Technology in Action

Chapter 13

Behind the Scenes:
The Internet: How It Works
Chapter Topics

- Managing the Internet
- Interaction between Internet components
- Internet data transmission and protocols
- IP addresses and domain names
- FTP and Telnet
- HTML and XML
- How e-mail and instant messaging work and how to keep them secure
Management of the Internet

Who owns the Internet?

- Individuals
- Universities
- Government agencies
- Private companies

Who manages the Internet?

- Nonprofit organizations
- User groups

Who pays for the Internet?

- U.S. taxpayers
- Businesses
- Universities
- Other countries
Internet Networking

• **A network of networks**
  – Worldwide network of computer systems

• **Protocol**
  – Set of rules for communicating
  – All computers connected to the Internet use common protocols so they can understand one another
Network Hierarchy

- **Tier 1**
  - Internet backbone
  - Move large amounts of data
  - Provide access to regional ISPs

- **Tier 2**
  - Regional ISPs
  - Provide access to local ISPs

- **Tier 3**
  - Local ISPs
  - Provide Internet access to homes and businesses
T Lines

- **High speed fiber-optic lines**
  - **T-1 lines**
    - 24 simultaneous voice or data channels
    - 1.544 Mbps throughput
  - **T-2 lines**
    - 4 T-1 lines
    - 6.3 Mbps throughput
  - **T-3 lines**
    - 28 T-1 lines
    - 44.736 Mbps throughput
  - **T-4 lines**
    - 168 T-1 lines
    - 274.176 Mbps throughput
Network Access Points (NAPs)

- Points of connection between ISPs
- Routers move data between networks
Points of Presence (POP)

• Bank of modems where individual users connect to an ISP
The Network Model of the Internet

- Internet communications follows the client/server network model
- Clients request services
- Servers respond to requests
- Types of servers include
  - Web servers
    - Host Web pages
  - Commerce servers
    - Enable the purchase of goods and services over the Internet
  - File servers
    - Provide remote storage space for files that users can download
P2P File sharing

**STEP 1:** Your computer, acting as a client, runs the Kazaa software (which you downloaded from Kazaa’s Web site). Using this software, you request access to a particular music file. Your computer transmits this request to Kazaa’s server.

**STEP 2:** The Kazaa server makes your computer aware of other users (Users A and B) running Kazaa software.

**STEP 3:** Your computer determines that User A has the music file you wish to access. Acting as a client, your computer requests the file from User A.

**STEP 4:** User A’s computer, acting as a server, sends the requested file to your computer.

**STEP 5:** User B’s computer (having been alerted to your presence by the Kazaa server) determines you have a file it wants. Acting as a client, it requests the file from your computer.

**STEP 6:** Your computer receives the request from User B. It then switches roles from client to server, and serves the requested file up to User B.
Data Transmission and Protocols

- Computer protocols are rules for electronic information exchange
- Open system protocols
  - Any computer can communicate with other computers using the same protocols
Circuit Switching

- Dedicated connection between two points
- Remains active until the transmission is terminated
- Used in telephone communications
Packet Switching

- Data is broken into small units called packets
- Packets are sent over various routes to their destination
- Packets are reassembled by the receiving computer
- Packets contain
  - Destination/source addresses
  - Reassembling instructions
  - Data
Packet Switching

E-mail to your aunt broken into packets by your computer

Your computer in Philadelphia

ISP in PA

ISP in MN

ISP in NC

ISP in OR

ISP in FL

ISP in CA

ISP in TX

Your aunt's computer in San Diego

Your aunt's computer reconstructed by her computer
TCP/IP

• Transmission Control Protocol (TCP)
  – Prepares data for transmission
  – Provides error-checking
  – Enables resending lost data

• Internet Protocol (IP)
  – Responsible for sending data from one computer to another
IP Addresses

• **Unique number that identifies devices connected to the Internet**

• **Typical IP address**
  – 197.24.72.157

• **Static address**
  – Address never changes

• **Dynamic address**
  – Temporary address
Domain Names

- Name that takes the place of an IP address
- Sample domain name
  - www.mywebsite.com
- Top-level domains (TLD)
  - Portion of the domain name that follows the dot
  - Sample top-level domain names
    - .com, .org, .edu, and .net
- Second-level domains
  - Unique name within a top-level domain
  - Sample second-level domain names
    - Yahoo.com, Google.com, and Unesco.org
Having Enough IP Addresses

- IPv4 addressing scheme didn’t foresee explosive growth
- CIDR (Classless Inter-Domain Routing)
  - Allows a single IP address to represent several unique addresses
  - Uses a network prefix (slash and number)
  - Identifies how many bits in the IP address are unique identifiers
DNS
Domain Name Server

- Internet servers that translate domain names to IP addresses
- ISPs go first to a default DNS to resolve a name
- Name queries work up the hierarchy to the root DNS servers if required
Other Protocols

• File Transfer Protocol (FTP)
  – File-sharing protocol
  – Files are downloaded and uploaded using the Internet

• Telnet
  – Protocol for connecting to a remote computer and a TCP/IP service
  – Enables a client computer to control a server computer
HTTP and SSL

• Hypertext Transfer Protocol
  – Protocol for transferring hypertext documents
  – Hypertext documents are linked to other documents (through hyperlinks)

• Secure Socket Layer
  – Security protocols that protect sensitive information
  – Encrypts data
  – S-HTTP is used for individual messages
HTML/XHTML

• Hypertext Markup Language (HTML)
  – Format for creating Web pages

• Extensible Hypertext Markup Language (XHTML)
  – Successor to HTML
  – Has much more stringent rules than HTML regarding tagging

• HTML/XHTML
  – are not programming languages but sets of rules for marking up blocks of text so that a browser knows how to display them
**HTML/XHTML Example**

**HTML/XHTML**

```html
<h1>This is the Heading</h1>

<p><font face="Arial">This is text using Arial font.</font></p>

<p><font face="Arial"><i>This text is italicized</i>.</font></p>

<p><font face="Arial"><b>This text is bold</b>.</font></p>

<p><font face="Arial"><font color="#FF0000">This text color is red</font></font></p>

<p><font face="Arial">This is a hyperlink <a href="http://vig.prenhall.com/">www.prenhall.com</a></font></p>

**Web Page Display**

This is the Heading

This is text using Arial font.

*This text is italicized.*

**This text is bold.**

This text color is red.

This is a hyperlink [www.prenhall.com](http://vig.prenhall.com/)

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Common Gateway Interface (CGI)

- Browsers request that a program file executes (runs)
- CGI files often called CGI scripts
- Adds Web page interaction
  - Adding names to guest books/mailing lists
  - Completing forms
Client-Side Applications

- A program that runs on a client computer with no interaction with the server
- Types of client-side applications include
  - HTML/XHTML document embedded with JavaScript code
  - Applet: Small program that resides on the server
Extensible Markup Language (XML)

- Designed for information exchange
- Tools used to create your own markup language
- Used in e-commerce transactions
Communications Over the Internet

- **E-mail**
  - Created in 1971 by Ray Tomlinson
  - Simple Mail Transfer Protocol (SMTP)
  - Multipurpose Internet Mail Extensions (MIME): Protocol for attaching files to e-mail
Communications over the Internet

- **E-mail security**
  - Encryption
    - Private-key encryption
    - Public-key encryption
  - Secure data transmission software
    - SafeMessage
Instant Messaging (IM)

- Client/server application program for real-time, text-based conversations
- Popular instant messaging programs
  - AOL Instant Messenger
  - ICQ
  - Yahoo! Messenger
  - Windows Messenger
- Increasing security threats
  - 1600% rise in threats
  - Should not be used for sensitive data