

E-Business Tenth Edition

Chapter 2 E-Business Technology Basics

Learning Objectives

In this chapter, you will learn:

- About the origin, growth, and current structure of the Internet
- How packet-switched networks are combined to form the Internet
- How Internet, e-mail, and Web protocols work
- About Internet addressing and how Web domain names are constructed

Learning Objectives (cont'd.)

- About the history and use of markup languages on the Web
- How HTML tags and links work
- About technologies people and businesses use to connect to the Internet
- About Internet2 and the Semantic Web

The Internet and the World Wide Web

- **Computer network**
 - Technology allowing people to connect computers
 - **Internet**
 - Interconnected global computer networks (capital “I”)
 - **internet** (small “i”): group of interconnected computer networks
- **Basic technology structure**
 - Supports networks, the Internet, and e-commerce
- **World Wide Web (Web)**
 - Subset of Internet computers
 - Includes easy-to-use interfaces

New Uses for the Internet

- 1969 Advanced Research Projects Agency (ARPA)
 - Packet network connected four computers
 - ARPANET: earliest network (became the Internet)
 - Academic research use (1970s and 1980s)
- 1970s: other uses
 - E-mail (1972)
 - Networking technology
 - Remote file transfer and computer access
 - **Mailing lists**
 - E-mail address forwards message to subscribed users
- 1979: **Usenet (User's News Network)**
 - Read and post articles
 - **Newsgroups** (topic areas)

New Uses for the Internet (cont'd.)

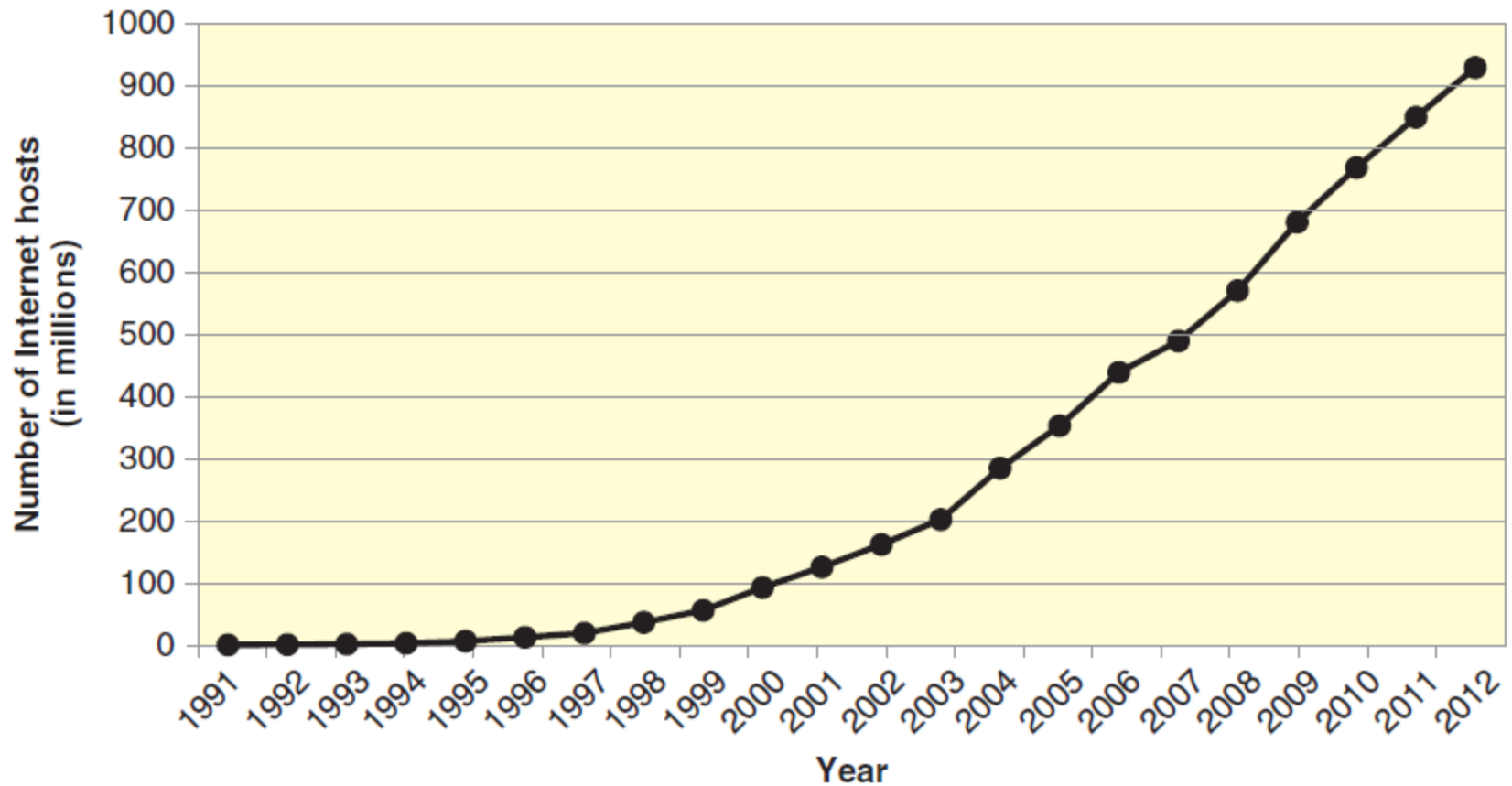
- Limited Internet use
 - Research and academic communities
- 1979 – 1989
 - Network applications improved and tested
 - Defense Department's networking software
 - Gained wider academic and research institution use
 - Common communications network benefit recognized
 - Security problems recognized
- 1980s: personal computer use explosion
 - Academic and research networks merged

Commercial Use of the Internet

- **National Science Foundation (NSF)**
 - Provided funding
 - Prohibited commercial network traffic
- Businesses turned to commercial e-mail providers
- Larger firms built networks (leased telephone lines)
- 1989: NSF permitted two commercial e-mail services
 - MCI Mail and CompuServe
 - Commercial enterprises could send e-mail
 - Research, education communities sent e-mail directly to MCI Mail and CompuServe

Growth of the Internet

- 1991
 - Further easing of commercial Internet activity restrictions
- 1995: privatization of the Internet
 - Operations turned over to privately owned companies
 - Internet based on four **network access points (NAPs)**
- **Network access providers**
 - Sell Internet access rights directly to larger customers
 - Use **Internet service providers (ISPs)**
 - Sell to smaller firms and individuals



Source: Internet Software Consortium (<http://www.isc.org/>) and author's estimates

FIGURE 2-1 Growth of the Internet

Growth of the Internet (cont'd.)

- **Internet hosts:** directly connected computers
- Internet growth
 - One of the most significant technological and social accomplishments of last millennium
 - Nearly every country involved
 - Used by millions of people
 - Billions of dollars change hands yearly

Packet-Switched Networks

- **Local area network (LAN)**
 - Network of computers located close together
- **Wide area networks (WANs)**
 - Networks of computers connected over greater distances
- **Circuit**
 - Combination of telephone lines and closed switches connecting them to each other
- **Circuit switching**
 - Centrally controlled, single-connection model
 - Single electrical path between caller and receiver

Packet-Switched Networks (cont'd.)

- **Circuit switching** (cont'd.)
 - Works well for telephone calls
 - Does not work as well for:
 - Sending data across large WAN and interconnected network (Internet)
- **Circuit-switched network problem**
 - Connected circuit failure
 - Causes interrupted connection and data loss
- **Solution**
 - Packet switching: move data between two points

Packet-Switched Networks (cont'd.)

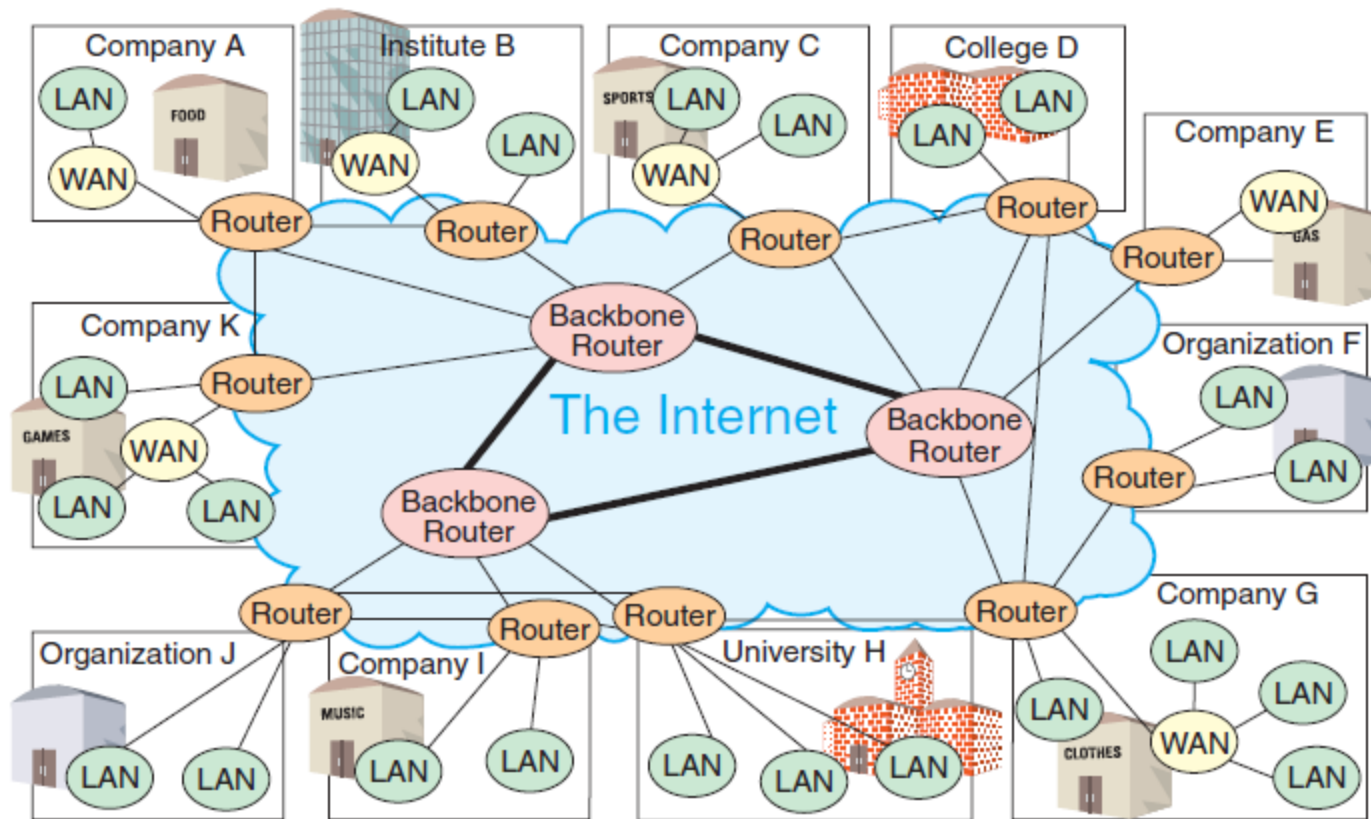
- **Packet-switched network**
 - **Packets**
 - Small pieces labeled electronically (origin, sequence, and destination address)
 - Travel along interconnected networks
 - Can take different paths
 - May arrive out of order
 - Destination computer
 - Collects packets
 - Reassembles original file or e-mail message

Routing Packets

- **Routing computers**
 - Decide how best to forward each packet
 - Also known as:
 - **Router computers, routers, gateway computers, border routers**
 - Gateway from LAN or WAN to Internet
 - Border routers between organization and the Internet
- **Routing algorithms**
 - Programs on routing computers
 - Determine best path for packet

Routing Packets (cont'd.)

- Routing algorithms applied to **routing table (configuration table)** information
- Routing table (configuration table) information
 - Includes lists of connections
 - Includes rules for:
 - Specifying connection to use first
 - Handling heavy packet traffic and network congestion
- Variety of rules and standards for creating packets
- **Hubs, switches, and bridges**
 - Devices that move packets



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FIGURE 2-3 Router-based architecture of the Internet

- Routers connect networks
 - Translate packets into standard format
 - **Internet backbone** consists of **backbone routers** and telecommunication lines

Public and Private Networks

- **Public network**
 - Public availability
- **Private network**
 - Private, leased-line connection
 - Physically connects intranets to one another
- **Leased line**
 - Permanent telephone connection between two points
 - Advantage: security
 - Drawback: costs
 - **Scaling problem:** adding companies

Virtual Private Network (VPN)

- Connection via public networks and protocols
 - Sends sensitive data
 - Uses **IP tunneling** (encapsulation) system
 - Private passageway through public Internet
 - Secure transmission
 - **Encapsulation**
 - Encrypts packet content, places inside another packet
 - **IP wrapper**: outer packet
 - VPN software installed on both computers
- “Virtual” since connection seems permanent
 - Actually a temporary connection

Intranets and Extranets

- Intranet
 - An internet within the boundaries of the organization
 - Interconnected private networks
- Extranet
 - An internet that extends beyond the organization and incorporates networks of outside entities
- Technologies (public networks, private networks, or VPNs)
 - Independent of organizational boundaries

Internet Protocols

- **Protocol:** collection of network data rules
 - Includes transmission rules
 - Computers must use same protocol
- ARPANET: **Network Control Protocol (NCP)**
- **Proprietary architecture (closed architecture)**
 - Manufacturer creates own protocol
- **Open architecture (Internet core)**
 - Uses common protocol
 - Four key message-handling rules
 - Contributed to the Internet's success

TCP/IP

- Internet protocols
 - **Transmission Control Protocol (TCP)**
 - Controls message or file disassembly into packets before Internet transmission
 - Controls packet reassembly into original formats at destinations
 - **Internet Protocol (IP)**
 - Specifies addressing details for each packet
 - Labels packet with origination and destination addresses
- **TCP/IP** refers to both protocols
 - Used today (replaced ARPANET NCP)

IP Addressing

- **Internet Protocol version 4 (IPv4)**
 - Used for past 20 years
- **IP address**
 - 32-bit number identifying computers
- **Base 2 (binary) number system**
 - Computers use for internal calculations
 - Digit: 0 or a 1 (on or off condition)
 - Four billion different addresses ($2^{32} = 4,294,967,296$)
 - Four numbers separated by periods
 - IP addresses range: 0.0.0.0 to 255.255.255.255
- Router breaks message into packets
 - Contains source and destination IP address

IP Addressing (cont'd.)

- New devices creating high demand for IP addresses
- **Subnetting**
 - Use reserved private IP LAN (WAN) addresses
 - Provide additional address space
- **Private IP addresses**
 - IP numbers not permitted on Internet packets
- **Network Address Translation (NAT) device**
 - Converts private IP addresses into normal IP addresses

IP Addressing (cont'd.)

- **Internet Protocol version 6 (IPv6)**
 - Replaces IPv4 (future)
 - IPv4 and IPv6 not directly compatible
 - Advantages
 - 128-bit number for addresses
 - 2^{28} addresses: 34 followed by 37 zeros
 - Packet format change eliminates unnecessary fields
 - Adds fields for security, other optional information
 - Shorthand notation system for expressing addresses (complex eight groups of 16 bits)
 - **Colon hexadecimal** or **colon hex**
Note: hexadecimal = base 16

Electronic Mail Protocols

- **Electronic mail (e-mail)**
 - Formatted according to common set of rules
 - Client/server structure
- **E-mail server**
 - Computer devoted to e-mail handling
 - Stores, forwards e-mail messages
- **E-mail client software**
 - Reads and sends e-mail
 - Communicates with e-mail server software
- Standardization and rules very important

Electronic Mail Protocols (cont'd.)

- Two common protocols
 - **Simple Mail Transfer Protocol (SMTP)**
 - Specifies mail message format
 - Describes mail administration e-mail server
 - Describes mail transmission on the Internet
 - **Post Office Protocol (POP)**
 - Sends mail to user's computer; deletes from server
 - Sends mail to user's computer; does not delete
 - Asks if new mail arrived

Electronic Mail Protocols (cont'd.)

- **Multipurpose Internet Mail Extensions (MIME)**
 - Set of rules for handling binary files
- **Interactive Mail Access Protocol (IMAP)**
 - Newer e-mail protocol
 - Same basic POP functions
 - Additional features that support user access to email from any computer
 - IMPAP Disadvantage: storage of e-mail messages on e-mail server

Web Page Request and Delivery Protocols

- **Web client computers**
 - **Web client software (Web browser software)**
 - Sends Web page file requests to other computers (Web servers)
- **Web server computer**
 - **Web server software**
 - Receives requests from many different Web clients
- **Client/server architecture**
 - **Combination: client computers, server computers**

Web Page Request and Delivery Protocols (cont'd.)

- **Hypertext Transfer Protocol (HTTP)**
 - Internet Web page file delivery rules
- Web page request using Web browser
 - User types protocol name
 - Followed by “//:” characters before the domain name
 - **Uniform Resource Locator (URL)**
 - Combination: protocol name, domain name
 - Locates resources (Web page) on another computer (Web server)

Emergence of the World Wide Web

- Web
 - Software running on Internet-connected computers
 - Generates network traffic
 - Web software: largest single traffic category
 - Outpaces: e-mail, file transfers, and other data transmission traffic
 - Web resulted from new ways of thinking about information storage and retrieval
- Key technological Web elements
 - Hypertext
 - Graphical user interfaces

The Development of Hypertext

- **Hypertext server**
 - Stores **Hypertext Markup Language (HTML)** files
 - Computers connect and read files
- **Web servers (today)**
 - Hypertext servers used on the Web
- **HTML**
 - Set of codes (tags) attached to text
 - Describes relationships among text elements
- **Hypertext link (hyperlink)**
 - Points to another location
 - Same or another HTML document

Graphical Interfaces for Hypertext

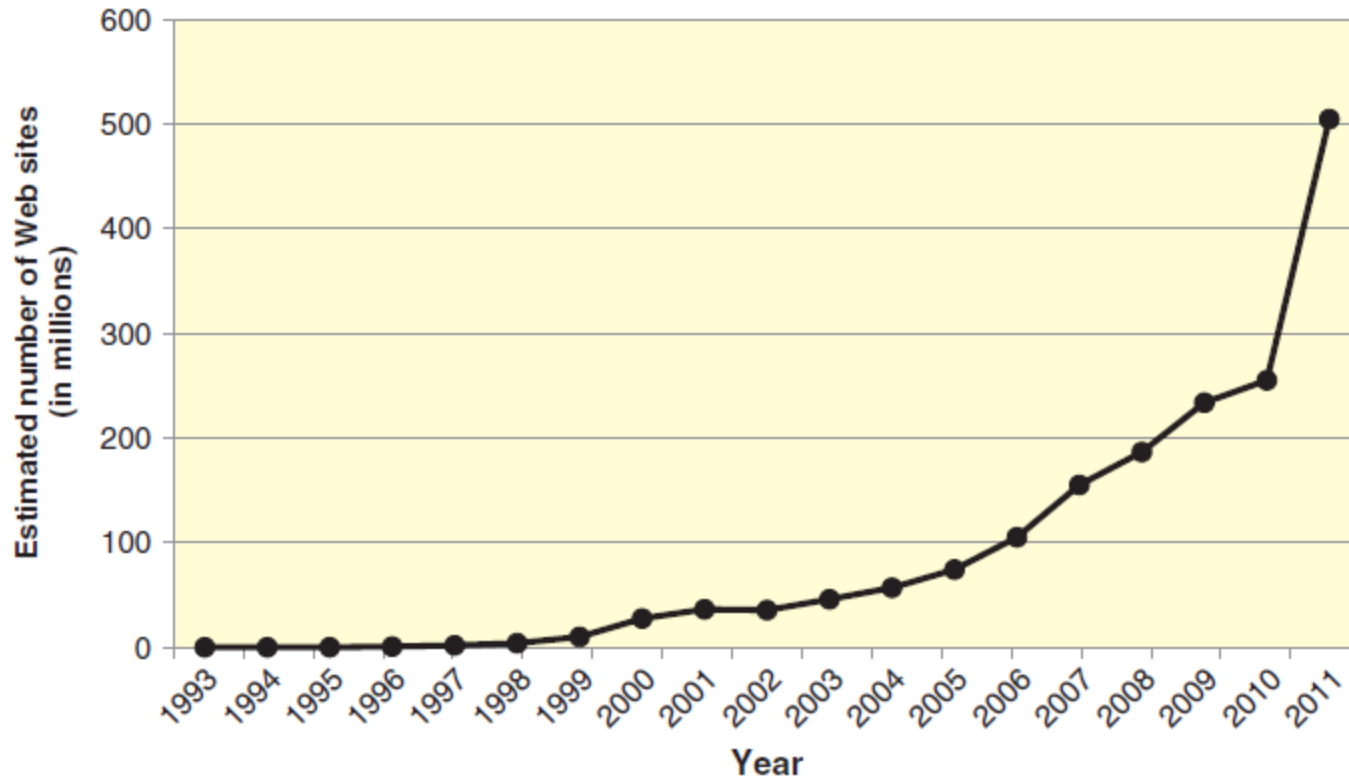
- **Web browser**
 - Software, e.g., Mozilla Firefox or MS Internet Explorer
 - Users read (browse) HTML documents
 - Move from one HTML document to another
 - Text formatted with hypertext link tags in file
- HTML document
 - No specification of text element appearance
- **Graphical user interface (GUI)**
 - Presents program control functions, output to users, and input from users
 - Pictures, icons, and other graphical elements

The World Wide Web (cont'd.)

- World Wide Web: Berners-Lee's name for system of hyperlinked HTML documents
- Quick acceptance in scientific research community
- 1993: first GUI program (Mosaic)
 - Read HTML
 - Used HTML hyperlinks for page-to-page navigation
 - First Web browser widely available for personal computers

The World Wide Web (cont'd.)

- Easy way to access Internet information
 - Provided by functional system of pages connected by hypertext links
 - Profit-making potential
- Netscape Communications founded in 1994
 - Netscape Navigator Web browser (based on Mosaic)
 - Microsoft: Internet Explorer (most widely used)
 - Mozilla Firefox: Netscape Navigator descendant
- Number of Web sites
 - More rapid growth than the Internet itself



Adapted from Netcraft Computer Surveys (<http://www.netcraft.com>) and author's estimates

FIGURE 2-2 Growth of the World Wide Web

- More than 250 million Web sites/50 billion Web pages
- Commercial business Web use increasing
- 2010 to 2011: number of Web sites doubled

The Deep Web

- Non-permanent Web pages can be created based on customized response to user's search
 - Example: search for “online business” book on Amazon.com
- **Deep Web**: information that is stored in databases and is accessible to users through Web interfaces
 - Potentially trillions of Web pages available using deep Web

Domain Names

- Dotted decimal notation difficult to remember
- **Domain names**
 - Sets of words assigned to specific IP addresses
 - Example: www.sandiego.edu
 - Contains three parts separated by periods
 - **Top-level domain (TLD)**: rightmost part
 - **Generic top-level domains (gTLDs)**
 - **Sponsored top-level domains (sTLD)**
 - **Internet Corporation for Assigned Names and Numbers (ICANN)**
 - Manages addition of gTLDs: less stringent in recent years

TLD	Use
.com	U.S. commercial
.edu	Four-year educational institution
.gov	U.S. federal government
.mil	U.S. military
.net	U.S. general use
.org	U.S. not-for-profit organization
.us	U.S. general use
.asia	Companies, individuals, and organizations based in Asian–Pacific regions
.biz	Businesses
.info	General use
.name	Individual persons
.pro	Licensed professionals (such as accountants, lawyers, physicians)
.au	Australia
.ca	Canada
.de	Germany
.fi	Finland
.fr	France
.jp	Japan
.se	Sweden
.uk	United Kingdom

Source: Internet Assigned Numbers Authority Root Zone Database, <http://www.iana.org/domains/root/db/>

FIGURE 2-4 Commonly used domain names

Markup Languages and the Web

- **Text markup language**
 - Specifies set of tags inserted into text
- **Markup tags (tags)**
 - Formatting instructions Web client understands
- **HTML**
 - Web markup language
 - Most commonly used
 - **Standard Generalized Markup Language (SGML)** subset
 - Older, more complex text markup language
 - **Meta language**: used to define other languages

Markup Languages and the Web (cont'd.)

- **Extensible Markup Language (XML)**
 - Derived from SGML
 - Mark up shared information
 - Meta language
 - User creates markup elements extending XML usefulness
- **World Wide Web Consortium (W3C)**
 - Maintains Web standards
- **Extensible Hypertext Markup Language (XHTML)**
 - HTML version 4.0 reformulation as XML application

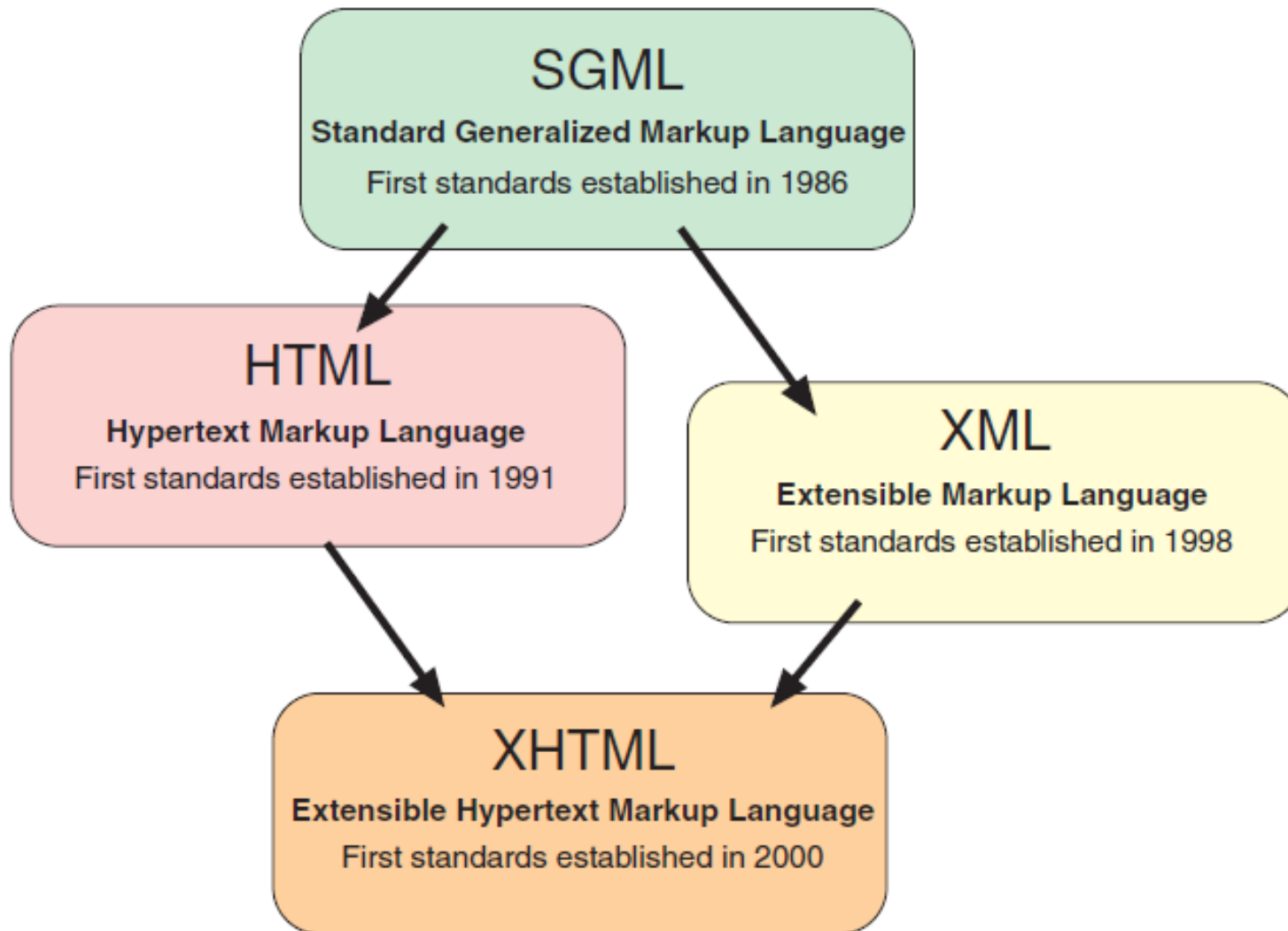


FIGURE 2-5 Development of markup languages

Hypertext Markup Language

- **Hypertext elements**
 - Text elements related to each other
- **HTML**
 - Prevalent markup language to create Web documents
 - **W3C HTML Working Group** page
 - Detailed HTML versions; related topic information
- **HTML extensions**
 - Features that work in specific Web browsers
- **Draft HTML version 5.0**
 - Includes audio and video features within the markup language itself

Hypertext Markup Language (cont'd.)

- HTML tags
 - Interpreted by Web browser
 - Format text display
 - Enclosed in angle brackets (<>)
- **Opening tag** and **closing tag**
 - Format text between them
- Closing tag
 - Preceded by slash within angle brackets (</>)
- User may customize tag interpretations

```

<html>

  <head>

    <title>HTML Tag Examples</title>

  </head>

  <body>

    <h1>This text is set in Heading one tags</h1>
    <h2>This text is set in Heading two tags</h2>
    <h3>This text is set in Heading three tags</h3>

    <p>
    This text is set within Paragraph tags. It will appear as one paragraph: the
    text will wrap at the end of each line that is rendered in the Web browser no
    matter where the typed text ends. The text inside Paragraph tags is rendered
    without regard to extra spaces typed in the text, such as these:
    Character formatting can also be applied within Paragraph tags. For
    example, <strong>the Strong tags will cause this text to appear bolded in
    most Web browsers</strong> and <em>the emphasis tags will cause this to
    appear italicized in most Web browsers</em>.
    </p>

    <pre>
    HTML includes tags that instruct the Web browser to render the text
    Exactly the way it is typed,
    as in this example.
    </pre>

```

```

<p>
HTML includes tags that instruct the Web browser to place text in bulleted or
numbered lists:
</p>

<ul>
  <li>Bulleled list item one</li>
  <li>Bulleled list item two</li>
  <li>Bulleled list item three</li>
</ul>

<ol>
  <li>Numbered list item one</li>
  <li>Numbered list item two</li>
  <li>Numbered list item three</li>
</ol>

<p>
The most important tag in HTML is the Anchor Hypertext Reference tag,
which is the tag that provides a link to another Web page (or another location
in the same Web page). For example, the underlined text
<a href="http://www.w3c.org">World Wide Web Consortium</a>
is a link to the not-for-profit organization that develops Web technologies.
</p>

</body>

</html>

```

FIGURE 2-6 Text marked up with HTML tags

This text is set in Heading one tags

This text is set in Heading two tags

This text is set in Heading three tags

This text is set within Paragraph tags. It will appear as one paragraph: the text will wrap at the end of each line that is rendered in the Web browser no matter where the typed text ends. The text inside Paragraph tags is rendered without regard to extra spaces typed in the text, such as these: Character formatting can also be applied within Paragraph tags. For example, **the Strong tags will cause this text to appear bolded in most Web browsers** and *the emphasis tags will cause this to appear italicized in most Web browsers.*

HTML includes tags that instruct the Web browser to render the text
Exactly the way it is typed,
as in this example.

HTML includes tags that instruct the Web browser to place text in bulleted or numbered lists:

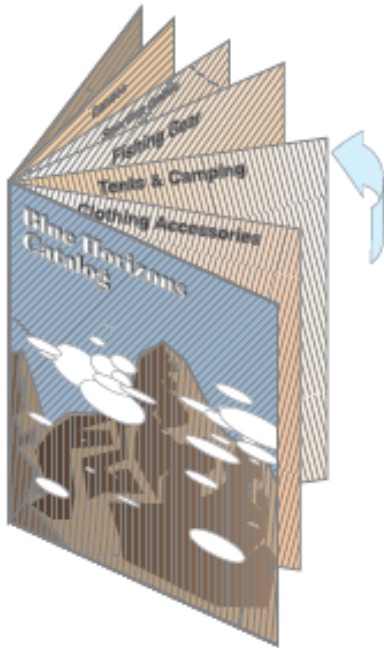
- Bulleted list item one
 - Bulleted list item two
 - Bulleted list item three
-
1. Numbered list item one
 2. Numbered list item two
 3. Numbered list item three

The most important tag in HTML is the Anchor Hypertext Reference tag, which is the tag that provides a link to another Web page (or another location in the same Web page). For example, the underlined text [World Wide Web Consortium](#) is a link to the not-for-profit organization that develops Web technologies.

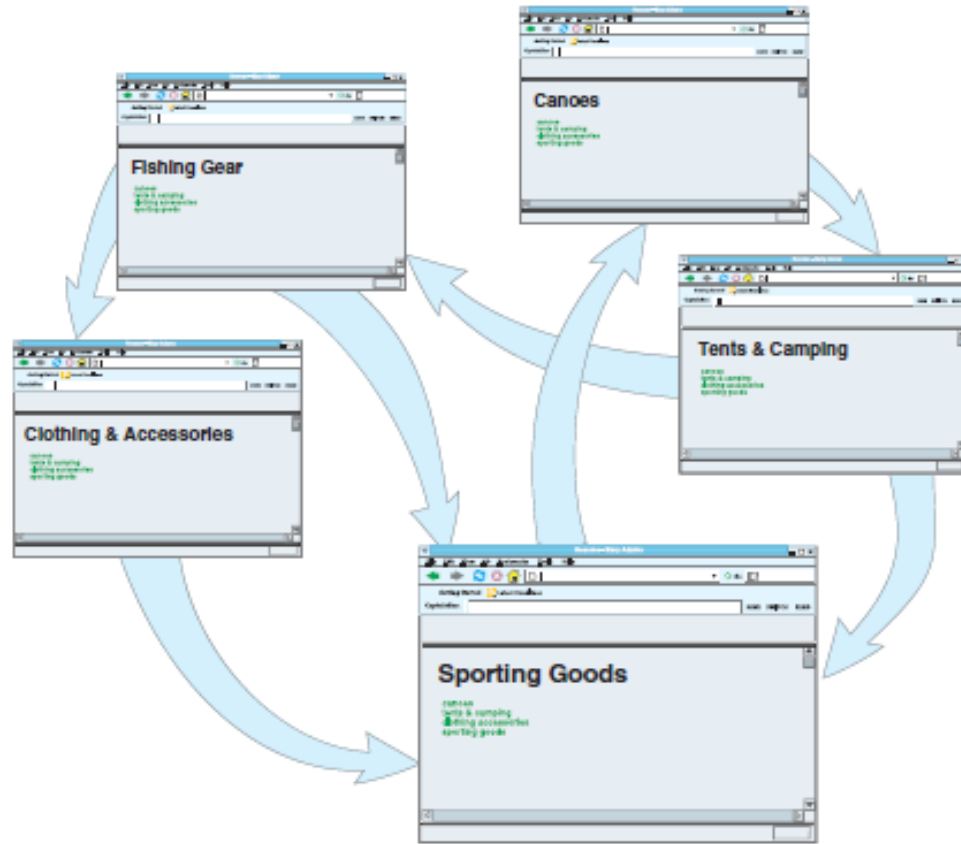
FIGURE 2-7 Text marked up with HTML tags as it appears in a Web browser

Hypertext Markup Language (cont'd.)

- HTML links
 - Hyperlinks on interlinked pages form a “web”
- **Linear hyperlink structure**
 - Reads Web page in serial fashion
 - Works well when customer fills out form
- **Hierarchical hyperlink structure**
 - Uses an introductory page (**home page, start page**) linking to other pages
 - **Site map** often available for hierarchical sites
- Anchor tags used to specify document's remote or local address



Reading a linear document



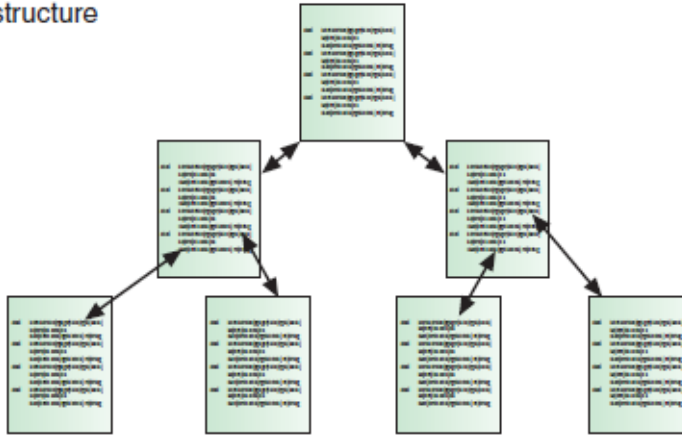
Reading a hypertext document

FIGURE 2-8 Linear vs. nonlinear paths through documents

Linear structure



Hierarchical structure



Hybrid structure

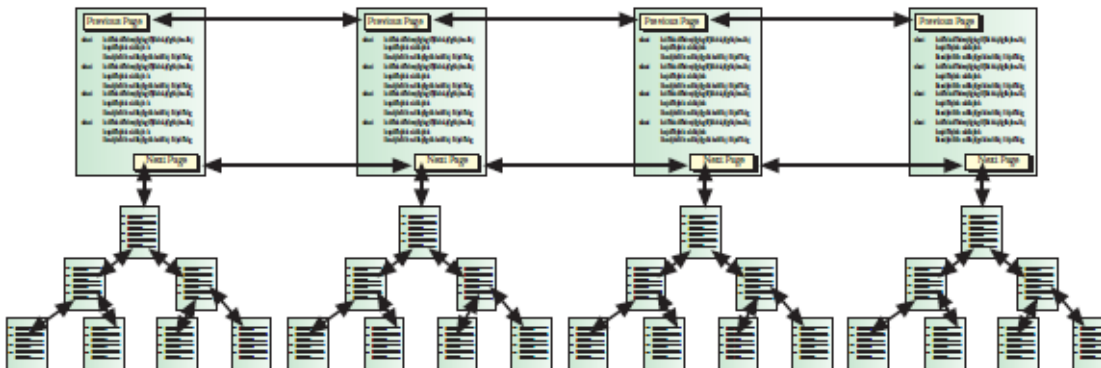


FIGURE 2-9 Three common Web page organization structures

Hypertext Markup Language (cont'd.)

- Scripting languages and style sheets
- HTML version released (after 1997)
 - Object tag
 - Embeds scripting language code on HTML pages
 - **Cascading Style Sheets (CSS)**
 - Provide more control over displayed page format
 - **Style sheet**
 - Instructions stored in separate file
 - Referenced using HTML style tag
 - May be included in Web page's HTML file

Extensible Markup Language (XML)

- Web design tool
 - For presenting or maintaining information lists, data
- Includes data-management capabilities
 - HTML cannot provide
- See Figures 2-10 and 2-11
 - Illustrate HTML shortcomings in presenting lists
- XML different from HTML
 - XML: not a markup language with defined tags
 - XML: tags do not specify text appearance on page

```

<html>
  <head>
    <title>Countries</title>
  </head>
  <body>
    <h1>Countries</h1>
    <h2>CountryName</h2>
    <h3>CapitalCity</h3>
    <h4>AreaInSquareKilometers</h4>
    <h5>OfficialLanguage</h5>
    <h6>VotingAge</h6>
    <h2>Argentina</h2>
    <h3>Buenos Aires</h3>
    <h4>2,766,890</h4>
    <h5>Spanish</h5>
    <h6>18</h6>
    <h2>Austria</h2>
    <h3>Vienna</h3>
    <h4>83,858</h4>
    <h5>German</h5>
    <h6>19</h6>
    <h2>Barbados</h2>
    <h3>Bridgetown</h3>
    <h4>430</h4>
    <h5>English</h5>
    <h6>18</h6>
    <h2>Belarus</h2>
    <h3>Minsk</h3>
    <h4>207,600</h4>
    <h5>Byelorussian</h5>
    <h6>18</h6>
  </body>
</html>

```

FIGURE 2-10 Country list data marked up with HTML tags

Countries

CountryName

CapitalCity

AreaInSquareKilometers

OfficialLanguage

Voting Age

Argentina

Buenos Aires

2,766,890

Spanish

18

Austria

Vienna

83,858

German

19

Barbados

Bridgetown

430

English

18

Belarus

Minsk

207,600

Byelorussian

18

FIGURE 2-11 Country list data as it appears in a Web browser

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FIGURE 2-12 Country list data marked up with XML tags

- Figures 2-12 and 2-13
- Advantages of XML list presentation
 - More effectively communicates the meaning of data

```

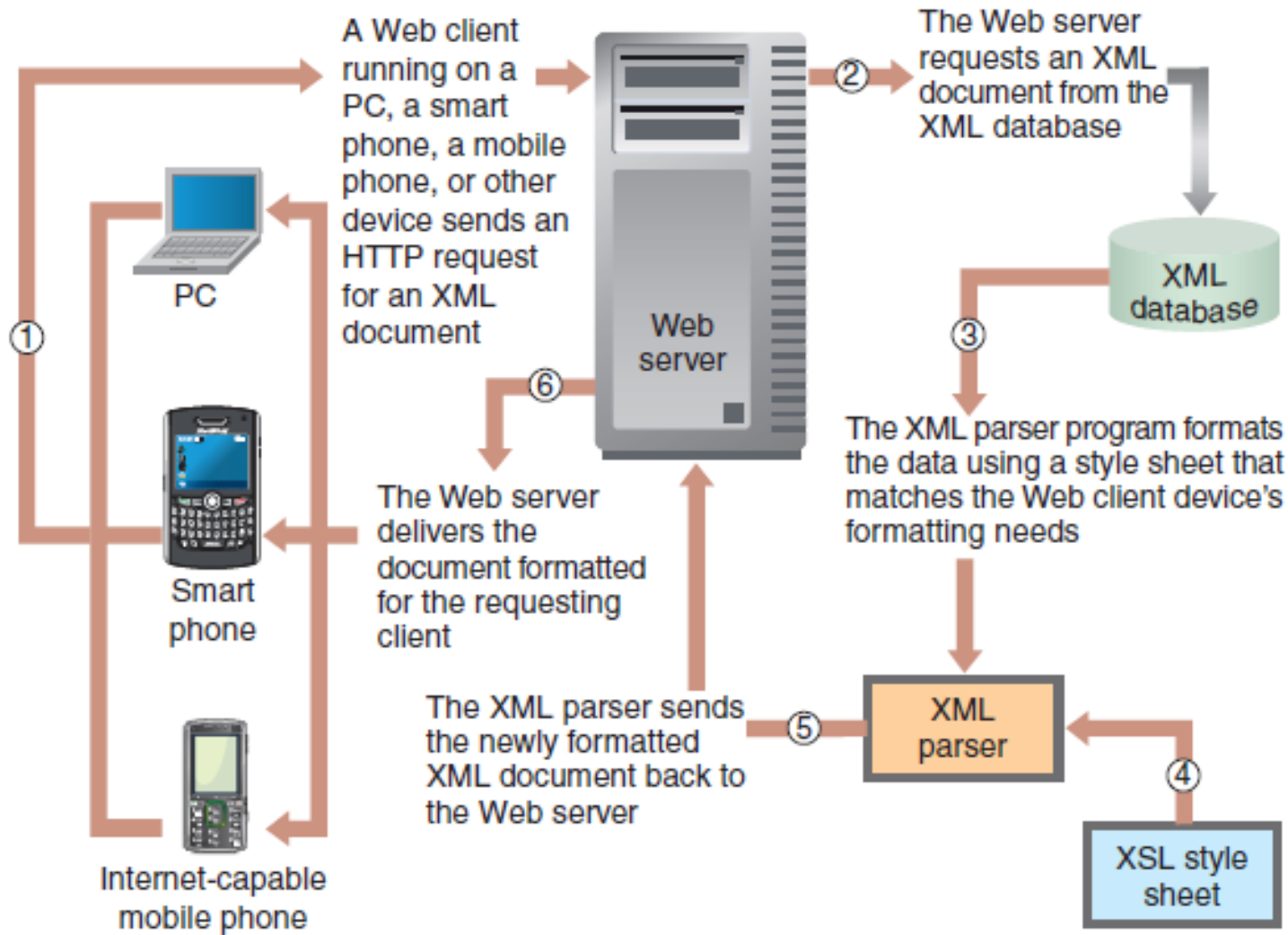
<?xml version="1.0" ?>
<CountriesList>
- <Country Name="Argentina">
  <CapitalCity>Buenos Aires</CapitalCity>
  <AreaInSquareKilometers>2,766,890</AreaInSquareKilometers>
  <OfficialLanguage>Spanish</OfficialLanguage>
  <VotingAge>18</VotingAge>
</Country>
- <Country Name="Austria">
  <CapitalCity>Vienna</CapitalCity>
  <AreaInSquareKilometers>83,858</AreaInSquareKilometers>
  <OfficialLanguage>German</OfficialLanguage>
  <VotingAge>19</VotingAge>
</Country>
- <Country Name="Barbados">
  <CapitalCity>Bridgetown</CapitalCity>
  <AreaInSquareKilometers>430</AreaInSquareKilometers>
  <OfficialLanguage>English</OfficialLanguage>
  <VotingAge>18</VotingAge>
</Country>
- <Country Name="Belarus">
  <CapitalCity>Minsk</CapitalCity>
  <AreaInSquareKilometers>207,600</AreaInSquareKilometers>
  <OfficialLanguage>Byelorussian</OfficialLanguage>
  <VotingAge>18</VotingAge>
</Country>
</CountriesList>

```

FIGURE 2-13 Country list data marked up with XML tags as it would appear in Internet Explorer

Extensible Markup Language (XML) (cont'd.)

- Strength of XML
 - Users may define their own tags (weakness as well)
- Solution to user tag definitions
 - Common XML tags standards
 - Data-type definitions (DTDs) or XML schemas
 - 2001: W3C released set of rules for XML documents
 - **XML vocabulary**: set of XML tag definitions
- XML files not intended to display in browser
 - **Extensible Stylesheet Language (XSL)**
 - Contains formatting instructions
 - **XML parsers**: format XML file for device screen



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FIGURE 2-14 Processing requests for Web pages from an XML database

Internet Connection Options

- Internet
 - Set of interconnected networks
- Organizations connect computers using a network
- **Internet access providers (IAPs) or ISPs**
 - Provide Internet access to:
 - Individuals, businesses, other organizations
 - Offer several connection options
 - Voice-grade telephone lines, various types of broadband connections, leased lines, wireless

Voice-Grade Telephone Connections

- Local telephone service provider
 - Most common way for an individual to connect to ISP
- **Plain old telephone service (POTS)**
 - Uses existing telephone lines, analog modem
 - Bandwidth between 28 and 56 Kbps
- **Digital Subscriber Line (DSL) protocol**
 - Higher grade of service
 - Use DSL modem (type of network switch)
- **Integrated Services Digital Network (ISDN)**
 - First technology developed using DSL protocol suite

Broadband Connections

- Broadband: connection speeds > 200 Kbps
 - **Asymmetric digital subscriber line (ADSL)**
 - DSL protocol providing broadband range service
 - **High-speed DSL (HDSL)**
 - More than 768 Kbps symmetric bandwidth
 - Cable modems
 - Transmission speeds to server: 300 Kbps to 1 Mbps
 - Connection bandwidths vary
 - Subscribers compete for shared resource
 - DSL: Private line with no competing traffic
 - Rural connection option issues: **voice-grade lines**
 - **Data-grade lines** in most urban and suburban locations
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Leased-Line Connections

- More expensive technologies
 - Classified by equivalent number of telephone lines included
- DS0 (digital signal zero)
 - Carries one digital signal (56 Kbps)
- **T1** line (DS1)
 - Carries 24 DS0 lines (1.544 Mbps)
- **T3** (DS3): 44.736 Mbps

Leased-Line Connections (cont'd.)

- Large organizations require very high bandwidth
- NAPs use T1 and T3 lines
- NAPs and Internet backbone routing computers
 - **Frame relay, asynchronous transfer mode (ATM)**
 - **Optical fiber** (instead of copper wire)
 - Bandwidth determined by fiber-optic cable class
 - OC3 (optical carrier 3): 156 Mbps
 - OC12: 622 Mbps
 - OC48: 2.5 Gbps
 - OC192: 10 Gbps

Wireless Connections

- Previous satellite microwave transmissions
 - Download speeds of 500 Kbps
 - Upload handled by POTS modem connection
- Today: POTS modem connection not required
 - Use microwave transmitter for uploads (150 Kbps)
 - Costs and accuracy improving
- Many wireless network types now available
 - Internet-capable mobile phones, smart phones, game consoles, and notebook computers
 - More than half of U.S. Internet users used a wireless device for Internet access

Wireless Connections (cont'd.)

- Bluetooth and Ultra Wideband (UWB)
- **Bluetooth** design for use over short distances
 - Low-bandwidth technology (722 Kbps)
 - **Personal area networks (PANs) or piconets**
 - Small Bluetooth networks
 - Advantages:
 - Devices consume very little power
 - Devices can discover one another and exchange information automatically

Wireless Connections (cont'd.)

- **Ultra Wideband (UWB)**
 - Provides bandwidth up to 480 Mbps
 - Connections over short distances (30 to 100 feet)
 - Future personal area networking applications
- **Wireless Ethernet (Wi-Fi)**
 - **Wi-Fi (wireless Ethernet, 802.11b)**
 - **Wireless access point (WAP)**
 - Transmits packets between Wi-Fi-equipped computers and other devices within range
 - **802.11b** (11 Mbps): range of about 300 feet

Wireless Connections (cont'd.)

- Wireless Ethernet (Wi-Fi) (cont'd.)
 - **802.11a** (54 Mbps): not 802.11b compatible
 - **802.11g** (54 Mbps): 802.11b compatible
 - **802.11n**: “Draft-N” (300 to 450 Mbps range)
 - Finalized specification: predicted for 2010
 - **Roaming**
 - Shifting from one WAP to another
 - No user intervention
 - **Hot spots**
 - WAPs open to public

Wireless Connections (cont'd.)

- **Fixed-point wireless**
 - System of repeaters
 - Forward radio signal from ISP to customers
 - **Repeaters**
 - Transmitter-receiver devices (**transceivers**)
 - Uses **mesh routing**
 - Directly transmits Wi-Fi packets through short-range transceivers (hundreds or thousands)
 - Located close to each other

Wireless Connections (cont'd.)

- Mobile telephone networks
 - Broadcast signals to/receive signals from antennas
 - Three miles apart in grid
 - **Short message service (SMS)** protocol
 - Send and receive short text messages
 - Also used for **netbooks** and **tablet devices**
 - **Third-generation (3G) wireless technology**
 - 2 Mbps download/800 Kbps upload speeds
 - **Fourth-generation (4G) technology**
 - **Long Term Evolution (LTE)** and **Worldwide Interoperability for Microwave Access (WiMAX)**
 - Significance in **Mobile commerce** or **m-commerce**

Service	Upstream Speed (Kbps)	Downstream Speed (Kbps)	Capacity (Number of Simultaneous Users)	One-time Startup Costs	Continuing Monthly Costs
Residential-Small Business Services					
POTS	28–56	28–56	1	\$0–\$20	\$9–\$20
Wireless 3G network	10–800	10–2000	1	\$0–\$120	\$30–150
ISDN	128–256	128–256	1–3	\$60–\$300	\$50–\$90
ADSL	100–640	500–9000	4–20	\$50–\$100	\$200–\$500
Cable	300–1500	500–10,000	4–10	\$0–\$100	\$40–\$300
Satellite	125–150	400–500	1–3	\$0–\$800	\$40–\$100
Fixed-point wireless	250–1500	500–3000	1–4	\$0–\$350	\$50–\$150
Wireless 4G network	500–5000	1000–12,000	1	\$0–\$200	\$80–\$200
Business Services					
Leased digital line (DS0)	64	64	1–10	\$50–\$200	\$40–\$150
Fixed-point wireless	500–10,000	500–10,000	5–1000	\$0–\$500	\$300–\$5000
T1 leased line	1544	1544	100–200	\$100–\$2000	\$300–\$1600
T3 leased line	44,700	44,700	1000–10,000	\$1000–\$9000	\$3000–\$12,000
Large Organization					
OC3 leased line	156,000	156,000	1000–50,000	\$3000–\$12,000	\$9000–\$22,000
OC12 leased line	622,000	622,000	Backbone	Negotiated	\$25,000–\$100,000
OC48 leased line	2,500,000	2,500,000	Backbone	Negotiated	Negotiated
OC192 leased line	10,000,000	10,000,000	Backbone	Negotiated	Negotiated

FIGURE 2-15 Internet connection options

Internet2 and the Semantic Web

- Internet2
 - Replacement for original ARPANET laboratory
 - Experimental networking technologies test bed
 - High end of the bandwidth spectrum (10 Gbps)
 - Used by universities, medical schools, CERN
 - Focus
 - Mainly technology development

Internet2 and the Semantic Web (cont'd.)

- **Semantic Web** project (next-generation Web)
 - Goal: blending technologies and information into a next-generation Web
 - Have words on Web pages tagged (using XML) with their meanings
 - Uses **software agents** (intelligent programs)
 - Read XML tags, determine meaning of words in their contexts
 - **Resource description framework (RDF)**
 - Set of XML syntax standards
 - Development of Semantic Web will take many years
 - Start with ontologies for specific subjects

Summary

- History of the Internet and the Web
 - Began from research and evolved to become framework for electronic commerce
- Networking technologies
 - Intranets and extranets
 - Public network, private network, virtual private network

Summary (cont'd.)

- Technologies supporting the Internet and World Wide Web
 - Protocols, programs, languages, architectures
 - TCP/IP
 - HTML, SGML, XML
- HTML defines structure and content of Web pages
- Extensible Markup Language (XML)
 - Uses markup tags to describe the meaning or semantics of text

Summary (cont'd.)

- Internet service provider connection types
 - Basic telephone connections, broadband cable, satellite microwave transmission, DSL, wireless (fixed-point, mobile)
- Internet2 experimental test bed
 - Creating, perfecting future high-speed networking technologies
- Semantic Web project
 - Goal of making research data widely available
 - May enable Web interaction using intelligent software agents