E-commerce

business. technology. society.

Fourth Edition

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Chapter 3

The Internet and World Wide Web: E-commerce Infrastructure

All Mashed Up
Class Discussion

- What are Web mashups and what technology makes them possible?
- Why would Google and others allow their software to be combined with other software?
- What is the potential benefit to consumers?
- If mashups ultimately make money, how will the revenues be divided?
- Why would mashups be supportive of "context" advertising?

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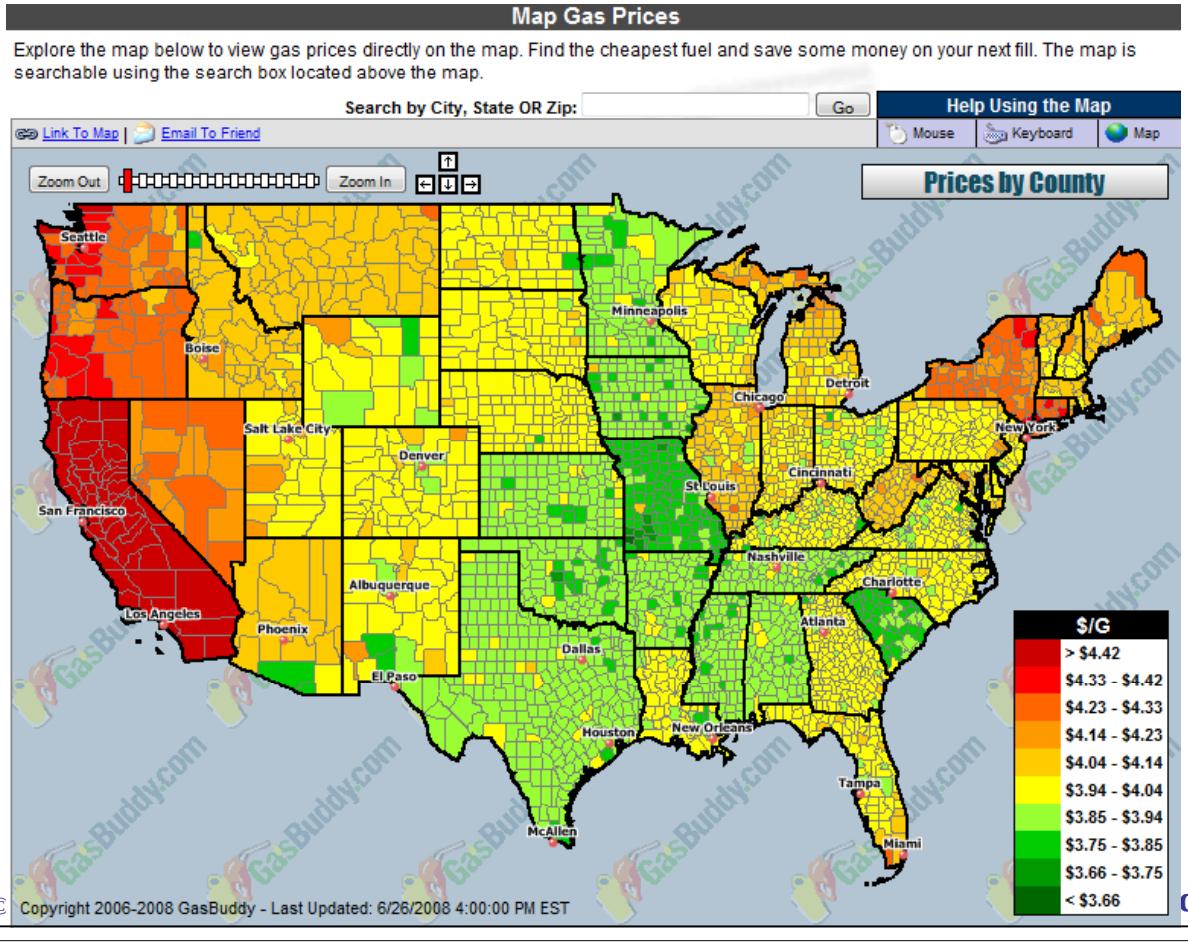

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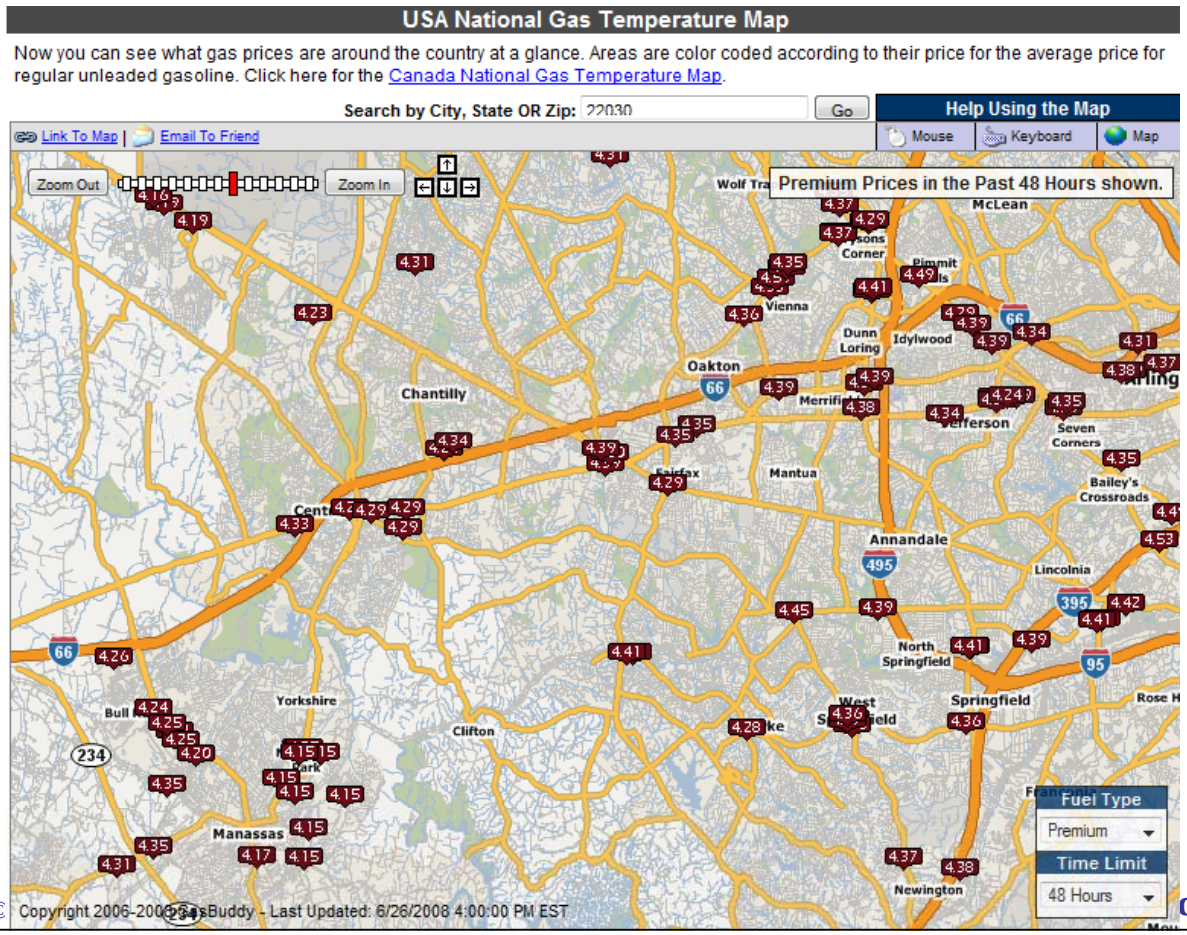

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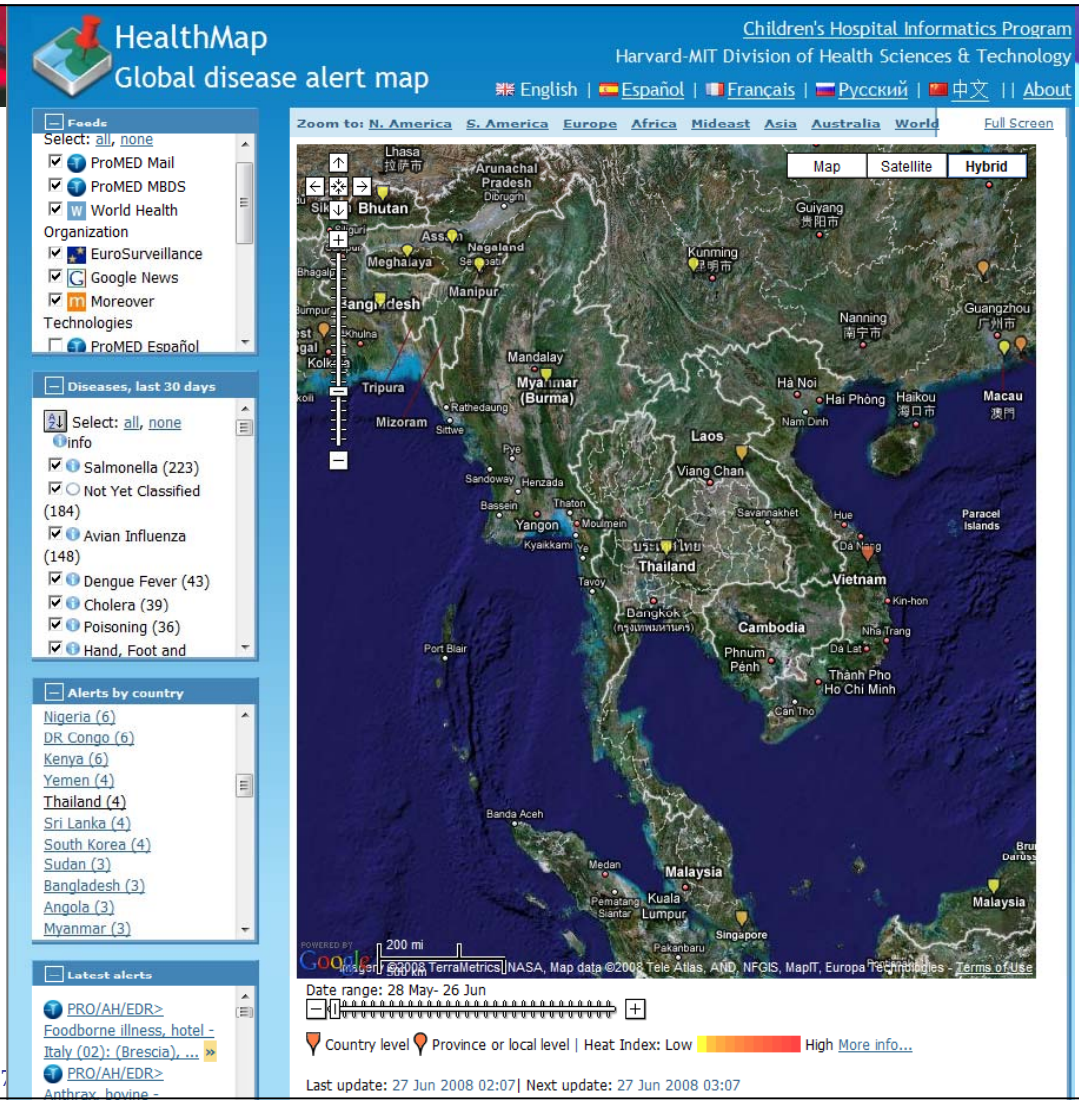

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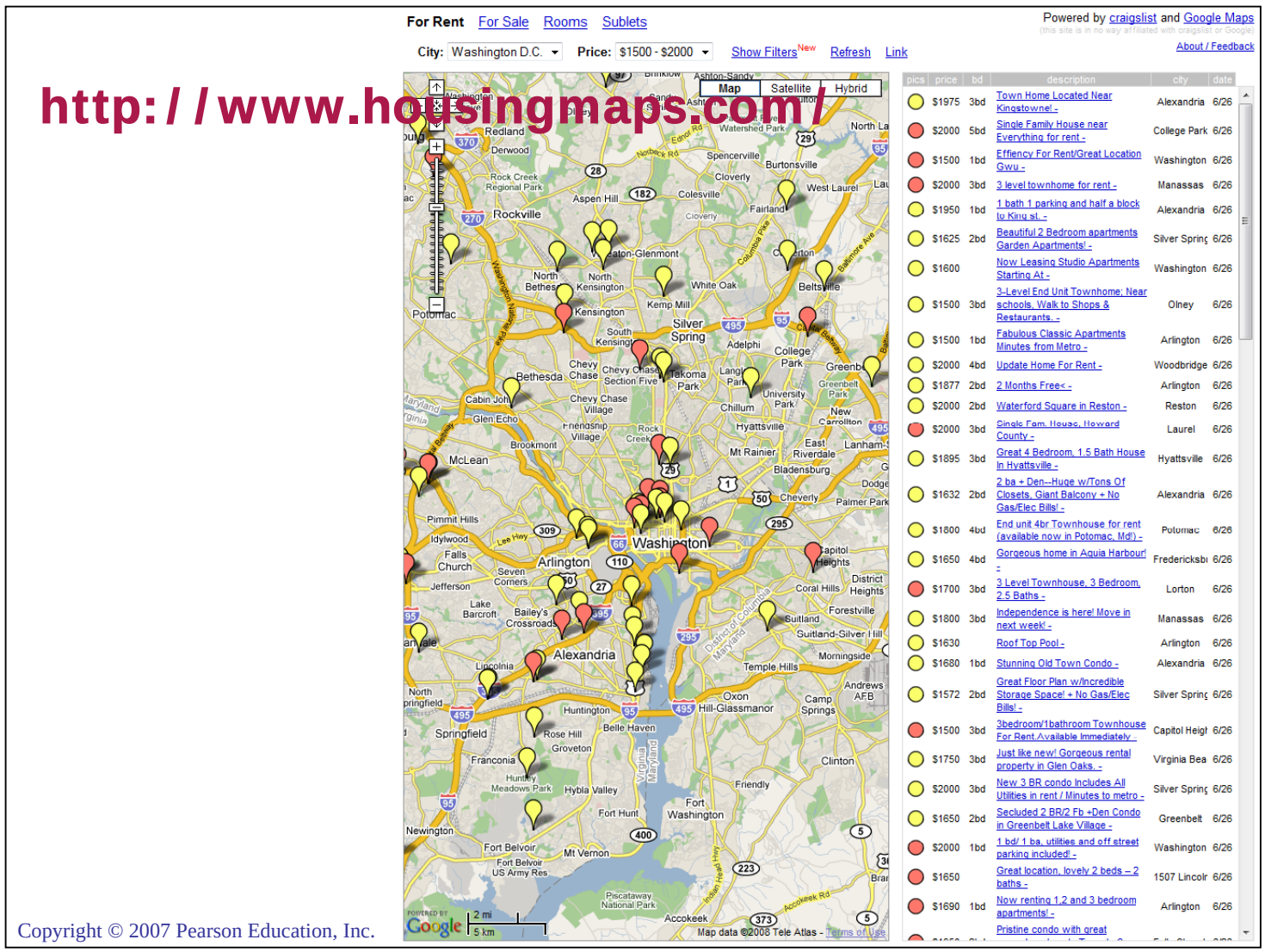

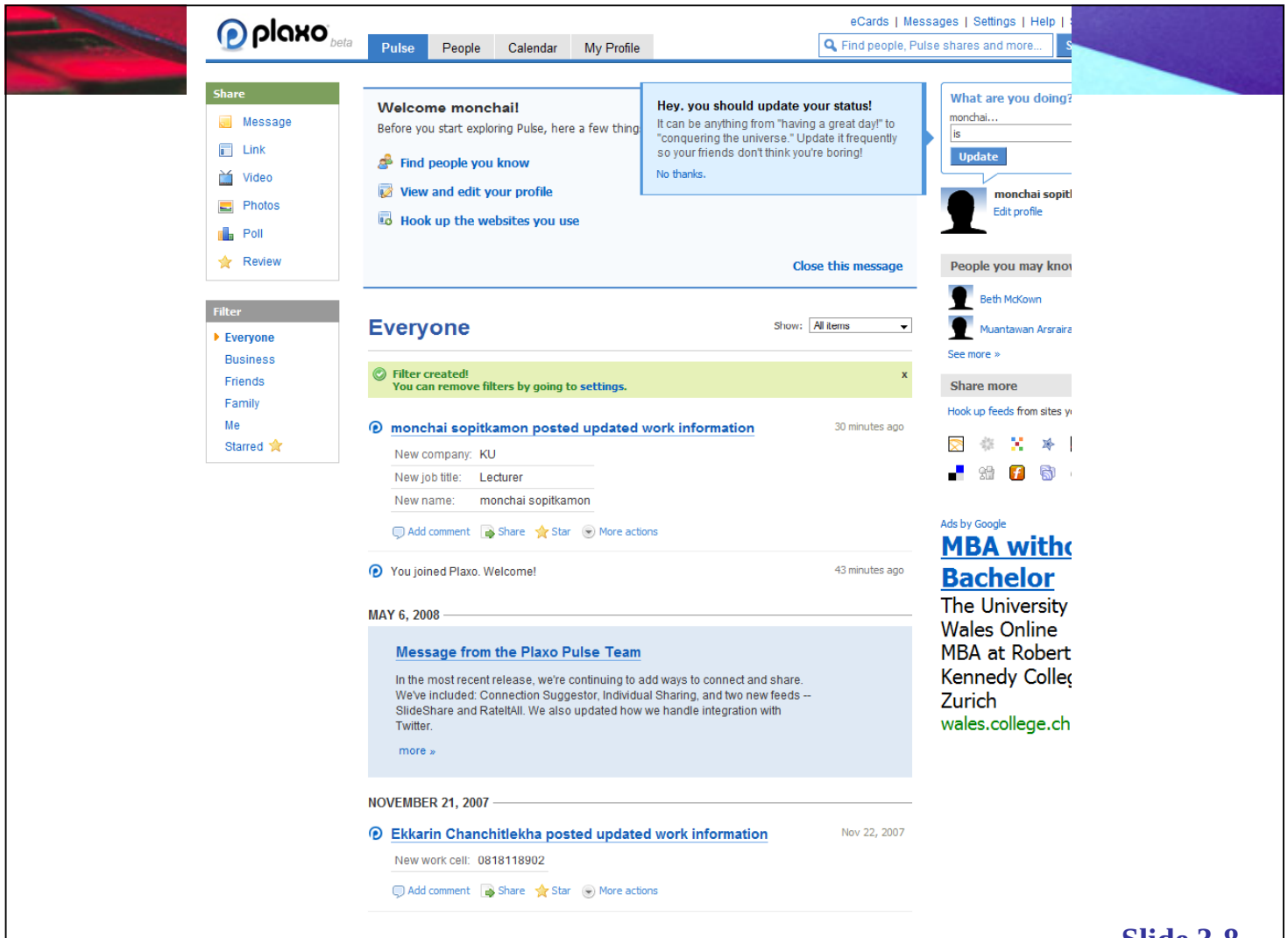


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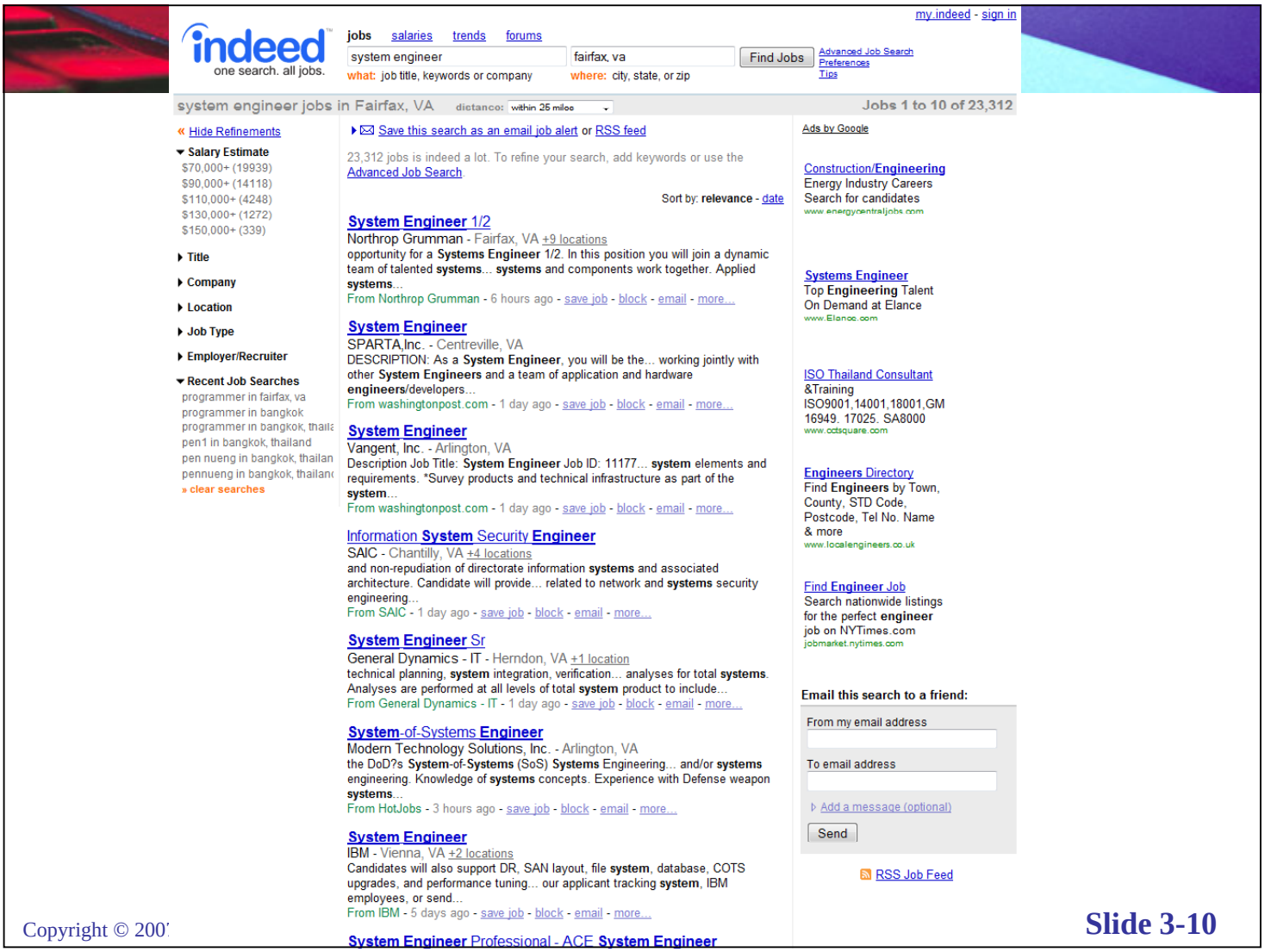
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The Internet: Technology Background

- Internet
  - An interconnected network of thousands of networks and millions of computers, linking businesses, educational institutions, government agencies, and individuals
- World Wide Web (Web)
  - One of the Internet's most popular services, providing access to over 50 billion Web pages

The Evolution of the Internet 1961—The Present

- History of Internet can be segmented into three phases:
  - Innovation Phase (1961 – 1974) : packet-switching networks, client/server paradigm, TCP/IP
  - Institutionalization Phase (1975 – 1995): DoD and NSF together helped created ARPANET → NSFNET later
  - Commercialization Phase (1995 →): Amazon, eBay, Internet2 (10Gbps)

The Internet: Key Technology Concepts

- Federal Networking Council definition of Internet highlights three important concepts that are the basis for understanding the Internet:
  - Packet switching
  - TCP/IP communications protocol
  - Client/server computing

Packet Switching

- Packet switching: Method of slicing digital messages into packets, sending the packets along different communication paths as they become available, and then reassembling the packets once they arrive at their destination
  - Uses routers (special purpose computers that interconnect the computer networks that make up the Internet and route packets) and routing algorithms to ensure packets take the best available path toward their destination

Packet Switching

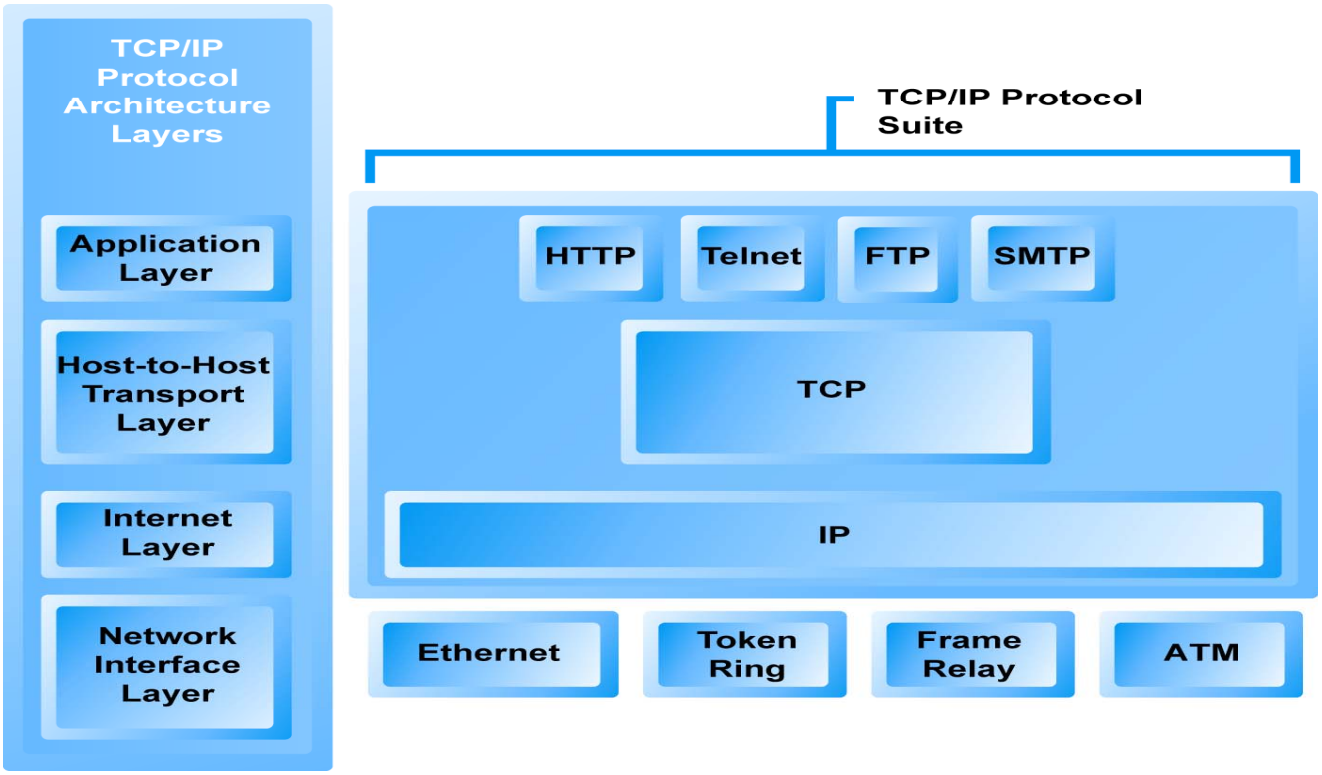
Figure 3.3, Page 128

TCP/IP

- Transmission Control Protocol (TCP):
  - Establishes the connections among sending and receiving Web computers, handles the assembly of packets at the point of transmission, and their reassembly at the receiving end
- Internet Protocol (IP):
  - Provides the Internet's addressing scheme
- TCP/IP divided into four separate layers:
  - Network Interface Layer: placing packets on and receiving them from network medium
  - Internet Layer: addressing, packaging, routing packets
  - Transport Layer: acknowledging and sequencing packets to and from application
  - Application Layer: access services of lower layers, e.g., HTTP, FTP, SMTP

The TCP/IP Architecture and Protocol Suite

Figure 3.4, Page 130

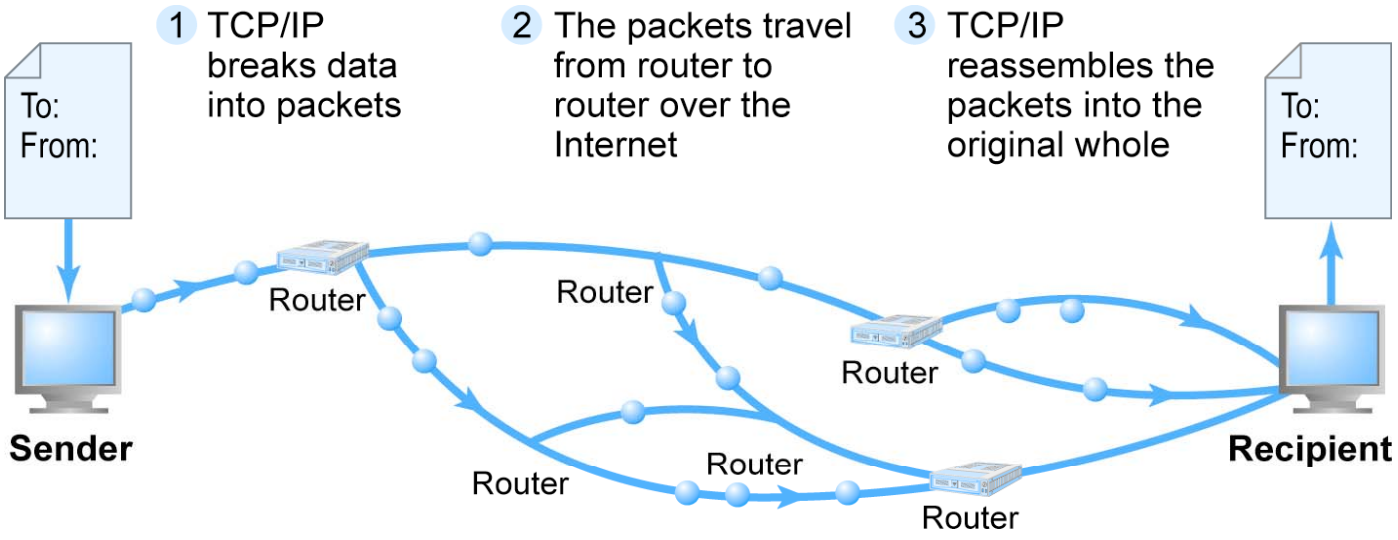


Internet (IP) Addresses

- IPv4:
  - 32-bit number expressed as a series of four separate numbers marked off by periods, such as 201.61.186.227
  - Supports 4 billion addresses (2^{32})
- IPv6:
  - 128-bit addresses; able to handle up to 1 quadrillion (10^{15}) addresses

Routing Internet Messages: TCP/IP and Packet Switching

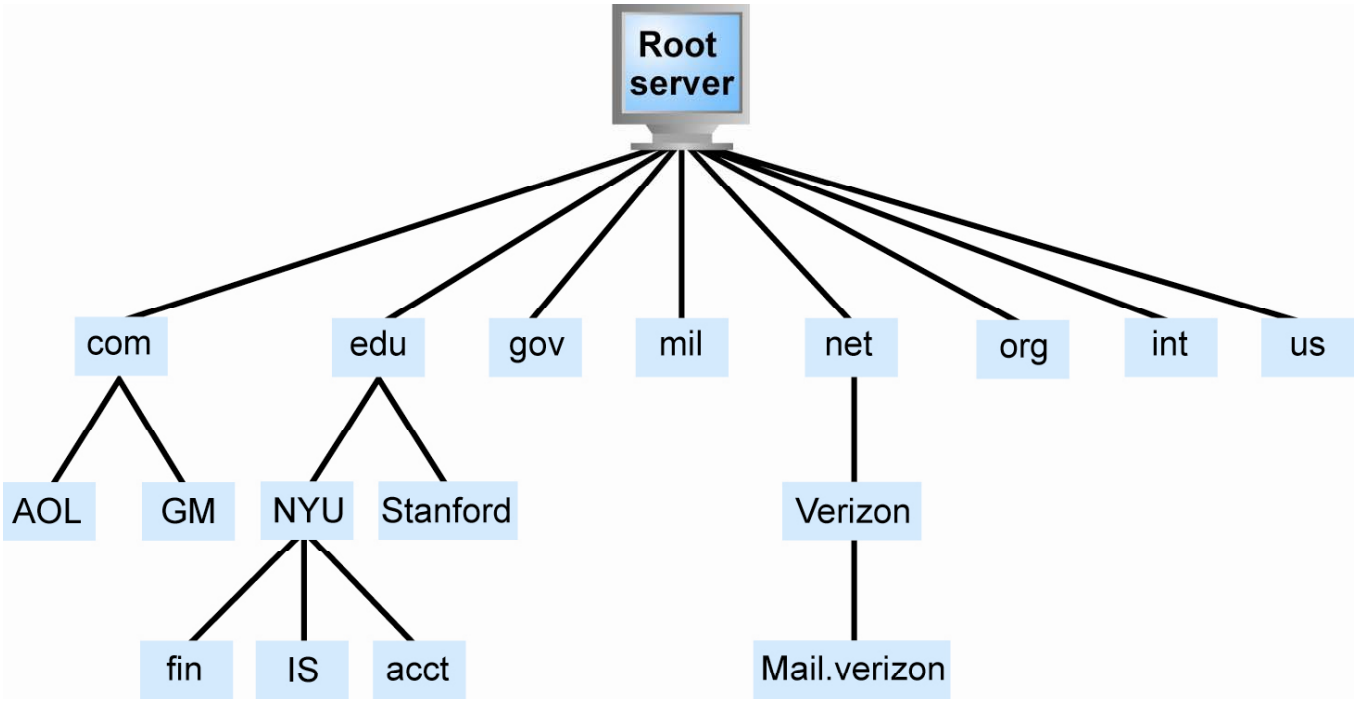
Figure 3.5, Page 131



Domain Names, DNS, and URLs

- Domain name
  - IP address expressed in natural language
- Domain name system (DNS)
  - Allows numeric IP addresses to be expressed in natural language
- Uniform resource locator (URL)
  - Addresses used by Web browsers to identify location of content on the Web

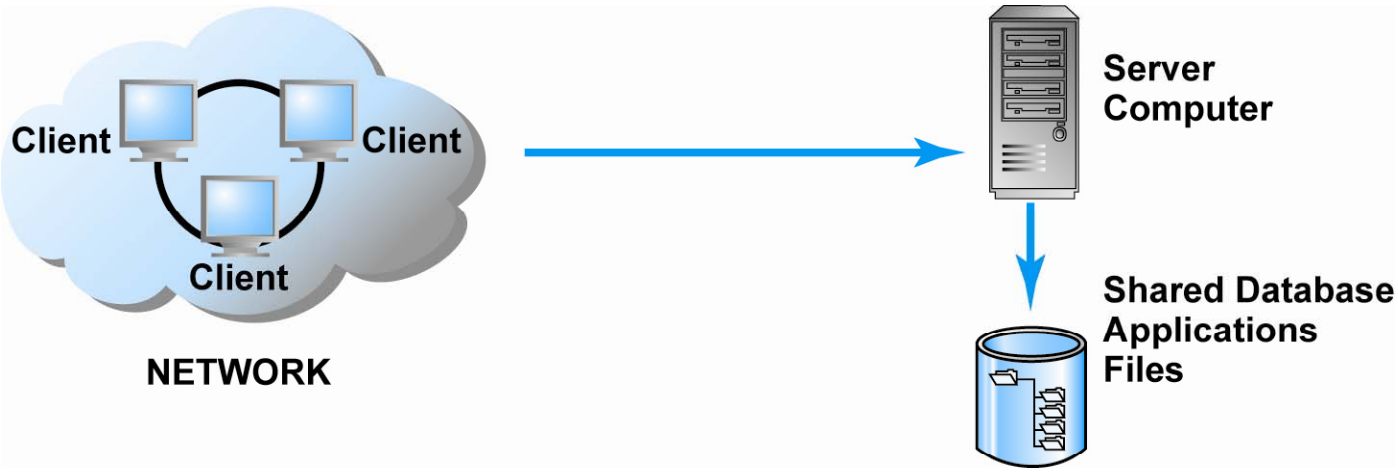
Hierarchical Domain Name System



Client/Server Computing

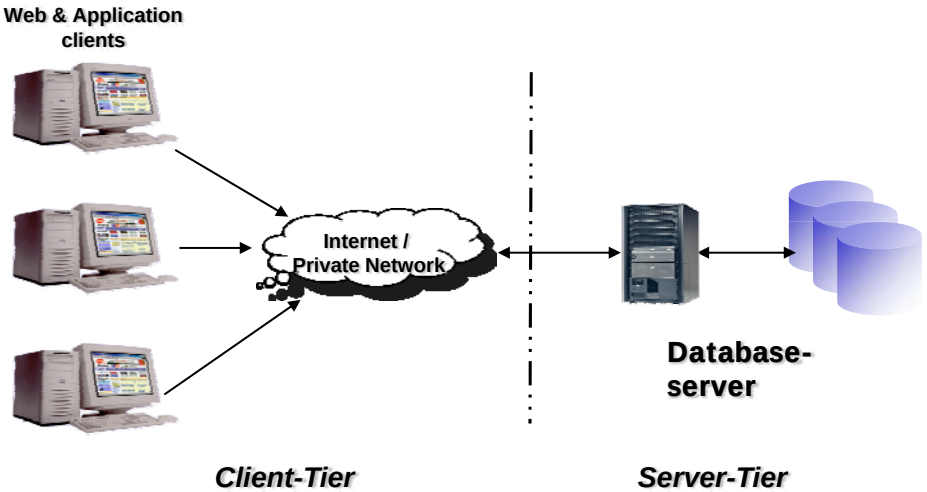
- Model of computing in which very powerful personal computers (clients) are connected in a network with one or more server computers that perform common functions for the clients, such as storing files, software applications, etc.
- Advantages:
  - Easy to expand capacity by adding servers
  - Less vulnerable than centralized mainframe thru backup and mirror servers
  - Load balancing over many smaller computers
  - Software and hardware can be built more simply and economically

Client/Server Computing Model



Two-tier Client/Server Architecture

- Client/server introduces a two-tier client/server architecture.
- The tiers in a client/server application refer to the # of elements into which the application is partitioned, not the # of platforms where the executables are deployed.
- The tiers into which an application is partitioned is known as the logical partitioning of an application as opposed to physical partitioning (# of platforms where the application executables are deployed).



Drawbacks of the Two-tier Client/Server Architecture

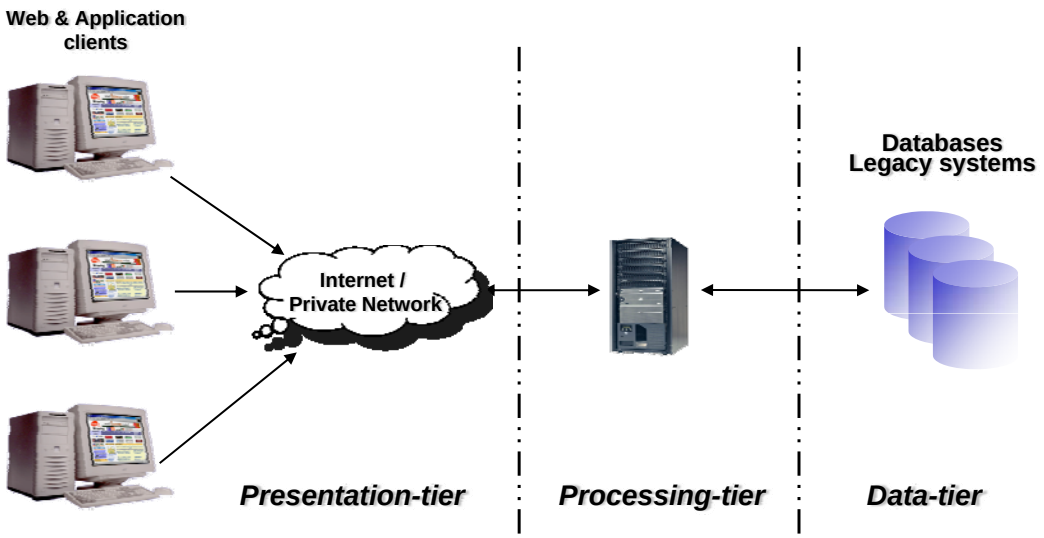
- The client in such a two-tier system is known as “fat client” while the server is commonly referred to as the database server. Conversations occur at the level of the server’s database language.
- The two-tier architecture has several drawbacks, which are especially problematic for large and distributed applications:
  - Scalability problems
  - Poor business logic sharing
  - Client reliance on the database structure
  - Limited interoperability
  - High-maintenance costs

Three-tier Architecture

- The three-tier architecture overcomes the limitations of the two-tier architecture. A middle tier is introduced between the user system interface client environment and the database management server environment.
- The application is partitioned into 3 logical tiers:
  - presentation tier: responsible for the graphical user interface (GUI) layer usually in the form of a web-browser
  - processing tier (or middle-tier): contains the business logic & is responsible for the processing associated applications supported.
  - data tier: holds the permanent data associated with the applications supported e.g., modern and legacy application databases, and transaction management applications. It interprets requests from a client and routes them to a suitable data resource.

Three-tier Architecture

- The processing tier enables developers to isolate the main part of an application that can change over time: data & relationships inherent in the data.
- This tier has the effect of logically and physically decoupling business logic from the presentation and database functions. Here we can find business objects that correspond to entities in the business domain, e.g., sales orders, invoices, products ..
- There are a variety of ways of implementing this middle tier, such as transaction processing monitors, message servers, or application servers.



Three-tier client/server architecture.

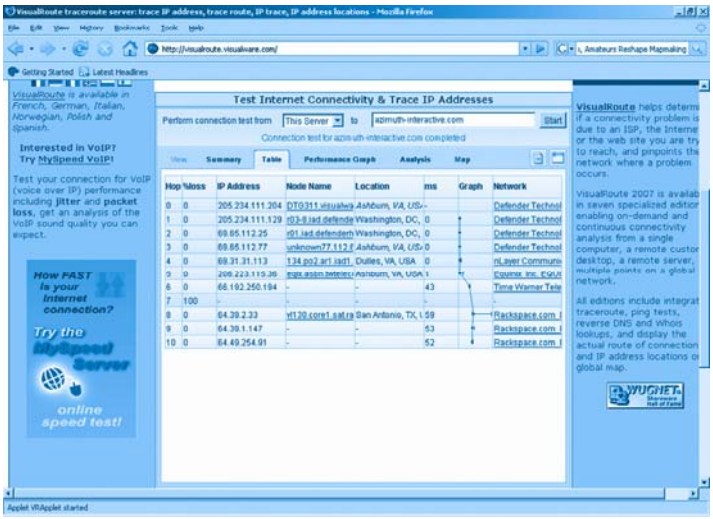
Other Internet Protocols

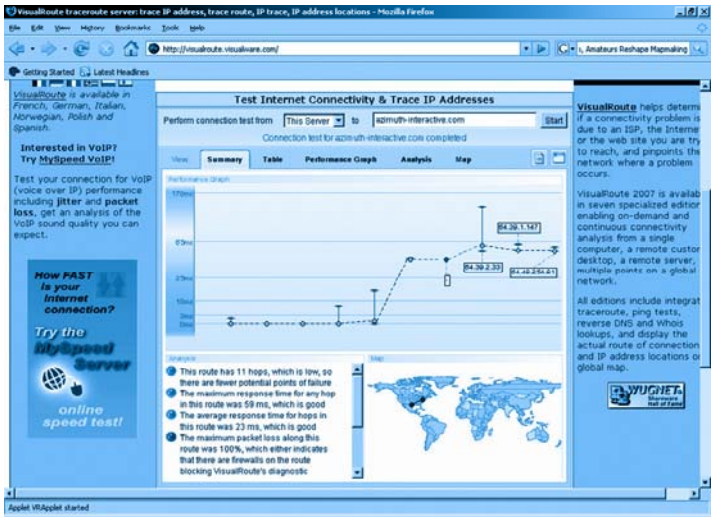
- HTTP: Used to transfer Web pages
- SMTP, POP, and IMAP: Used to send and receive e-mail
- FTP: Permits users to transfer files from server to client and vice versa
- Telnet: Program that enables a client to emulate a mainframe computer terminal
- SSL: Protocol that provides secure communications between client and server

Utility Programs

- Ping: Utility program that allows you to check connection between client and server
- Tracert: Utility program that allows you to follow part of a message sent from a client to a remote computer
- Pathping: Utility program that combines functionality of Ping and Tracert

Tracing the Route a Message Takes on the Internet



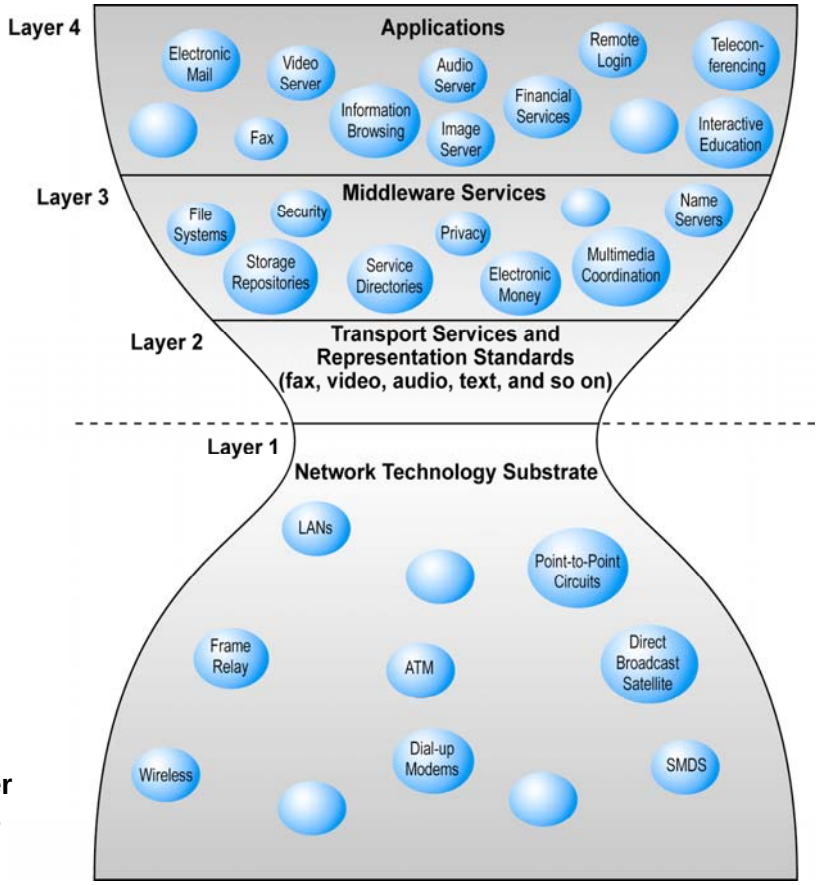


The Internet Today

- Client/server computing model, coupled with hourglass, layered architecture has allowed Internet to handle explosive growth without disruption
- Hourglass/layered architecture – 4 layers:
  - Network Technology Substrate
  - Transport Services and Representation Standards
  - Middleware Services
  - Applications

The Hourglass Model of the Internet

Figure 3.10, Page 139



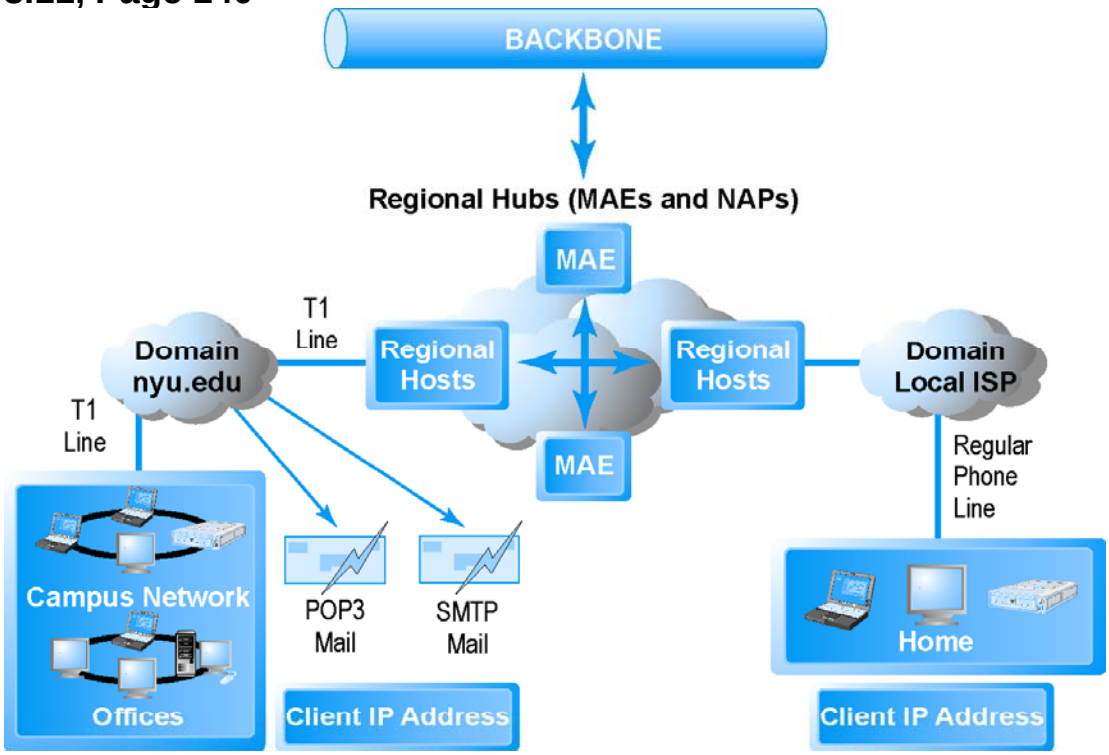
SOURCE: Adapted from Computer Science and Telecommunications Board (CSTB), 2000.

Internet Network Architecture

- Backbone: High-bandwidth fiber-optic cable owned by a variety of NSPs
- IXPs: Hubs where backbones intersect with regional and local networks, and backbone owners connect with one another
- CANs: LANs operating within a single organization that leases Internet access directly from regional or national carrier
- ISPs: Lease Internet access to home owners and businesses

Internet Network Architecture

Figure 3.11, Page 140



Some Major US Internet Exchange Points (IXPs)

Region	Name	Location	Operator
EAST	MAE East	Virginia and Miami	MCI
	New York International Internet Exchange (NYIIX)	New York	Telehouse
	Peering and Internet Exchange (PAIX)	New York, Philadelphia and Northern Virginia	Switch and Data
	NAP of the Americas	Miami	Terramark
CENTRAL	MAE Chicago	Chicago	MCI
	Chicago NAP	Chicago	SBC
	MAE Central	Dallas and Atlanta	MCI
	Peering and Internet Exchange (PAIX)	Atlanta	Switch and Data
WEST	MAE West	San Jose and Los Angeles	MCI
	Peering and Internet Exchange (PAIX)	Palo Alto, San Jose, and Seattle	Switch and Data
	Los Angeles International Internet Exchange (LAIIX)	Los Angeles	Telehouse

ISPs (Internet Service Providers)

- Retail providers that deal with “last mile of service”
- Offer both narrowband (traditional telephone modem connection at 56.6 Kbps) and broadband (service based on DSL, cable modem, T1 or T3 telephone lines, and satellite)

Broadband Service Choices

- Digital Subscriber Line (DSL): High-speed access through ordinary telephone lines; 1-3 Mbps
- Cable modem: Piggybacks digital access to Internet on top of analog video cable line; 1-15 Mbps
- T1 (1.54 Mbps) and T3 (45 Mbps): International telephone standards for digital communication; offer guaranteed delivery rates
- Satellite: high-speed downloads, slower uploads; 250 Kbps – 1 Mbps

Intranets and Extranets

- Intranet: TCP/IP network located within a single organization for purposes of communication and information processing
- Extranet: Formed when firms permit outsiders to access their internal TCP/IP networks

Who Governs the Internet?

- Organizations that influence Internet and monitor its operations include:
  - Internet Architecture Board (IAB) – defines overall Internet structure
  - Internet Corporation for Assigned Names and Numbers (ICANN) – manage IP addresses and 13 root domain name servers
  - Internet Engineering Steering Group (IESG) – overseas standard Internet setting
  - Internet Engineering Task Force (IETF): forecasts next step in growth of the Internet
  - Internet Society (ISOC) – monitors Internet policies and practices
  - World Wide Web Consortium (W3C) – sets HTML and other programming standards for the Web

Insight on Society: Government Regulation of the Internet Class Discussion

- How is it possible for any government to “control” or censor the Web?
- Does the Chinese government, or the U.S. government, have the right to censor content on the Web?
- How should U.S. companies deal with governments that want to censor content?
- What would happen to e-commerce if the existing Web split into a different Web for each country?

Internet II: The Future Infrastructure

- Internet II: Second era of Internet being built by private corporations, universities, government agencies
- To appreciate benefits, must understand limitations of the Internet’s current infrastructure
  - Bandwidth limitations: congestion at the “last-mile” homes
  - Quality of service limitations: latency created “jerky” videos
  - Network architecture limitations: same music track being sent to thousands of clients in same area
  - Language development limitations: fixed and generic HTML tags not supporting “rich documents”
  - Wired Internet limitations: mobility restriction due to wired nature

The Internet2® Project

- Internet2: Consortium of 200+ universities, government agencies, and private businesses collaborating to find ways to make the Internet more efficient
- Primary goals:
  - Create leading edge very-high speed network for national research community
  - Enable revolutionary Internet applications
  - Ensure rapid transfer of new network services and applications to broader Internet community

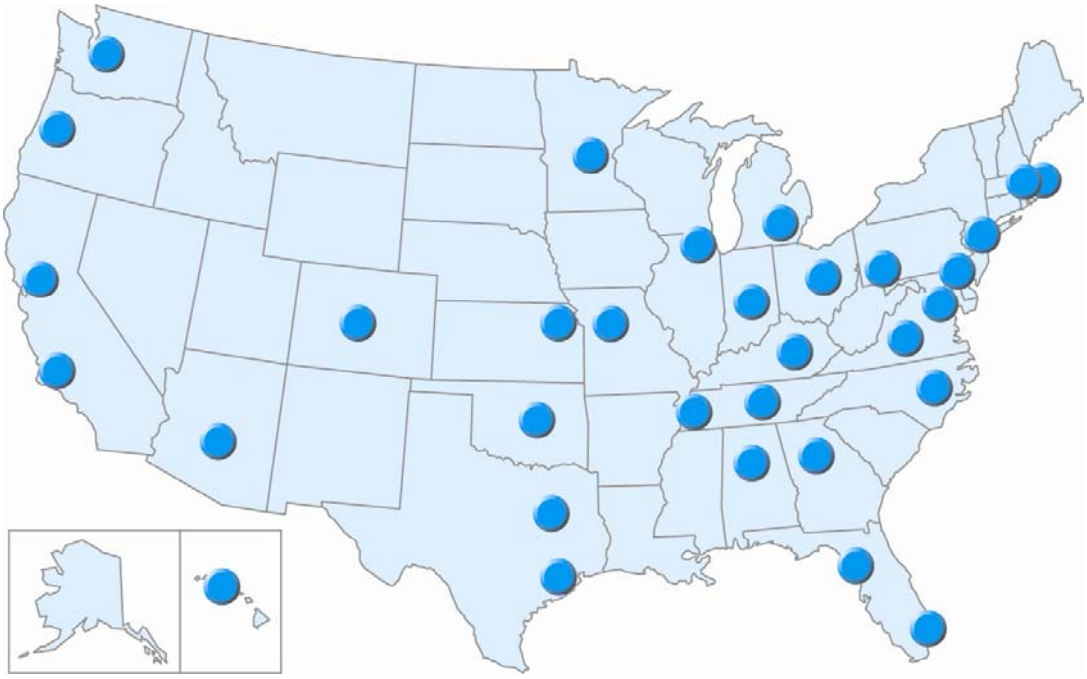
Areas of Focus of Internet2

- Advanced network infrastructure
- New networking capabilities
- Middleware
- Advanced applications

The Larger Internet II Technology Environment: The First Mile and the Last Mile

- GENI Initiative: Proposed by NSF to develop new core functionality for Internet, e.g., new naming, addressing, identity and security architecture, high availability, new services, and applications
- Private initiatives in fiber optics trunk and wireless Internet services

Internet2 GigaPoP Exchanges



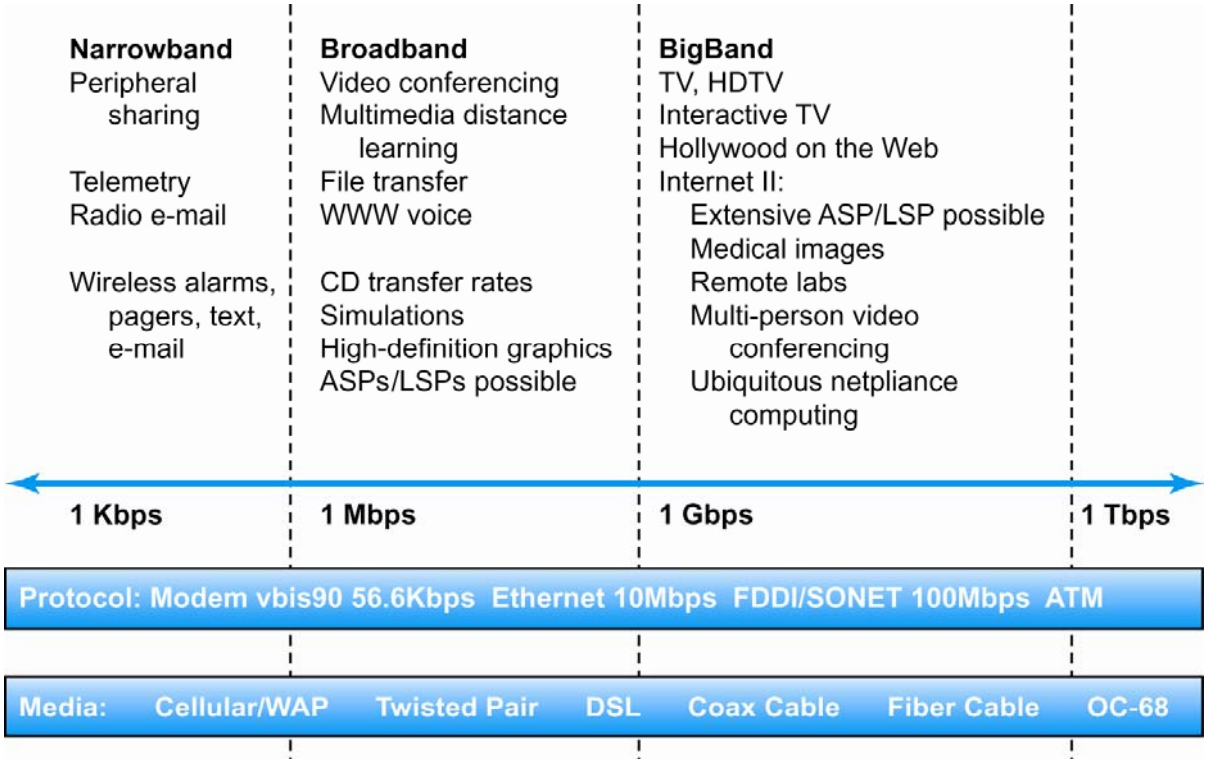
Fiber Optics and the Bandwidth Explosion in the First Mile

- Fiber optics concerned with “first mile” or backbone Internet services that carry bulk traffic over long distances
- Older transmission lines being replaced with fiber-optic cable
- Right now, much of fiber-optic cable laid in United States is “dark”, but represents a vast digital highway that can be utilized in the future

Photonics Technologies

- Photonics: Study of communicating with light waves
- Technologies that will have impact on achieving Internet II include
  - Dense Wavelength Division Multiplexing (DWDM)
  - Optical and fiber switches, and switching components
  - Optical integrated circuits
  - Optical networks
- Big Band: Next step in Internet access; will provide bandwidth of 10 Gbps +

Bandwidth Demand of Various Web Applications



The Last Mile: Mobile Wireless Internet Access

- Wireless Internet access concerned with the "last mile"—from Internet backbone to user's computer, cell phone, PDA, etc.
- Two different basic types of wireless Internet access:
  - Telephone-based
  - Computer network-based

Telephone-based Wireless Internet Access

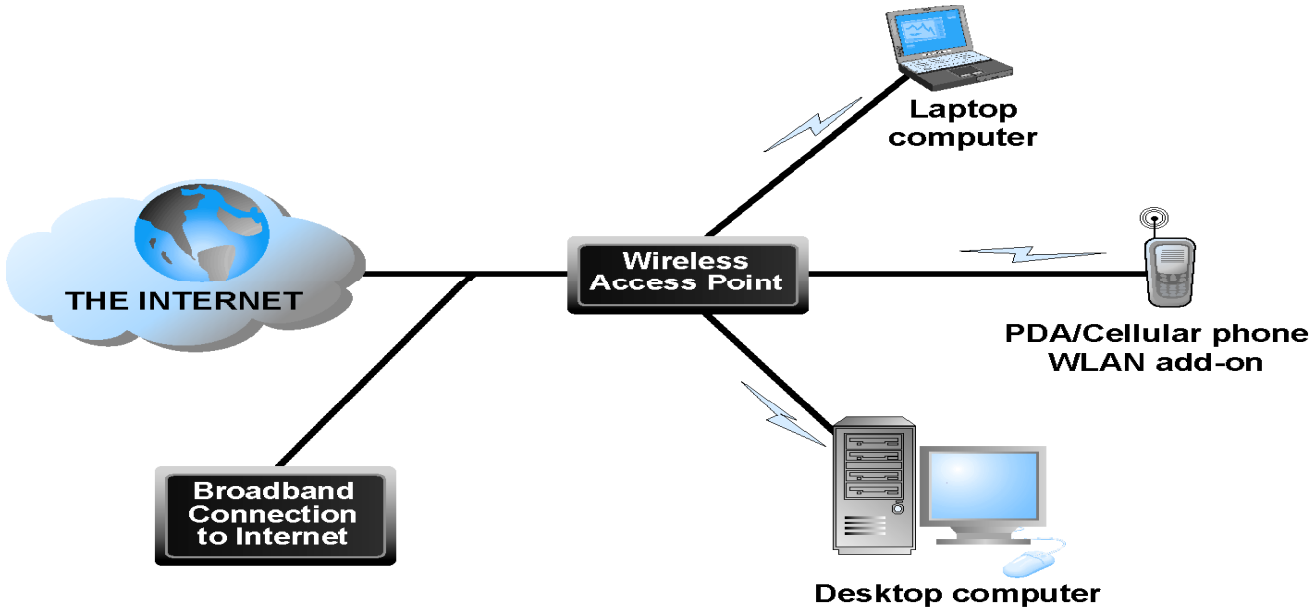
- Different standards
  - Global System for Mobile Communications (GSM): used primarily in Europe: single shared freq w/ TDMA
  - Code Division Multiple Access (CDMA): used primarily in U.S.: random assignment of different freq over full spectrum
- 1G: analog based cellular networks
- 2G (10 Kbps): slow circuit-switched digital networks
- 2.5G: packet-switched networks (GPRS 60-144 Kbps, EDGE 384 Kbps)
- 3G (384 Kbps – 2Mbps) cellular networks

Wireless Local Area Networks (WLANs)

- Wi-Fi (300 ft/11-70Mbps): High-speed, fixed broadband wireless LAN. Different versions for home and business market. Limited range
- WiMax (30 ml/50-70Mpbs): High-speed, medium range broadband wireless metropolitan area network
- Bluetooth (1-30 m/1-3Mpbs): Low-speed, short range connection
- Ultra-Wideband (UWB, 30 ft/5-10 Mbps): Low power, short-range high bandwidth network
- Zigbee (30 ft/250 Kbps): Short-range, low-power wireless network technology for remotely controlling digital devices

Wi-Fi Networks

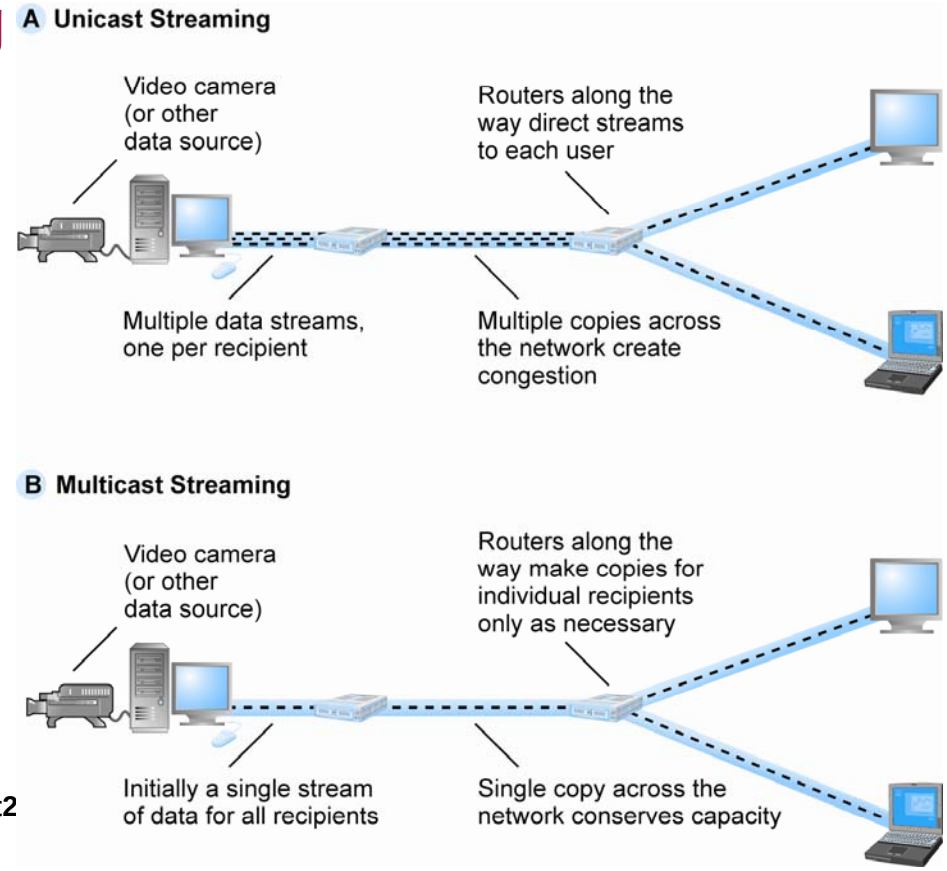
Figure 3.15, Page 158



Benefits of Internet II Technologies

- IP multicasting: Enables efficient delivery of data to many locations on a network
- Latency solutions: diffserv (differentiated quality of service) assigns different levels of priority to packets depending on type of data being transmitted
- Guaranteed service levels: ability to purchase right to move data through network at guaranteed speed in return for higher fee
- Lower error rates
- Declining costs

IP Multicasting



SOURCE: Adapted from Internet2 2000; Cisco Systems, 2007.

Development of the Web

- 1989–1991: Web invented by Tim Berners-Lee at CERN
- 1993: Marc Andreesen and others at NCSA create Mosaic, Web browser with GUI that runs on Windows, Macintosh, or Unix
- 1994: Andreessen, Jim Clark found Netscape; create first commercial Web browser, Netscape Navigator
- August 1995: Microsoft introduces Internet Explorer, its version of Web browser

Hypertext

- A way of formatting pages with embedded links that connect documents to one another, and that also link pages to other objects such as sound, video, or animation files
- Uses Hypertext Transfer Protocol (HTTP) and URLs to locate resources on the Web

Markup Languages

- Generalized Markup Languages (GMLs) include:
  - Standard Generalized Markup Language (SGML)—early GML
  - Hypertext Markup Language (HTML)—GML that is relatively easy to use; provides fixed set of markup “tags” used to format Web pages
  - eXtensible Markup Language (XML)—new markup language specification developed by W3C; designed to describe data and information; tags used are defined by user

Sample XML Code for a Company Directory

```
<?xml version="1.0"?>
<Companies>
    <Company>
          <Name>Azimuth Interactive Inc.</Name>
        <Specialties>
                <Specialty>HTML development</Specialty>
                  <Specialty>technical documentation</Specialty>
               <Specialty>ROBO Help</Specialty>
                <Country>United States</Country>
        </Specialties>
       <Location>
                <Country>United States</Country>
             <State />
              <City>Chicago</City>
       </Location>
            <Telephone>301-555-1212</Telephone>
    </Company>
    <Company>
       ...
    </Company>
   ...
</Companies>
```


Web Servers and Web Clients

- Web server software: Enables a computer to deliver Web pages written in HTML or XML to clients on network that request this service by sending an HTTP request
  - Basic capabilities: Security services, FTP, search engine, data capture
- Term Web server also used to refer to physical computer that runs Web server software
- Web client: Any computing device attached to the Internet that is capable of making HTTP requests and displaying HTML pages

Web Browsers

- Primary purpose to display Web pages
- Internet Explorer (75%) and Firefox (20%) dominate the market
- Other browsers include:
  - Netscape
  - Opera
  - Safari (for Apple)

The Internet and Web: Features

- Internet and Web features on which the foundations of e-commerce are built include:
  - E-mail
  - Instant messaging
  - Search engines
  - Intelligent agents (bots)
  - Online forums and chat
  - Streaming media
  - Cookies

E-mail

- One of the most used applications of the Internet
- Uses a series of protocols to enable messages containing text, images, sound, video clips, etc., to be transferred from one Internet user to another
- Also allows attachments
- Can be an effective marketing tool
- Spam a worsening problem

Instant Messaging

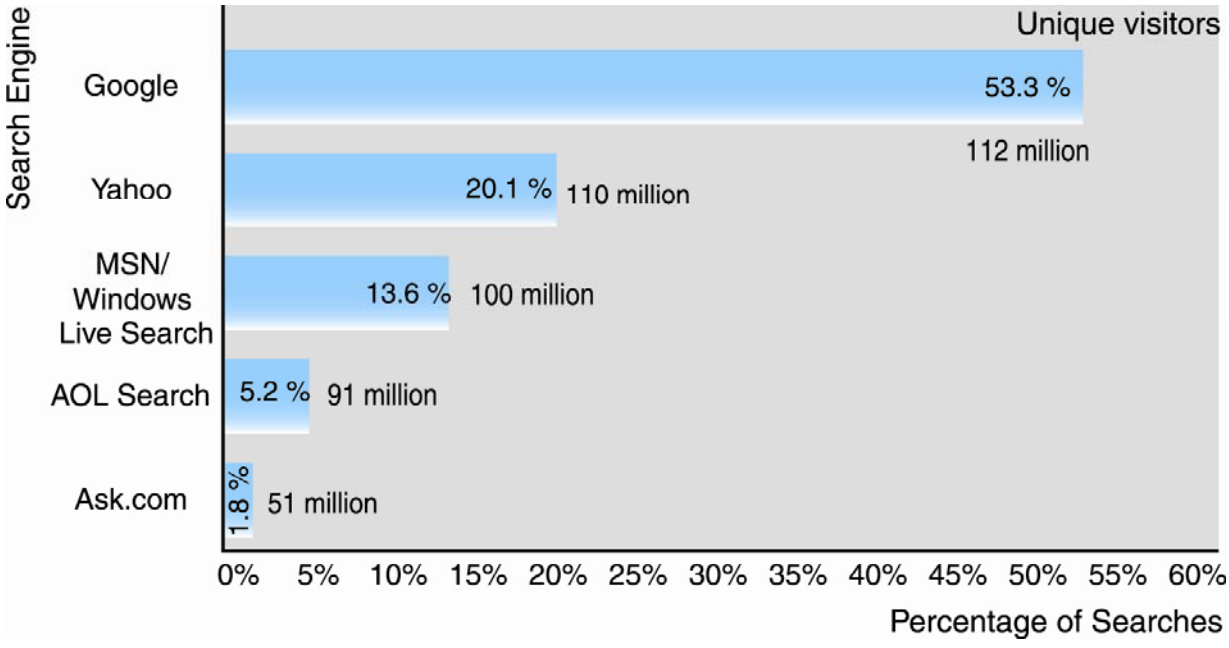
- One of fastest growing forms of online human communication
- Displays words typed on a computer almost instantly, and recipients can then respond immediately in the same way
- Different proprietary systems offered by AOL, MSN, Yahoo, and Google

Search Engines

- Identifies Web pages that appear to match keywords (queries) entered by a user, and provides list of best matches based on one or more of a variety of techniques
- No longer simply search engines, but also shopping tools and advertising vehicles (search engine marketing)

Top Five Search Engines

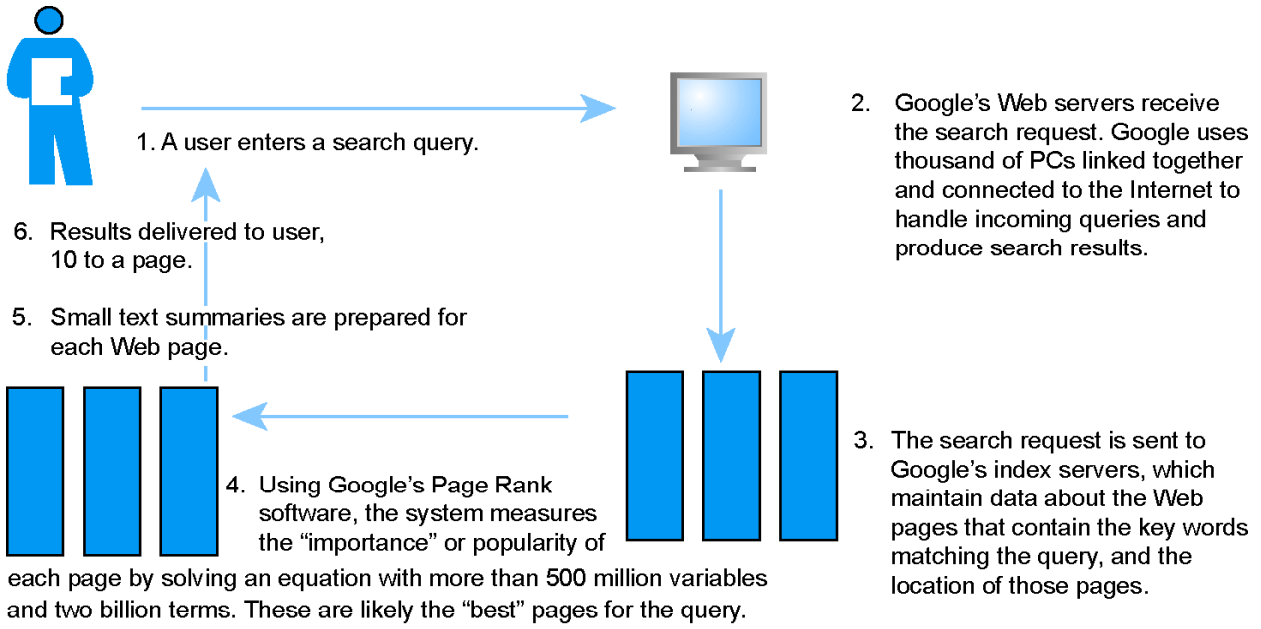
Figure 3.22, Page 168



SOURCE: Based on data from Sullivan, 2006; Pew Internet & American Life Project, 2005c; comScore Networks, 2006.

How Google Works

Figure 3.21, Page 174



Intelligent Agents (Bots)

- Software programs that gather and/or filter information on a specific topic and then provide a list of results
- Types include search bot, shopping bot, Web monitoring bot, news bot, chatterbot

Insight on Technology: Chatterbots Meet Avatars
Class Discussion

- What are chatterbots? Why would any firm use them?
- Have you experienced a chatterbot on the Web or telephone? Was this a useful or helpful experience?
- What are avatars? Why would a business use avatars?
- Visit a business center on the Second Life web site. Do you think it is worthwhile for businesses to set up such business centers? Why or why not

Other Internet and Web Features Relevant to E-commerce

- Online forums/chat: Enables users to communicate with each other via computer. Online chat occurs in real time (simultaneously)
- Streaming media: Enables music, video and other large files to be sent to users in chunks so that when received and played, file comes through uninterrupted
- Cookies: Small text file stored on user's computer with information about the user that can be accessed by Web site the next time user returns to the site

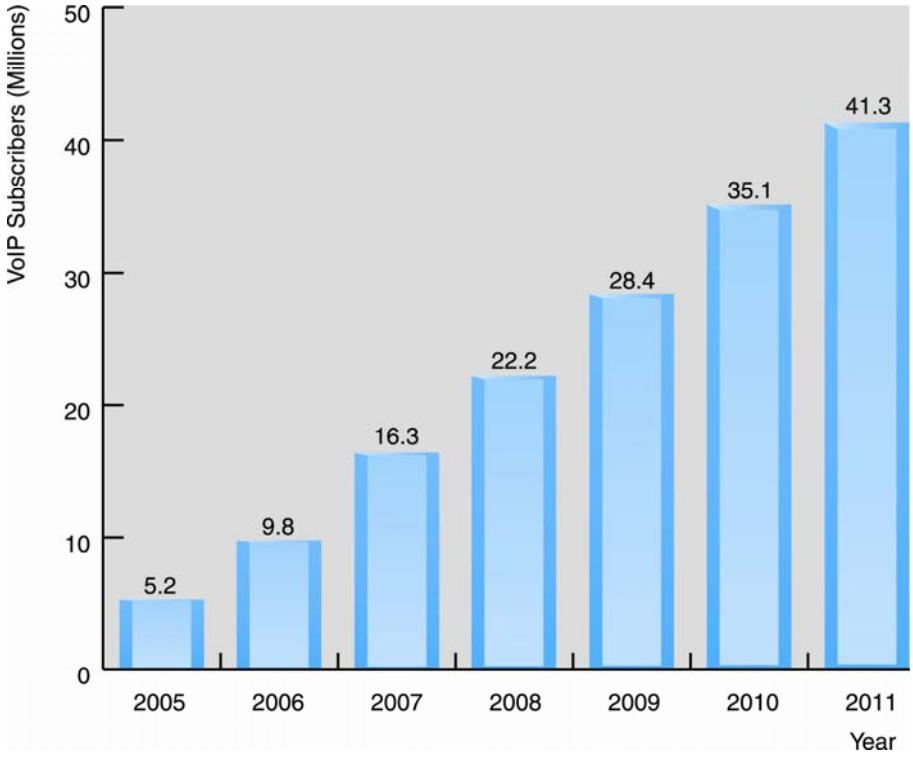
Internet II and E-commerce: New and Disruptive Web Features and Services

- Blogs: Personal Web page that typically contains a series of chronological entries by its author, and links to related Web pages
- Really Simple Syndication (RSS): Allows users to have digital content automatically sent to them; typically used for news
- Podcasting: Audio presentation stored as an audio file and available for download from Web

Internet II and E-commerce: New and Disruptive Web Features and Services

- Wiki: Allows user to easily add and edit content on a Web page
- New music and video services: Videocasts; digital video on demand
- Internet Telephony: Use Voice Over Internet Protocol (VOIP) and Internet's packet-switched network to transmit voice and other forms of audio communication over the Internet

The Growth of Internet Telephony



Internet II and E-commerce: New and Disruptive Web Features and Services

- Internet television (IPTV): SDTV (3Mbps), HDTV (19Mbps), MPEG4 (10Mpbs)
- Video conferencing
- Online software and Web services: Web apps (salesforce.com), widgets (iLike) and gadgets (desktop.google.com/plugins), digital software libraries, distributed storage (iBackup.com, Xdrive.com)
- M-commerce applications (iPhone, Google's Android, Blackberry's Curve)