - Not a programming language
  - Set of rules for marking blocks of text
  - Browser knows how to display text
  - Surrounded by pairs of HTML tags
  - Tags and text referred to as an element

  <i>*This should be bolded and italicized.*</i>

Web Technologies
Web Development (2 of 4) (Objective 13.6)

- Cascade style sheet (CSS) is a list of rules defining how to display HTML elements

Cascading Style Sheet	Resulting Formatted View

body
{
font-size:75%;
font-family:"lucida calligraphy",arial,'sans serif';
background-color:#DCDCDC;
color:#8A2BE2;
margin:10px;
}
 	
h1 {font-size:200%;}
h2 {font-size:140%;}
h3 {font-size:110%;}
 	
th {background-color:#D3D3D3;}
td {background-color:#FFFAF0;}
	Heading 1
	This is some text in a paragraph.
	This is another paragraph.
	Heading 2
	Name / E-mail
	Doe, John / jdoe@example.com
	Smith, Eva / esmith@example.com
	Heading 3

Each cascading style sheet dictates the specific font

Each cascading style sheet sets a different background image or color

body
{
font-size:75%;
font-family:verdana,arial,'sans serif';
background-image:url('gradient.png');
background-repeat:repeat-x;
background-color:#FFFFF0;
color:#000080;
margin:70px;
}
h1 {font-size:200%;}
h2 {font-size:140%;}
h3 {font-size:110%;}
	Heading 1
	This is some text in a paragraph.
	This is another paragraph.
	Heading 2
	Name / E-mail
	Doe, John / jdoe@example.com
	Smith, Eva / esmith@example.com
	Heading 3

Web Technologies
Web Development (3 of 4) (Objective 13.6)

- XML is different from HTML
  - eXtensible Markup Language (XML) describes what data is
  - Users build markup languages to accommodate data formats and needs
  - Provides a method of data validation through XML schema diagrams (XSD)
- JSON stands for JavaScript Object Notation
  - Data interchange that is easy for humans to read and write

Web Technologies
Web Development (4 of 4) (Objective 13.6)

- Hypertext Transfer Protocol (HTTP) was created to transfer hypertext documents across the Internet

- Hypertext Transfer Protocol Secure (HTTPS) ensures that data is sent securely over the web
  - SSL
  - TLS

Web Technologies
Application Architecture (1 of 3) (Objective 13.7)

- Server-side applications

  – The web is a client/server network

  – Program on server is considered server-side

  – Can require many communication sessions between client and server

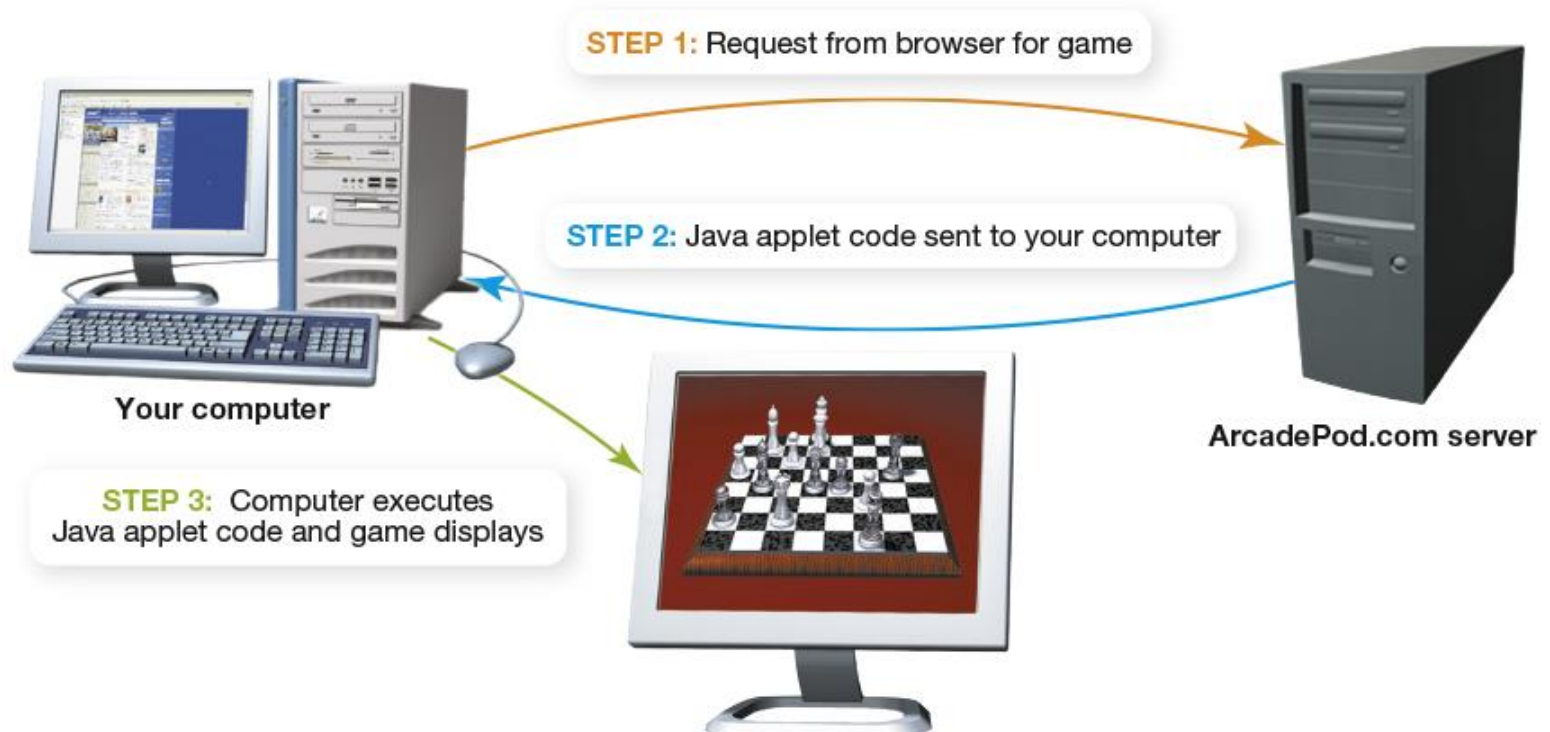 – Can perform very complex operations

Web Technologies
Application Architecture (2 of 3) (Objective 13.7)

- Client-side applications

  – Programs that run on client computer

  – Require no interaction with web server

  – New data is only sent in response to a request

  – Exchange of data can make interactivity inefficient and slow

  – More efficient on local computer

Web Technologies
Application Architecture (3 of 3) (Objective 13.7)

- JavaScript is a commonly used scripting language

STEP 1: Request from browser for game

STEP 2: Java applet code sent to your computer

Your computer

STEP 3: Computer executes Java applet code and game displays
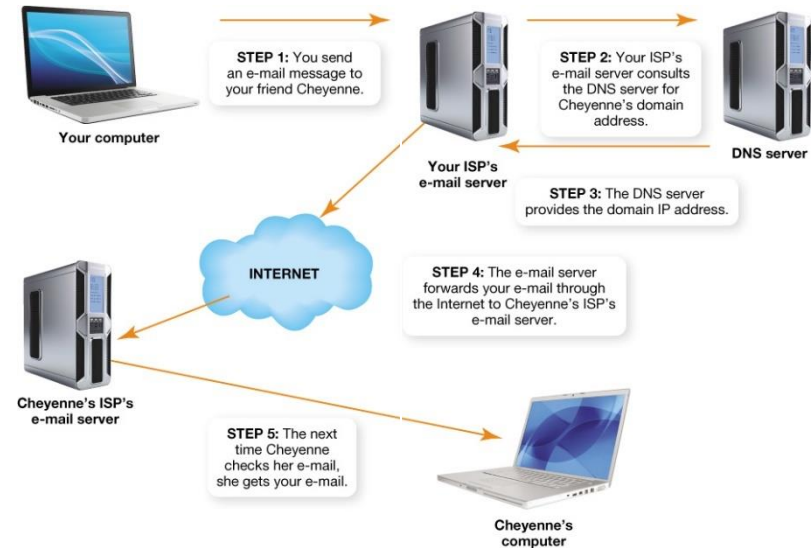
ArcadePod.com server

Communications Over the Internet
Types of Internet Communication (1 of 2)
(Objective 13.8)

- E-mail is one of the most common communication methods

    - Created in 1971

    - Simple Mail Transfer Protocol (SMTP) is responsible for sending e-mail

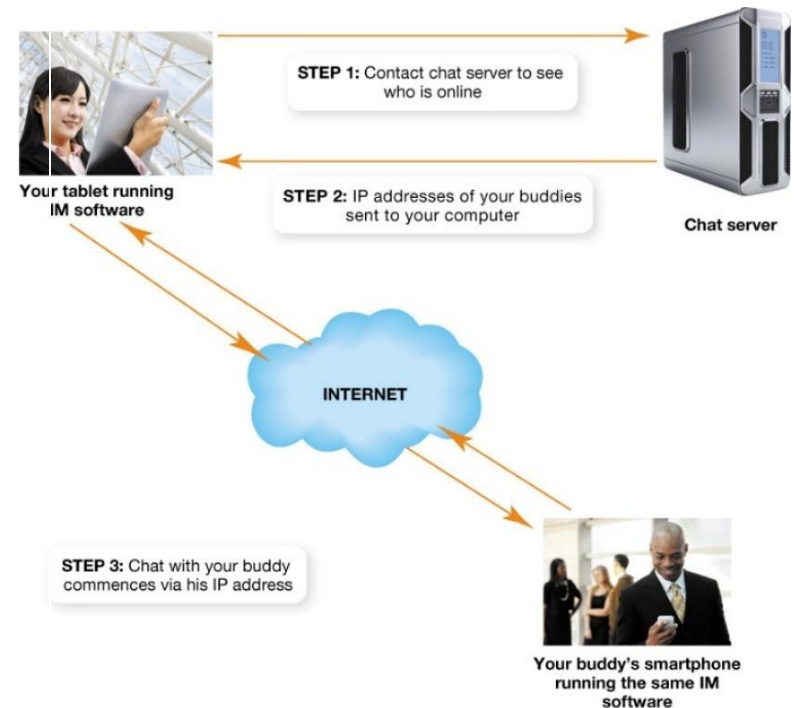   - Multipurpose Internet Mail Extensions (MIME) allows sending of files

STEP 1: You send an e-mail message to your friend Cheyenne.

Your computer

STEP 2: Your ISP's e-mail server consults the DNS server for Cheyenne's domain address.

DNS server

Your ISP's e-mail server

STEP 3: The DNS server provides the domain IP address.

INTERNET

STEP 4: The e-mail server forwards your e-mail through the Internet to Cheyenne's ISP's e-mail server.

Cheyenne's ISP's e-mail server

STEP 5: The next time Cheyenne checks her e-mail, she gets your e-mail.

Cheyenne's computer

Communications Over the Internet
Types of Internet Communication (2 of 2)
(Objective 13.8)

- Instant messaging

  – Another very common communication method

  – Uses a client program

  – Makes connection with chat server

  – Chatting takes place between two devices

STEP 1: Contact chat server to see who is online

Your tablet running IM software

STEP 2: IP addresses of your buddies sent to your computer

Chat server

INTERNET

STEP 3: Chat with your buddy commences via his IP address

Your buddy's smartphone running the same IM software

Communications Over the Internet
Encryption (1 of 3) (Objective 13.9)

- Encryption

  – Email is susceptible to being read by unintended parties

  – Might remain on servers

  – Process of coding e-mail so that only the person with the key can decode the message

Communications Over the Internet
Encryption (2 of 3) (Objective 13.9)

- Private-key encryption

  – Only the two parties have the code

  – Could be a shift code

  – Could be more complex substitution code

  – Main problem is key security

A = C	N = P
B = D	O = Q
C = E	P = R
D = F	Q = S
E = G	R = T
F = H	S = U
G = I	T = V
H = J	U = W
I = K	V = X
J = L	W = Y
K = M	X = Z
L = N	Y = A
M = O	Z = B

The word **C O M P U T E R** using the two-position code at the left now becomes:

E Q O R W V G T

This is difficult to interpret without the code key at the left.

Communications Over the Internet
Encryption (3 of 3) (Objective 13.9)

- Public-key encryption
  - Two keys (key pair) are created
    - One for coding, one for decoding
  - Coding key is distributed as public key
    - Message being sent is coded using public key
  - Decode using private key
    - Only receiver knows private key
  - Mathematical relationship between two keys
  - Pretty Good Privacy (PGP) are available for download

Questions

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