Chapter 3: Making the Connection: The Basics of Networking

Fluency with Information Technology Third Edition
by Lawrence Snyder

Networked Computers Change Our Lives

- The Information Age has brought profound changes
  - Nowhere is remote
  - People are interconnected
  - Social relationships are changing
  - English is becoming a universal language
  - Freedom of speech and assembly have expanded

Nowhere Is Remote

- Internet is a complete information resource no matter where you are
  - Some differences remain because older sources are not yet all online
- Homes are not remote from work
  - Information workers can telecommute and live long distances from their offices

People Are More Interconnected

- Family and friends stay in closer, more frequent contact via Internet than via telephone or "snail mail"
- WWW lets us meet people passively
  - People with similar interests find each other through search engines
  - Associations can form rapidly
Social Interactions Are Changing

- Time spent online displaces other in-person social activities (displacement effect)
- The effects are complicated (pros/cons)
- The Internet is changing social interactions, but we don't fully understand how

English Is Becoming a Universal Language

- Influence of American pop culture since World War II
- Dominance of science and technology in English-speaking countries
- Much software is available only in English
- Most web pages are in English

Freedom of Speech and of Assembly HaveExpanded

- Internet use is unmediated
  - No editorial oversight or significant restrictions
  - Wikis
- Allows for political and artistic expression
- Blogs record personal thoughts for public viewing
- Like-minded people can communicate, even on private topics

Communication Types

- General Communication
  - Synchronous: sender and receiver are active at the same time
    - e.g., telephone call, instant messaging (IM)
  - Asynchronous: sending and receiving occur at different times
    - e.g., e-mail
  - Broadcast communication (or multicast): single sender and many receivers
  - Point-to-point communication: single sender and single receiver
The Internet's Communication Properties

- Internet provides a general communication "fabric" linking all computers connected to it
  - Can be applied in many ways:
    - Point-to-point asynchronous
      - E-mail is alternative to standard mail
    - Point-to-point synchronous
      - IM is alternative to telephone
    - Multicasting
      - Chat rooms are alternatives to magazines
    - Broadcasting
      - Web pages are alternatives to radio and television

The Client/Server Structure

- **Server** is the computer that stores the web page
  - Web server, file server, mail server
- **Client** is the computer that accesses the web page
- When you click link, your computer enters client/server relationship with web server
- Once the page is sent to you, the client/server relationship ends
- Server can form many brief relationships so it can serve many clients at the same time

Figure 3.1. A diagram of the Internet.

Figure 3.2. The basic client/server interaction, as illustrated by the browser (client) requesting Web pages provided by the Web server.
The Medium of the Message

- The Name Game of Computer Addresses
  - **IP addresses**: Each computer connected to the Internet is given a unique numerical address
    - For example: 128.95.1.207
  - **Hostnames**: Human-readable symbolic names, based on domain hierarchy
    - Easier to read and remember
    - For example: spiff.cs.washington.edu
DNS Servers

- The Domain Name System (DNS) translates the human-readable hostnames into IP addresses.
- Internet host knows the IP address of its nearest DNS server, a computer that keeps a list of host/domain names and corresponding IP addresses.
- When you use a hostname to send information, your computer asks the DNS server to look up the IP address.
- If the DNS server doesn't know the IP address, it asks a Root name server, which keeps the master list of name-to-address relationships.

Top-level Domains

- Domain is a related group of networked computers.
- Top-level domains appear in the last part of domain name:
  - .edu educational institutions
  - .org organizations
  - .net networks
  - .mil military
  - .gov government agencies
  - Mnemonic two-letter country designators such as .ca (Canada)

Following Protocol

- A protocol describes how the information is actually sent.
- TCP/IP (Transmission Control Protocol/Internet Protocol)
  - Information is broken into a sequence of small fixed-size units called IP packets.
  - Each packet has space for the unit of data, the source and destination IP addresses, and a sequence number.
  - The packets are sent over the Internet one at a time using whatever route is available.
  - Because each packet can take a different route, congestion and service interruptions do not delay transmissions.
Moving Packets: Wires and More

- Internet uses electrical, electronic, and optical communication means
- Telephone lines, dedicated fiber optic lines, etc.
- The technology used to move the packet is independent from the protocol; transmission of a single file may use multiple technologies

Far and Near: WAN and LAN

- Internet is a collection of *Wide Area Networks (WAN)*, designed to send information between widely separated locations
  - Multiple *hops*
    - ping, traceroute
- *Local Area Networks (LAN)* connect computers close enough to be linked by a single cable or wire pair
  - *Ethernet* is the main technology for LAN
**Ethernet**

- Channel (wire, wire pair, or optical fiber) that winds past a set of computers
- Each computer is connected to the channel, allowing it to send a signal that can be detected by all computers connected to the channel
- Decentralized scheme: Each computer listens to the channel, and if it's quiet, it's free. The computer transmits unless another starts at the same time. In that case, both stop for a random time and then try again.

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**Connecting a Computer to the Internet**

- **By ISP:**
  - *Internet Service Providers* sell connections to Internet (like AOL and Earthlink)
  - User plugs into telephone system or dedicated connection to ISP (DSL, cable)
  - Home computer talks to ISP's computer
  - ISP's computer is connected to Internet, and relays information for its customers

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**Connecting a Computer to the Internet (cont'd)**

- **By Enterprise Network Connections (LAN):**
  - Large networked organizations such as schools, businesses, or governmental units
  - The organization creates a LAN or *intranet*
  - The intranet connects to the Internet by a gateway
  - Information from a Web computer is sent across Internet, through gateway, across LAN to user's computer
Wireless Networks

- A variation on the LAN connection
- A computer (called the access point or hub) is physically connected to the Internet (wired)
  - The hub broadcasts and receives radio frequency (rf) signals (wireless)
  - Mobile computers also send and receive signals (wireless)
  - Access point hands out temporary IP addresses via DHCP (Dynamic Host Configuration Protocol)
- The hub relays Internet requests for the connected wireless computers

The World Wide Web

- **Web servers**: Computers programmed to send files to browsers running on other computers connected to the Internet
- Web servers and their files make up the World Wide Web
- The World Wide Web is a subset of the Internet

Requesting a Web Page

- Web request creates a client/server interaction
- Uniform Resource Locator (URL) has three main parts
  1. Protocol:
    - http://
    - Hypertext Transfer Protocol
    - Tells the computer how to handle the file
  2. Server computer's name:
    - Server's IP address given by the domain hierarchy
  3. Page's pathname:
    - Tells the server which file (page) is requested and where to find it.

Describing a Web Page

- Pages are stored as a description of how they should appear on the screen
- Web browser created the image from the description file
  - Browser can adapt the source image more easily
**Hypertext**

- **Hypertext Markup Language (HTML)**
- **Markup languages** describe the layout of a document
  - Margin width
  - Font
  - Text style
  - Image placement
  - Etc.
- Hypertext provides a way to jump from point to point in documents (non-linear)
- Combination of hypertext and markup languages lets us build non-linear documents for the dynamic and interconnected Net and Web
  - Much more on HTML in Chapter 4

**The Internet and the Web**

- When is the "www" required and when is it optional?
- WWW is just a name; web servers do not have to use it
- In order for DNS to work, user must give the exact hostname
- To help users reach them, organizations do two things:
  1. Redirection: server inserts the "www" or redirects to a different server
  2. Registering multiple domain names
     - Museum of Modern Art has registered both "moma.org" and "www.moma.org" to the same IP address

**File Structure**

- **Directory**, or folder, is a named collection of files, other directories, or both
- **Directory Hierarchy**: Directories can contain other directories, which can contain other directories, etc.
  - Down, or lower in the hierarchy, means moving into subdirectories
  - Up, or higher in the hierarchy, means into enclosing (parent) directories

**File Structure (cont'd)**

- Part of the directory hierarchy is shown in the pathnames of URL's.
  http://www.nasm.si.edu/galleries/ga1100/pioneer.html
- Page is given by pathname:
  /galleries/ga1100/pioneer.html
- Each time we pass a slash (/), we move into a subdirectory or into the file (lower in the hierarchy)
Organizing the Directory

- When a URL ends in a slash, the browser looks for a file called *index.html* in that directory

- If the browser does not find an index.html file, the browser automatically tries to display a directory listing (index) of the files there

- Why are hierarchies important?
  - People use them to organize their thinking and work
  - Directories are free; there is no reason not to use them

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Table 3.1 Top-level country domain abbreviations

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<th>Domain</th>
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<td>Bolivia</td>
<td>bo</td>
</tr>
</tbody>
</table>

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Figure 3.13. The pathname hierarchy ending in *pioneer.html*.

Figure 3.3. Client/server relationships as they might evolve over time.
Fluency

Part 1
- Chapter 1
- Chapter 2
- Chapter 3
- Communication Types
- File Structure
- Directory Hierarchy

Figure 3.12. The hierarchy of this book highlighting the path to this figure.

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