

Chapter 2

Technology Infrastructure: The Internet and the World Wide Web

At a Glance

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Lecture Notes

Chapter Overview

In this chapter, you will learn about the history of the Internet and the Web, including how these technologies emerged from research projects and grew to be the supporting infrastructure for electronic commerce today. You will also learn about the protocols, programs, languages, and architectures that support the Internet and the World Wide Web.

Chapter 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 protocols and Internet addressing work
- The history and use of markup languages on the Web, including SGML, HTML, and XML
- How HTML tags and links work on the World Wide Web
- The differences among internets, intranets, and extranets

- Options for connecting to the Internet, including cost and bandwidth factors
- Internet2 and the Semantic Web

Lecture Notes

Origins of the Internet

1. The Defense Department was concerned about the inherent risk of this single-channel method for connecting computers, and its researchers developed a different method of sending information through multiple channels.
2. In 1969, Defense Department researchers in the Advanced Research Projects Agency (ARPA) used this network model to connect four computers—one each at the University of California at Los Angeles, SRI International, the University of California at Santa Barbara, and the University of Utah—into a network called the ARPANET.

New Uses for the Internet

1. E-mail was born in 1972 when Ray Tomlinson, a researcher who used the network, wrote a program that could send and receive messages over the network.
2. Terms: **mailing list**, **Usenet**, and **newsgroups**.

Commercial Use of the Internet

1. In 1989, the NSF permitted two commercial e-mail services, MCI Mail and CompuServe, to establish limited connections to the Internet for the sole purpose of exchanging e-mail transmissions with users of the Internet.

Growth of the Internet

1. The opening of the Internet to business activity helped to dramatically increase its growth; however, there was another development that worked hand in hand with the commercialization of the Internet to spur its growth. That development was the World Wide Web.
2. Terms: **network access points (NAPs)**, **network access providers**, **Internet service providers (ISPs)**, and **Internet hosts**.

Emergence of the World Wide Web

1. Two important innovations that became key elements of the Web are hypertext and graphical user interfaces.
2. **The World Wide Web:** In 1993, a group of students led by Marc Andreessen at the University of Illinois wrote Mosaic, the first GUI program that could read HTML and

use HTML hyperlinks to navigate from page to page on computers anywhere on the Internet

Quick Quiz 1

1. The ____ is a large system of interconnected computer networks that spans the globe.
Answer: Internet
2. A(n) ____ is an e-mail address that forwards any message it receives to any user who has subscribed to the list.
Answer: mailing list
3. A(n) ____ is a software interface that lets users read (or browse) HTML documents and move from one HTML document to another through text formatted with hypertext link tags in each file.
Answer: Web browser
4. A(n) ____ is a way of presenting program control functions and program output to users.
Answer: graphical user interface (GUI)

Packet-Switched Networks

1. The early models for WANs were the circuits of the local and long-distance telephone companies of the time, because the first early WANs used leased telephone company lines for their connections.
2. Terms: **circuit, circuit switching, packet-switched, and packets, local area network (LAN) and wide area networks (WANs).**

Routing Packets

1. An important concept for students to understand is that, when packets leave a network to travel on the Internet, they must be translated into a standard format.
2. Terms: **routing computers, routing algorithms, and routing tables, backbone routers.**

Tip

To learn more about routing tables, see:
http://en.wikipedia.org/wiki/Routing_table.

Quick Quiz 2

1. The combination of telephone lines and the closed switches that connect them to each other is called a(n) _____.
Answer: circuit
2. The computers that decide how best to forward each packet are called _____.
Answer: routing computers, router computers, routers, gateway computers, border routers
3. A network of computers that are located close together is called a(n) _____.
Answer: local area network (LAN)
4. (True or False) Although circuit switching works well for telephone calls, it does not work as well for sending data across a large WAN or an interconnected network like the Internet.
Answer: True

Internet Protocols

1. The open architecture approach has contributed to the success of the Internet because computers manufactured by different companies (Apple, Dell, Hewlett-Packard, Sun, etc.) can be interconnected.
2. Terms: **Network Control Protocol (NCP)**, **protocol**, **proprietary architecture**, and **open architecture**.

TCP/IP

1. With the aid of diagrams, carefully explain that the TCP controls the disassembly of a message or a file into packets before it is transmitted over the Internet, and it controls the reassembly of those packets into their original formats when they reach their destinations. The IP specifies the addressing details for each packet, labeling each with the packet's origination and destination addresses.

IP Addressing

1. Computers do all of their internal calculations using a base 2 (or binary) number system in which each digit is either a 0 or a 1, corresponding to a condition of either off or on
2. Point out that, in the early days of the Internet, the 4 billion addresses provided by the IPv4 rules certainly seemed to be more addresses than an experimental research network would ever need.
3. The Internet Engineering Task Force (IETF) worked on several new protocols that could solve the limited addressing capacity of IPv4, and in 1997, approved Internet Protocol version 6 (IPv6) as the protocol that will replace IPv4.

4. Terms: **dotted decimal, byte, octet, subnetting, private IP addresses, and Network Address Translation (NAT).**

Tip

To learn more about IP addressing, see:
www.webopedia.com/DidYouKnow/Internet/2002/IPaddressing.asp.

Domain Names

1. Since 1998 the Internet Corporation for Assigned Names and Numbers (ICANN) has had the responsibility of managing domain names and coordinating them with the IP address registrars.
2. Terms: **generic top-level domain (gTLD)** and **sponsored top-level domain (sTLD).**

Web Page Request and Delivery Protocols

1. Terms: **Web client computers, Web client software, Web server software, client/server architecture, Hypertext Transfer Protocol (HTTP), and Uniform Resource Locator (URL).**

Electronic Mail Protocols

1. Most organizations use a client/server structure to handle e-mail.
2. If e-mail messages did not follow standard rules, an e-mail message created by a person using one e-mail client program could not be read by a person using a different e-mail client program.
3. Terms: **Simple Mail Transfer Protocol (SMTP), Post Office Protocol (POP), Multipurpose Internet Mail Extensions (MIME), and Interactive Mail Access Protocol (IMAP).**

Unsolicited Commercial E-Mail (UCE, Spam)

1. Besides wasting people's time and their computer disk space, spam can consume large amounts of Internet capacity.

Quick Quiz 3

1. A(n) ____ is a collection of rules for formatting, ordering, and error checking data sent across a network.
Answer: protocol

2. (True or False) The IP controls the disassembly of a message or a file into packets before it is transmitted over the Internet, and it controls the reassembly of those packets into their original formats when they reach their destinations.

Answer: False

3. The term ____ refers to the use of reserved private IP addresses within LANs and WANs to provide additional address space.

Answer: subnetting

4. ____ are sets of words that are assigned to specific IP addresses.

Answer: Domain names

Markup Languages and the Web

1. The most important parts of a Web page—the structure of the page and the text that makes up the main part of the page.
2. Terms: **text markup language, markup tags, Standard Generalized Markup Language (SGML), meta language, Extensible Markup Language (XML), and Extensible Hypertext Markup Language (XHTML).**

Standard Generalized Markup Language

1. Explain that SGML offers a system of marking up documents that is independent of any software application. Many organizations, such as the Association of American Publishers, Hewlett-Packard, and Kodak, use SGML because they have complex document-management requirements.

Hypertext Markup Language

1. The process for approval of new HTML features takes a long time, so Web browser software developers created some features, called HTML extensions, that would only work in their browsers.
2. **HTML Tags:** Most HTML tags have an opening tag and a closing tag that format the text between them.
3. **HTML Links:** Introduce the terms **linear hyperlink structure, hierarchical hyperlink structure, home page, site map, and anchor tag.**
4. **Scripting Languages and Style Sheets:** The most common scripting languages used on Web pages are JavaScript, JScript, Perl, and VBScript. Scripts written in these languages and embedded on Web pages can execute programs on computers that display those pages.

Extensible Markup Language (XML)

1. In the late 1990s, companies began turning to XML to help them maintain Web pages that contained large amounts of data.
2. XML differs from HTML in two important respects. First, XML is not a markup language with defined tags. It is a framework within which individuals, companies, and other organizations can create their own sets of tags. Second, XML tags do not specify how text appears on a Web page; the tags convey the meaning (the semantics) of the information included within them.
3. The greatest strength of XML, that it allows users to define their own tags, is also its greatest weakness.
4. Although it is possible to display XML files in some Web browsers, XML files are not intended to be displayed in a Web browser.
5. Terms: **Extensible Stylesheet Language (XSL)** and **XML parsers**.

HTML and XML Editors

1. Web site design tools include features that allow the designer to create a Web site on a PC and then upload the entire site (HTML documents, graphics files, and so on) to a Web server computer.

Quick Quiz 4

1. A(n) ____ language specifies a set of tags that are inserted into the text.
Answer: text markup
2. A(n) ____ structure resembles conventional paper documents in that the reader begins on the first page and clicks the Next button to move to the next page in a serial fashion.
Answer: linear hyperlink
3. In HTML, hyperlinks are created using the HTML ____.
Answer: anchor tag
4. (True or False) XML files, like HTML files, can be created in any text editor.
Answer: True

Intranets and Extranets

1. Although fax, telephone, e-mail, and overnight express carriers have been the main communications tools for business for many years, extranets can replace many of them at a lower cost.

Intranets

1. Intranets are an excellent low-cost way to distribute internal corporate information. Based on the client/server model, intranet requests for files, documents, or schematic drawings work the same way they do on the Internet.

Extranets

1. Each participant in an extranet has access to the databases, files, or other information stored on computers connected to the extranet. An extranet can be set up through the Internet, or it can use a separate network.

Public and Private Networks

1. Terms: **public network**, **private network**, **leased line**, and **scaling problem**.

Virtual Private Network (VPN)

1. Unlike private networks using leased lines, VPNs establish short-term logical connections in real time that are broken once the communication session ends.
2. Terms: **IP tunneling**, **encapsulation**, and **IP wrapper**.

Internet Connection Options

1. Terms: **Internet access providers (IAPs)**.

Connectivity Overview

1. The major distinguishing factors between various ISPs and their connection options—that is, the bandwidth they offer.
2. Terms: **symmetric connections**, **asymmetric connections**, **upstream bandwidth**, and **downstream bandwidth**.

Voice-Grade Telephone Connections

1. Terms: **plain old telephone service (POTS)**, **Digital Subscriber Line (DSL)**, and **Integrated Services Digital Network (ISDN)**.

Broadband Connections

1. DSL is a private line with no competing traffic. Note that, unlike DSL, cable modem connection bandwidths vary with the number of other subscribers competing for the shared resource.
2. Terms: **voice-grade lines** and **data-grade lines**.

Leased-Line Connections

1. Terms: **T1, fractional T1, T3, frame relay, asynchronous transfer mode (ATM), and optical fiber.**

Wireless Connections

1. People today use mobile phones, wireless personal digital assistants (PDAs), and notebook computers equipped with wireless network cards to connect to networks that, in turn, are connected to the Internet.
2. **Bluetooth and Ultra Wideband (UWB):** One major advantage of Bluetooth technology is that it consumes very little power, which is an important consideration for mobile devices.
3. **Wireless Ethernet (Wi-Fi):** Introduce the terms wireless access point (WAP), 802.11g protocol, 802.11n, roaming, and hot spots.
4. **Fixed-Point Wireless:** Introduce the terms **fixed-point wireless, repeaters, and mesh routing.**
5. **Cellular Telephone Networks:** Introduce the terms **third-generation (3G) cell phones, short message service (SMS), and mobile commerce.**

Internet2 and the Semantic Web

1. Internet2 is also used by universities to conduct large collaborative research projects that require several supercomputers connected at very fast speeds or that use multiple video feeds—things that would be impossible on the Internet given its lower bandwidth limits.
2. Terms: **Semantic Web, software agents, resource description framework (RDF), and ontology.**

Tip	To learn more about Internet2, see: www.eschoolnews.com/news/top-news/?i=53893 .
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Quick Quiz 5

1. A(n) ____ is any computer network or telecommunications network that is available to the public.

Answer: public network

2. A(n) _____ is a permanent telephone connection between two points.
Answer: leased line
3. _____ effectively creates a private passageway through the public Internet that provides secure transmission from one computer to another.
Answer: IP tunneling
4. _____ is the amount of data that can travel through a communication line per unit of time.
Answer: Bandwidth
5. A(n) _____ is a set of standards that defines, in detail, the relationships among RDF standards and specific XML tags within a particular knowledge domain.
Answer: ontology

Additional Resources

1. Routing packets: <http://computer.howstuffworks.com/router5.htm>
2. Frame relay: http://en.wikipedia.org/wiki/Frame_relay
3. Introduction to RDF: www.w3schools.com/rdf/rdf_intro.asp

Key Terms

- **802.11a**: capable of transmitting data at speeds up to 54 Mbps.
- **802.11b**: the most common wireless connection technology for use on LANs.
- **802.11g**: has the 54-Mbps speed of 802.11a and is compatible with 802.11b devices.
- **802.11n**: the technology should provide bandwidths in the 300 to 450 Mbps range.
- **Anchor tag**: used to create HTML hyperlinks.
- **Asymmetric connection**: provides different bandwidths for each direction.
- **Asymmetric digital subscriber line (ADSL or DSL)**: provides transmission bandwidths from 100 to 640 Kbps upstream and from 1.5 to 9 Mbps (million bits per second) downstream.
- **Asynchronous transfer mode (ATM)**: technology used by NAPs.
- **Backbone router**: very large computers that can each handle more than 3 billion packets per second.
- **Bandwidth**: the amount of data that can travel through a communication line per unit of time.
- **Base 2 (binary)**: number system in which each digit is either a 0 or a 1, corresponding to a condition of either off or on.
- **Bluetooth**: one of the first wireless protocols, designed for personal use over short distances.
- **Border router**: the computer that decides how best to forward each packet.
- **Broadband**: connections that operate at speeds of greater than about 200 Kbps.
- **Bulk mail**: electronic junk mail.
- **Byte**: an 8-bit number.

- **Cascading style sheets (CSS):** sets of instructions that give Web developers more control over the format of displayed pages.
- **Circuit:** the combination of telephone lines and the closed switches that connect them to each other.
- **Circuit switching:** centrally controlled, single-connection model.
- **Client/server architecture:** combination of client computers running Web client software and server computers running Web server software.
- **Client-side scripting:** embedding script languages in HTML documents.
- **Closed architecture:** in the early days of computing, each computer manufacturer created its own protocol, so computers made by different manufacturers could not be connected to each other.
- **Closing tag:** HTML tag that formats text.
- **Colon hexadecimal (colon hex):** notation system that uses eight groups of 16 bits ($8 \times 16 = 128$) with each group expressed as four hexadecimal digits and separated by colons.
- **Computer network:** any technology that allows people to connect computers to each other.
- **Configuration table:** information stored includes lists of connections that lead to particular groups of other routers, rules that specify which connections to use first, and rules for handling instances of heavy packet traffic and network congestion.
- **Data-grade lines:** made more carefully and of higher-grade copper than voice-grade lines.
- **Digital subscriber line (DSL):** connection methods do not use a modem. They use a piece of networking equipment that is similar to a network switch.
- **Domain name:** set of words that are assigned to specific IP addresses.
- **Dotted decimal:** four numbers separated by periods.
- **Download:** a measure of the amount of information that can travel from the Internet to a user in a given amount of time.
- **Downstream bandwidth (downlink bandwidth):** a measure of the amount of information that can travel from the Internet to a user in a given amount of time.
- **Electronic mail (e-mail):** mail sent across the Internet.
- **E-mail client software:** used to read and send e-mail.
- **E-mail server:** devoted to handling e-mail.
- **Encapsulation:** placing the encrypted packets inside another packet.
- **Extensible Hypertext Markup Language (XHTML):** a reformulation of HTML version 4.0 as an XML application.
- **Extensible Markup Language (XML):** another markup language that was derived from SGML for use on the Web.
- **Extensible Stylesheet Language (XSL):** used to write XML formatting instructions.
- **Extranet:** an intranet that has been extended to include specific entities outside the boundaries of the organization, such as business partners, customers, or suppliers.
- **Fixed-point wireless:** uses a system of repeaters to forward a radio signal from the ISP to customers.
- **Fractional T1:** transmitter-receiver devices (also called transceivers) that receive a signal, retransmit it toward users' roof-mounted antennas and to the next repeater.
- **Frame relay:** used by NAPs and the computers that perform routing functions on the Internet backbone.

- **Gateway computer:** the computer that decides how best to forward each packet.
- **Generalized Markup Language (GML):** emerged from early efforts to create standard formatting styles for electronic documents.
- **Generic top-level domain (gTLD):** .biz, .info, .name, and .pro.
- **Graphical user interface:** a way of presenting program control functions and program output to users.
- **Hexadecimal (base 16):** numbering system that uses 16 digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, and f).
- **Hierarchical hyperlink structure:** in this structure, the Web user opens an introductory page called a home page or start page.
- **High-speed DSL (HDSL):** connection service can provide more than 768 Kbps of symmetric bandwidth.
- **Home page:** an introductory page.
- **Hot spot:** WAP that is open to the public.
- **HTML extensions:** additional HTML features created by Web browser software developers to work solely in their browsers.
- **Hypertext:** system in which text on one page links to text on other pages.
- **Hypertext element:** text elements that are related to each other.
- **Hypertext link (hyperlink):** points to another location in the same or another HTML document.
- **Hypertext Markup Language (HTML):** a language that includes a set of codes (or tags) attached to text.
- **Hypertext server:** a computer that stores files written in Hypertext Markup Language (HTML).
- **Hypertext Transfer Protocol (HTTP):** the set of rules for delivering Web page files over the Internet is in a protocol.
- **Integrated Services Digital Network (ISDN):** the first technology developed to use the DSL protocol suite and has been available in parts of the United States since 1984.
- **Interactive Mail Access Protocol (IMAP):** a newer e-mail protocol that performs the same basic functions as POP, but includes additional features.
- **Internet:** a large system of interconnected computer networks that spans the globe.
- **Internet access provider (IAP):** companies that provide Internet access to individuals, businesses, and other organizations.
- **Internet backbone:** routers that handle packet traffic along the Internet's main connecting points and the telecommunications lines connecting them.
- **Internet host:** computers directly connected to the Internet.
- **Internet Protocol (IP):** specifies the addressing details for each packet, labeling each with the packet's origination and destination addresses.
- **Internet Protocol version 4 (IPv4):** uses a 32-bit number to identify the computers connected to the Internet.
- **Internet Protocol version 6 (IPv6):** uses a 128-bit number for addresses instead of the 32-bit number used in IPv4.
- **Internet service provider (ISP):** offers many different types of connections to the Internet.
- **Internet2:** an experimental test bed for new networking technologies that is separate from the original Internet.

- **Intranet:** an interconnected network (or internet), usually one that uses the TCP/IP protocol set and does not extend beyond the organization that created it.
- **IP address:** a 32-bit number used to identify the computers connected to the Internet.
- **IP tunneling:** effectively creates a private passageway through the public Internet that provides secure transmission from one computer to another.
- **IP wrapper:** the outer packet of an encrypted packet.
- **Leased line:** a permanent telephone connection between two points.
- **Linear hyperlink structure:** resembles conventional paper documents in that the reader begins on the first page and clicks the Next button to move to the next page in a serial fashion.
- **Local area network (LAN):** a network of computers that are located close together.
- **Mailing list:** an e-mail address that forwards any message it receives to any user who has subscribed to the list.
- **Markup tags (tags):** provide formatting instructions that Web client software can understand.
- **Mesh routing:** directly transmits Wi-Fi packets through hundreds, or even thousands, of short-range transceivers that are located close to each other.
- **Meta language:** a language that can be used to define other languages.
- **Mobile commerce (m-commerce):** term used to describe the kinds of resources people might want to access (and pay for) using wireless devices.
- **Multipurpose Internet Mail Extensions (MIME):** a set of rules for handling binary files, such as word-processing documents, spreadsheets, photos, or sound clips that are attached to e-mail messages.
- **Net bandwidth:** the actual speed that information travels.
- **Network access points (NAPs):** originally located in San Francisco, New York, Chicago, and Washington, D.C., each operated by a separate telecommunications company.
- **Network access provider:** sell Internet access rights directly to larger customers and indirectly to smaller firms and individuals
- **Network Address Translation (NAT) device:** converts those private IP addresses into normal IP addresses when it forwards packets from those computers to the Internet.
- **Network Control Protocol (NCP):** protocol used by ARPANET.
- **Network specification:** the set of rules that equipment connected to the network must follow.
- **Newsgroup:** the more than 1000 different topic areas used by Usenet.
- **Octet:** an 8-bit number.
- **Ontology:** a set of standards that defines, in detail, the relationships among RDF standards and specific XML tags within a particular knowledge domain.
- **Open architecture:** included the use of a common protocol for all computers connected to the Internet and four key rules for message handling.
- **Opening tag:** HTML tag that formats text.
- **Optical fiber:** technology used by NAPs.
- **Packet:** files and e-mail messages are broken down into small pieces.
- **Packet-switched:** on this network, files and e-mail messages are broken down into small pieces, called packets, that are labeled electronically with their origins, sequences, and destination addresses.
- **Personal area network (PAN):** small Bluetooth network.

- **Piconet**: small Bluetooth network.
- **Plain old telephone service (POTS)**: uses existing telephone lines and an analog modem to provide a bandwidth of between 28 and 56 Kbps.
- **Post Office Protocol (POP)**: used by an e-mail client program running on a user's computer to request mail from the organization's e-mail server.
- **Private IP address**: a series of IP numbers that are not permitted on packets that travel on the Internet.
- **Private network**: a private, leased-line connection between two companies that physically connects their intranets to one another.
- **Proprietary architecture**: in the early days of computing, each computer manufacturer created its own protocol, so computers made by different manufacturers could not be connected to each other.
- **Protocol**: a collection of rules for formatting, ordering, and error checking data sent across a network.
- **Public network**: any computer network or telecommunications network that is available to the public.
- **Repeater**: transmitter-receiver devices (also called transceivers) that receive the signal and then retransmit it toward users' roof-mounted antennas and to the next repeater.
- **Resource description framework (RDF)**: a set of standards for XML syntax. It would function as a dictionary for all XML tags used on the Web.
- **Roaming**: shifting from one WAP to another, without requiring intervention by the user.
- **Router**: the computer that decides how best to forward each packet.
- **Router computer (routing computer)**: the computers that decide how best to forward each packet.
- **Routing algorithm**: programs on router computers that determine the best path on which to send each packet contain rules.
- **Routing table**: information stored includes lists of connections that lead to particular groups of other routers, rules that specify which connections to use first, and rules for handling instances of heavy packet traffic and network congestion.
- **Scaling problem**: increasing the number of leased lines in private networks is difficult, costly, and time consuming.
- **Semantic Web**: project envisions words on Web pages being tagged (using XML) with their meanings.
- **Short message service (SMS)**: protocol used by many cell phones have a small screen and can be used to send and receive short text messages.
- **Simple Mail Transfer Protocol (SMTP)**: specifies the format of a mail message and describes how mail is to be administered on the e-mail server and transmitted on the Internet.
- **Site map**: a hierarchical structure included on a page on your Web site that contains a map or outline listing of the Web pages in their hierarchical order.
- **Small office home office (SOHO)**: small business users.
- **Software agents**: intelligent programs used to read XML tags to determine the meaning of words in their contexts.
- **Spam**: electronic junk mail.
- **Sponsored top-level domain (sTLD)**: a TLD for which an organization other than ICANN is responsible.

- **Standard Generalized Markup Language (SGML):** used for many years by the publishing industry to create documents that needed to be printed in various formats and that were revised frequently.
- **Start page:** an introductory page.
- **Style sheet:** defined formatting styles that can be applied to multiple Web pages.
- **Subnetting:** the use of reserved private IP addresses within LANs and WANs to provide additional address space.
- **Symmetric connection:** provides the same bandwidth in both directions.
- **T1:** carries 24 DS0 lines and operates at 1.544 Mbps.
- **T3:** offers 44.736 Mbps (the equivalent of 30 T1 lines or 760 DS0 lines).
- **TCP/IP:** the rules that govern how data moves through the Internet and how network connections are established and terminated.
- **Text markup language:** specifies a set of tags that are inserted into the text.
- **Third-generation (3G) cell phones:** the devices that combine the latest technologies available today.
- **Top-level domain (TLD):** the rightmost part of a domain name.
- **Transceiver:** transmitter-receiver device that receives a signal and then retransmits it toward users' roof-mounted antennas and to the next repeater.
- **Transmission Control Protocol (TCP):** controls the disassembly of a message or a file into packets before it is transmitted over the Internet.
- **Ultra Wideband (UWB):** provides wide bandwidth (up to about 480 Mbps in current versions) connections over short distances (30 to 100 feet).
- **Uniform Resource Locator (URL):** the combination of the protocol name and the domain name.
- **Unsolicited commercial e-mail (UCE):** electronic junk mail.
- **Upload bandwidth:** a measure of the amount of information that can travel from the user to the Internet in a given amount of time.
- **Upstream bandwidth:** a measure of the amount of information that can travel from the user to the Internet in a given amount of time.
- **Usenet (User's News Network):** allows anyone who connects to the network to read and post articles on a variety of subjects.
- **Virtual private network (VPN):** an extranet that uses public networks and their protocols to send sensitive data to partners, customers, suppliers, and employees using a system called IP tunneling or encapsulation.
- **Voice-grade lines:** cost less than telephone lines designed to carry data and are made of lower-grade copper.
- **Web:** a subset of the computers on the Internet that are connected to one another in a specific way that makes them and their contents easily accessible to each other.
- **Web browser:** a software interface that lets users read (or browse) HTML documents and move from one HTML document to another through text formatted with hypertext link tags in each file.
- **Web browser software:** sends requests for Web page files to other computers, which are called Web servers.
- **Web client computer:** sends requests for Web page files to other computers, which are called Web servers.
- **Web server:** a hypertext server.

- **Web server software:** receives requests from many different Web clients and responds by sending files back to those Web client computers.
- **Wi-Fi (wireless Ethernet, 802.11b, 802.11a, 802.11g, 802.11n):** the most common wireless connection technology for use on LANs.
- **Wide area network (WAN):** networks of computers that are connected over greater distances.
- **Wireless access point (WAP):** a device that transmits network packets between Wi-Fi-equipped computers and other devices that are within its range.
- **World Wide Web:** subset of the computers on the Internet that are connected to one another in a specific way that makes them and their contents easily accessible to each other.
- **World Wide Web Consortium (W3C):** a not-for-profit group that maintains standards for the Web, presented its first draft form of XML in 1996.
- **XML parser:** can format an XML file so it can appear on the screen of a computer, a wireless PDA, a mobile phone, or some other device.
- **XML vocabulary:** a set of XML tag definitions.