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Chapter 3

E-commerce Infrastructure: The Internet, Web, and Mobile Platform

The Internet: Technology Background

- **Internet**
  - Interconnected network of thousands of networks and millions of computers
  - Links businesses, educational institutions, government agencies, and individuals

- **World Wide Web (Web)**
  - One of the Internet's most popular services
  - Provides access to billions, possibly trillions, of Web pages

The Evolution of the Internet 1961–Present

- ■ **Innovation Phase, 1961–1974**
  - ❖ Creation of fundamental building blocks

- ■ **Institutionalization Phase, 1975–1995**
  - ❖ Large institutions provide funding and legitimization

- ■ **Commercialization Phase, 1995–present**
  - ❖ Private corporations take over, expand Internet backbone and local service

The Internet: Key Technology Concepts

- **Internet defined as network that:**
  - Uses IP addressing
  - Supports TCP/IP
  - Provides services to users, in manner similar to telephone system

- **Three important concepts:**
  - Packet switching
  - TCP/IP communications protocol
  - Client/server computing

Packet Switching

- **Slices digital messages into packets**

- **Sends packets along different communication paths as they become available**

- **Reassembles packets once they arrive at destination**

- **Uses routers**
  - ❖ Special purpose computers that interconnect the computer networks that make up the Internet and route packets
  - ❖ **Routing algorithms** ensure packets take the best available path toward their destination

- **Less expensive, wasteful than circuit-switching**

Packet Switching

I want to communicate with you.

Original text message

0010110110001001101110001101

Text message digitized into bits

01100010 10101100 11000011

Digital bits broken into packets

0011001 10101100 11000011

Header information added to each packet indicating destination, and other control information, such as how many bits are in the total message and how many packets

Figure 3.3, Page 117

TCP/IP

- **Transmission Control Protocol (TCP)**
  - ❖ Establishes connections among sending and receiving Web computers
  - ❖ Handles assembly of packets at point of transmission, and reassembly at receiving end

- **Internet Protocol (IP)**
  - ❖ Provides the Internet's addressing scheme

- **Four TCP/IP layers**
  - ❖ Network interface layer
  - ❖ Internet layer
  - ❖ Transport layer
  - ❖ Application layer
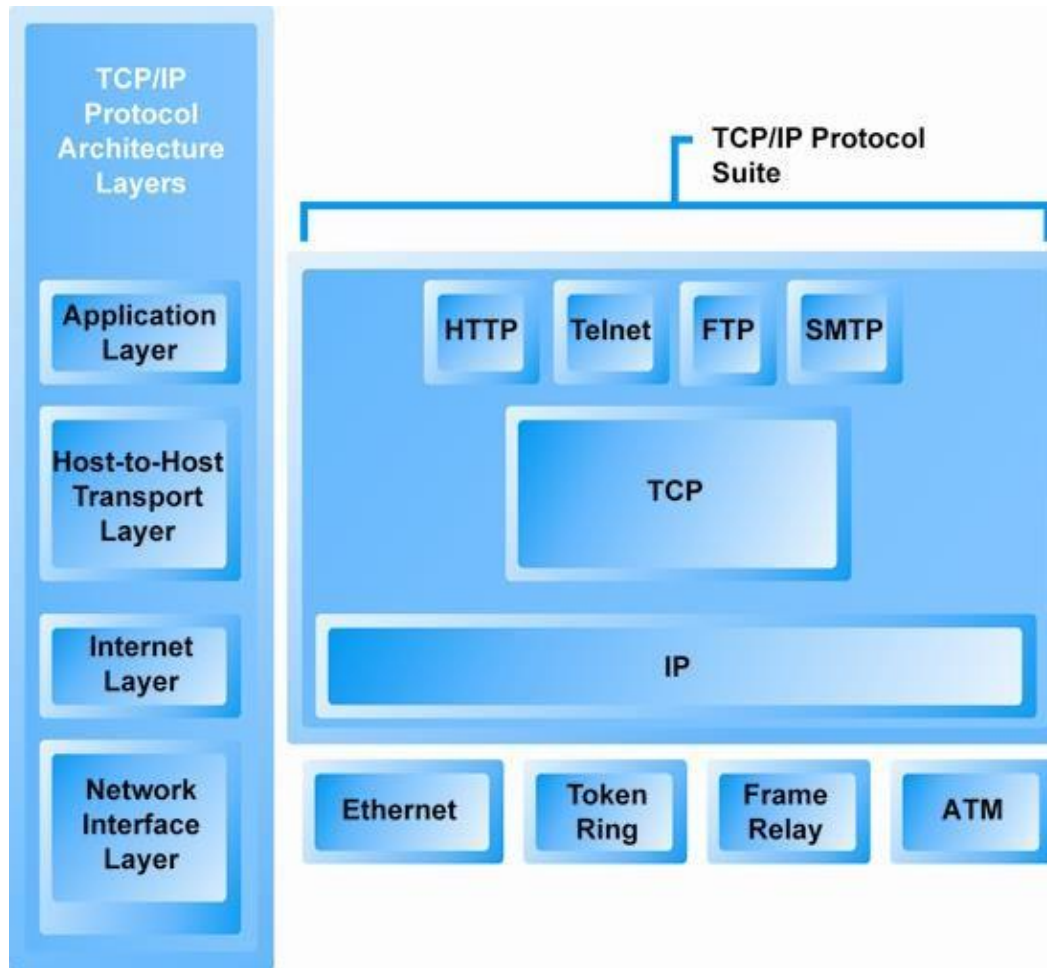
The TCP/IP Architecture and Protocol Suite

Figure 3.4, Page 119

Internet (IP) Addresses

IPv4

- 32-bit number

- Four sets of numbers marked off by periods: 201.61.186.227

  - Class C address: Network identified by first three sets, computer identified by last set

IPv6

- 128-bit addresses, able to handle up to 1 quadrillion addresses (IPv4 can handle only 4 billion)

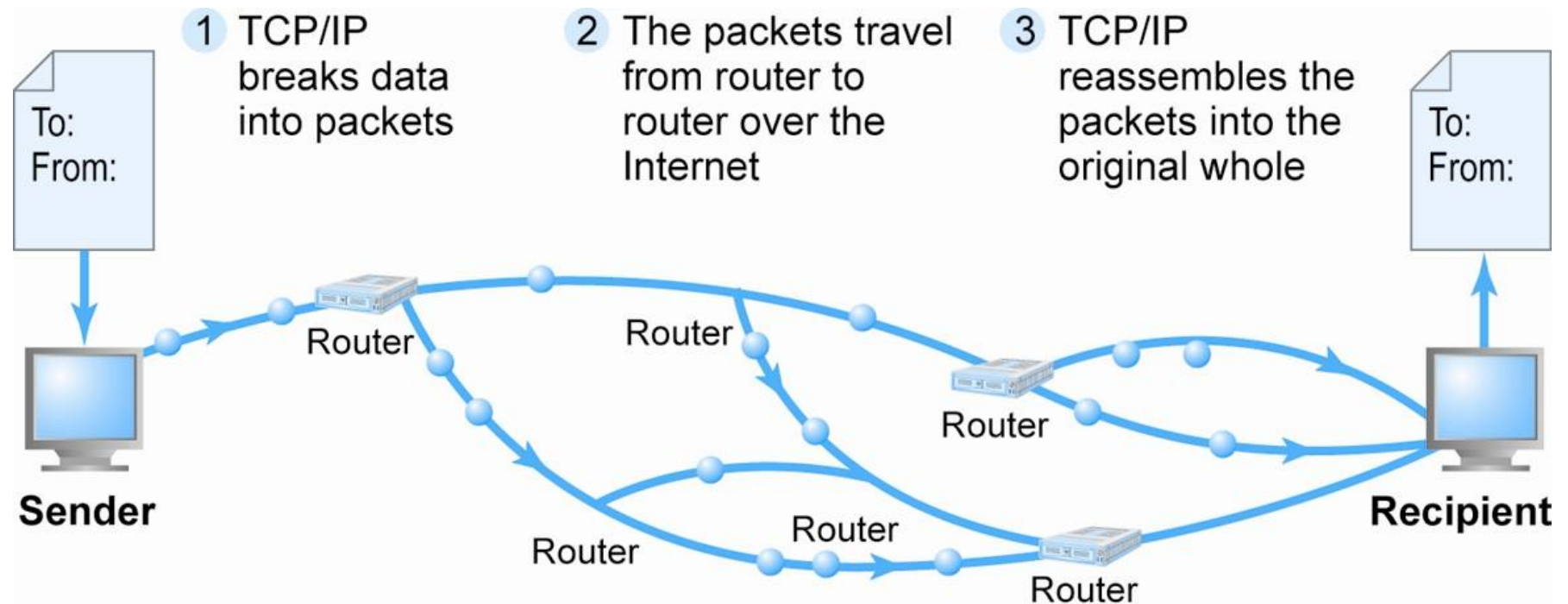# Routing Internet Messages: TCP/IP and Packet Switching

Figure 3.5, Page 120

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)**
  - ❖ Address used by Web browser to identify location of content on the Web
  - ❖ For example: http://www.azimuth-interactive.com/flash_test

Client/Server Computing

- **Powerful personal computers (clients) connected in network with one or more servers**

- **Servers perform common functions for the clients**
  - ❖ Storing files
  - ❖ Software applications
  - ❖ Access to printers, and so on

The New Client:
The Mobile Platform

- **Primary Internet access is now through:**
  - ❖ Tablets
    - Supplementing PCs for mobile situations
  - ❖ Smartphones
    - Disruptive technology
      - ❖ New processors
      - ❖ New operating systems
    - 42% of all cell phone users (1.84 billion) worldwide are smartphone users

Cloud Computing

- **Firms and individuals obtain computing power and software over Internet**

- **Public, private, and hybrid clouds**

- **Radically reduces costs of:**
  - ❖ Building and operating Web sites
  - ❖ Infrastructure, IT support
  - ❖ Hardware, software

- **Risks: Organizations become dependent on outside providers**

Other Internet Protocols and Utility Programs

- **Internet protocols**
  - ❖ HTTP
  - ❖ E-mail: SMTP, POP3, IMAP
  - ❖ FTP, Telnet, SSL/TLS
- **Utility programs**
  - ❖ Ping
  - ❖ Tracert

The Internet Today

- **Internet growth has boomed without disruption because of:**
  - Client/server computing model
  - Hourglass, layered architecture
    - Network Technology Substrate
    - Transport Services and Representation Standards
    - Middleware Services
    - Applications
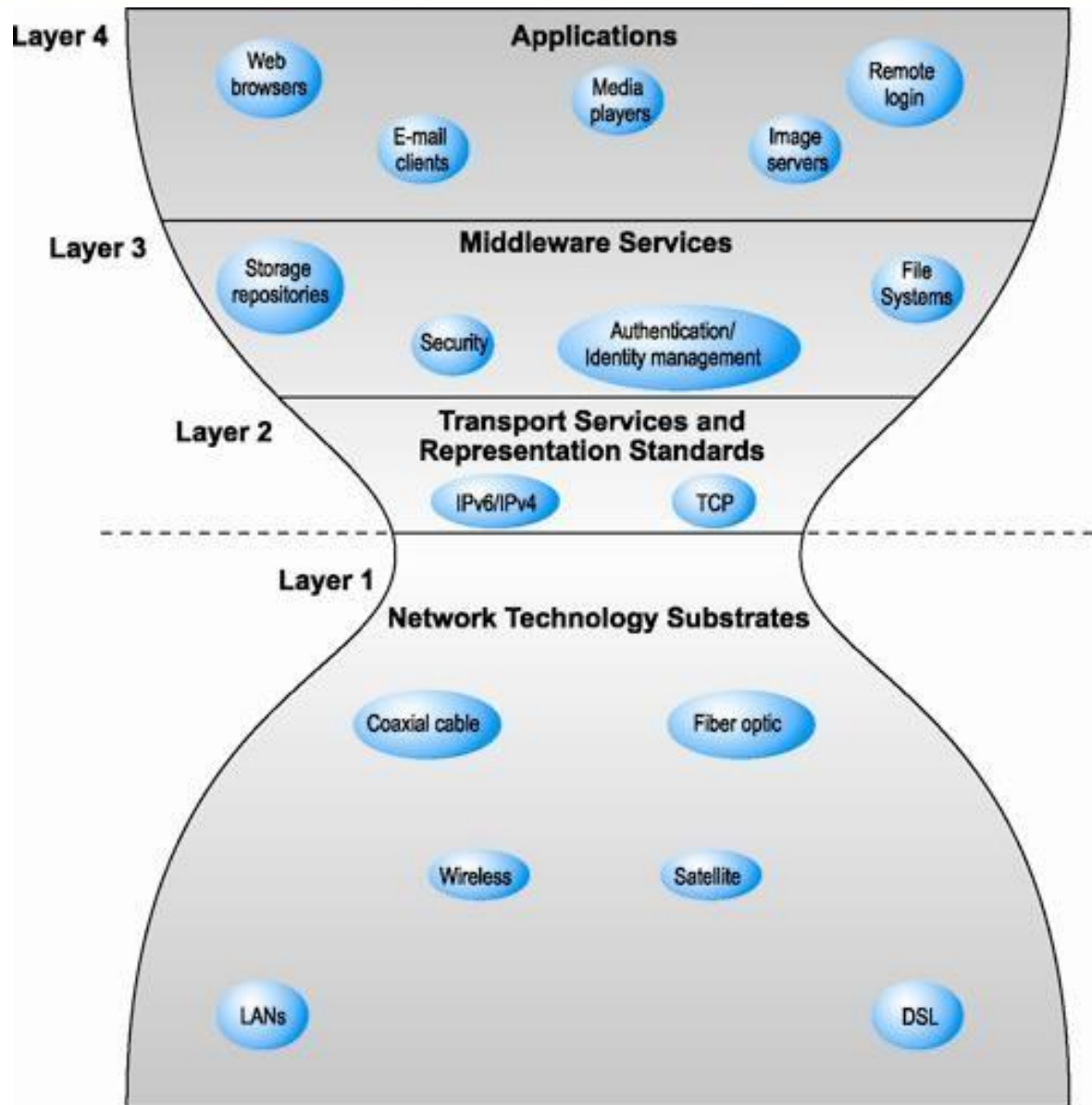
The Hourglass Model of the Internet

Figure 3.11, Page 131

Internet Network Architecture

■ Backbone

- ❖ High-bandwidth fiber-optic cable networks
- ❖ Private networks owned by Tier 1 ISPs
- ❖ Bandwidth: 155 Mbps–2.5 Gbps
- ❖ Built-in redundancy

■ 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
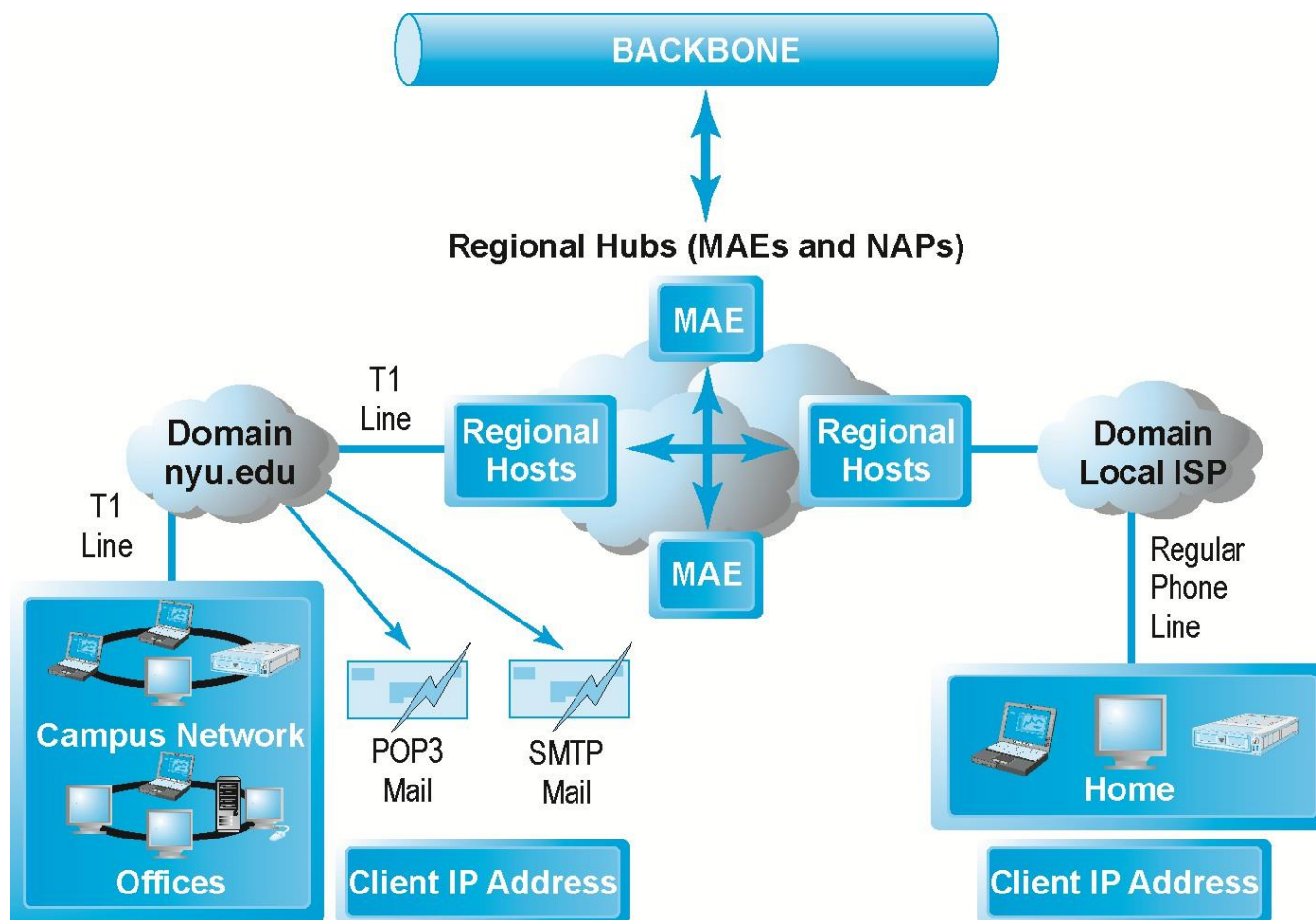
Internet Network Architecture

Figure 3.12, Page 132

Internet Service Providers (ISPs)

- **Provide lowest level of service to individuals, small businesses, some institutions**

- **Types of service**
  - ❖ Narrowband (dial-up)
  - ❖ Broadband
    - Digital Subscriber Line (DSL)
    - Cable Internet
    - T1 and T3
    - Satellite Internet

Intranets

- ## Intranet

    - ❖ TCP/IP network located within a single organization for communications and processing

    - ❖ Used by   private and government organizations for internal networks

    - ❖ All Internet applications can be used in private intranets

Who Governs the Internet?

- **Organizations that influence the Internet and monitor its operations include:**
  - ❖ Internet Corporation for Assigned Names and Numbers (ICANN)
  - ❖ Internet Engineering Task Force (IETF)
  - ❖ Internet Research Task Force (IRTF)
  - ❖ Internet Engineering Steering Group (IESG)
  - ❖ Internet Architecture Board (IAB)
  - ❖ Internet Society (ISOC)
  - ❖ Internet Governance Forum (IGF)
  - ❖ World Wide Web Consortium (W3C)
  - ❖ Internet Network Operators Groups (NOGs)

Limitations of the Current Internet

- **Bandwidth limitations**

    - Slow peak-hour service

- **Quality of service limitations**

    - Latency

- **Network architecture limitations**

    - Identical requests are processed individually

- **Wired Internet**

    - Copper and expensive fiber-optic cables

The Internet2 Project

■ **Consortium of 450+ institutions collaborating to facilitate revolutionary Internet technologies**

■ **Primary goals:**

❖ Create leading-edge very-high speed network for national research community

❖ Enable revolutionary Internet applications

❖ Distributed and collaborative computing environments for sciences, health, arts, and humanities initiatives

The First Mile and the Last Mile

- **GENI Initiative**
  - ❖ Initiated by NSF, transitioning to community governance
  - ❖ Virtual lab for developing new core functionality for Internet
- **Most significant private initiatives**
  - ❖ Fiber optic trunk-line bandwidth (first mile)
  - ❖ Wireless internet services (last mile)

Fiber Optics and the Bandwidth Explosion in the First Mile

- **"First mile": Backbone Internet services that carry bulk traffic over long distances**

- **Fiber-optic cable: hundreds of glass strands that use light to transmit data**
    - ❖ Faster speeds and greater bandwidth
    - ❖ Thinner, lighter cables
    - ❖ Less interference
    - ❖ Better data security

- **Substantial investments in fiber optic by telecommunications firms in last decade**
    - ❖ Enable integrated phone, broadband access, video services

The Last Mile: Mobile Internet Access

- **"Last mile": From Internet backbone to user's computer, smartphone, and so on**

- **Two different basic types of wireless Internet access:**

  - Telephone-based (mobile phones, smartphones)

  - Wireless local area network (WLAN)-based

Wireless Internet Access Network Technologies

■ Wi-Fi

- ❖ High-speed, fixed broadband wireless LAN (WLAN)
- ❖ Wireless access point ("hot spots")
- ❖ Limited range but inexpensive
- ❖ For-profit Wi-Fi networks: Boingo, AT&T Wi-Fi Services

■ WiMax

- ❖ High-speed, medium range broadband wireless metropolitan area network

■ Bluetooth

- ❖ Personal connectivity between devices and to Internet

■ Internet drone access

- ❖ Google, Facebook initiatives

Wi-Fi Networks
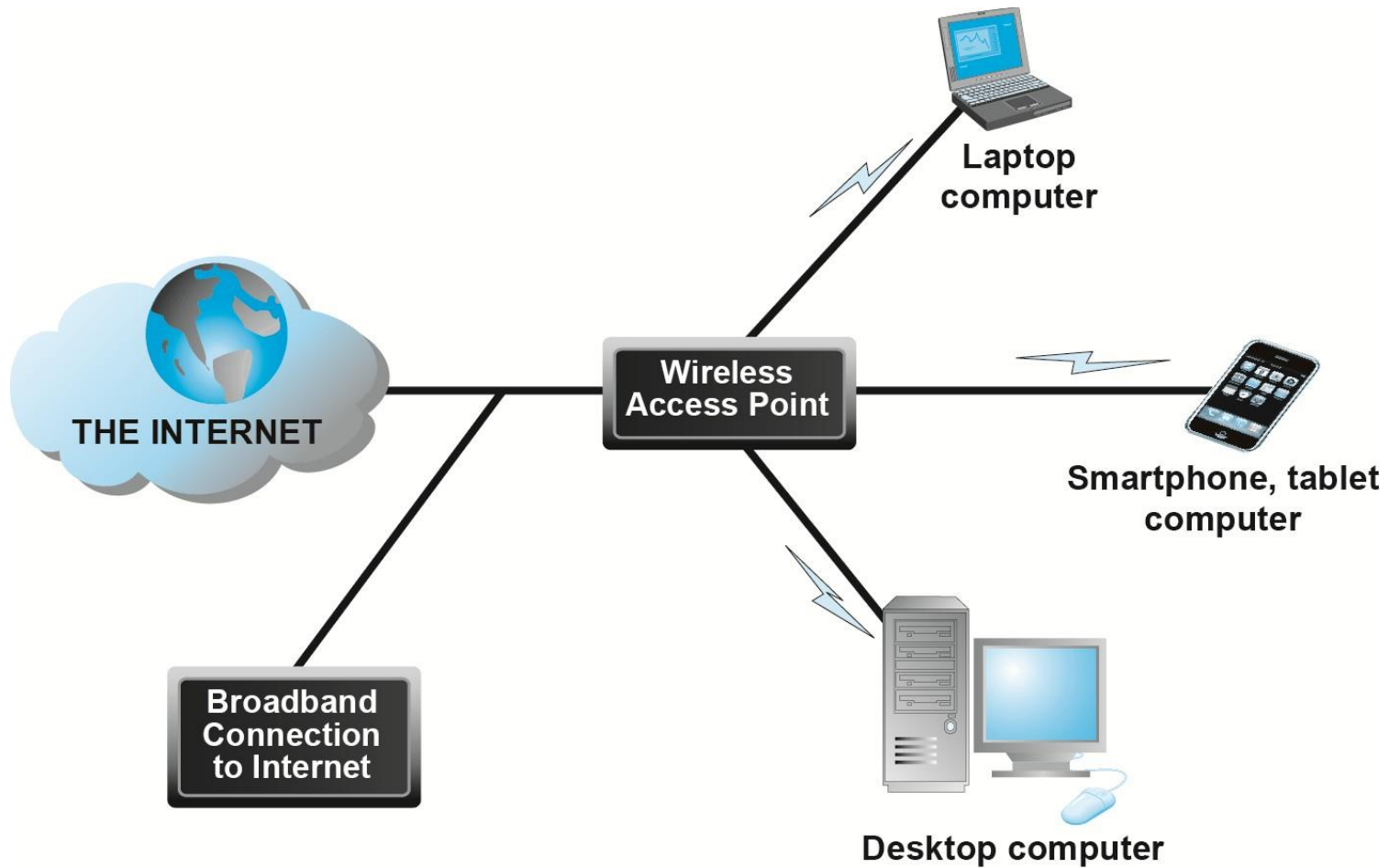

Figure 3.14, Page 149

The Future Internet

- **Latency solutions**
  - ❖ diffserv (differentiated quality of service)

- **Guaranteed service levels and lower error rates**

- **Declining costs**

- **The Internet of Things (IoT)**
  - ❖ Objects connected via sensors/RFID to the Internet
  - ❖ "Smart things"
  - ❖ Interoperability issues and standards
  - ❖ Security and privacy concerns

The Web

- **1989–1991: Web invented**
  - Tim Berners-Lee at CERN
  - HTML, HTTP, Web server, Web browser

- **1993: Mosaic Web browser w/GUI**
  - Andreessen and others at NCSA
  - Runs on Windows, Macintosh, or Unix

- **1994: Netscape Navigator, first commercial Web browser**
  - Andreessen, Jim Clark

- **1995: Microsoft Internet Explorer**

Hypertext

- **Text formatted with embedded links**
  - ❖ Links connect documents to one another, and to other objects such as sound, video, or animation files

- **Uses Hypertext Transfer Protocol (HTTP) and URLs to locate resources on the Web**
  - ❖ Example URL: http://megacorp.com/content/features/082602.html

Markup Languages

- ## Hypertext Markup Language (HTML)
  - Fixed set of pre-defined "tags" used to format text
  - Controls look and feel of Web pages
  - HTML5 the newest version

- ## eXtensible Markup Language (XML)
  - Designed to describe data and information
  - Tags used are defined by user

Web Servers and Web Clients

■ **Web server software**

- ❖ Enables a computer to deliver Web pages to clients on a network that request this service by sending an HTTP request
- ❖ Apache, Microsoft IIS
- ❖ Basic capabilities: Security services, FTP, search engine, data capture

■ **Web server**

- ❖ May refer to either Web server software or physical server
- ❖ Specialized servers: Database servers, ad servers, and so on

■ **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—52% of market**

- **Google's Chrome—30%**
  - ❖ Open source

- **Mozilla Firefox—11.5%**
  - ❖ Open source

- **Apple's Safari—5 %**

The Internet and Web: Features

- **Features on which the foundations of e-commerce are built:**
  - ❖ E-mail
  - ❖ Instant messaging
  - ❖ Search engines
  - ❖ Online forums
  - ❖ Streaming media
  - ❖ Cookies
  - ❖ Web 2.0 features and services

E-mail

- **Most used application of the Internet**
- **Uses series of protocols for transferring messages with text and attachments from one Internet user to another**

Instant Messaging

- **Displays words typed on a computer almost instantly, and recipients can respond immediately in the same way**
  - ❖ Advanced IM systems include voice/video chat

Search Engines

- **Identify Web pages that match queries based on one or more techniques**
  - ❖ Keyword indexes, page ranking

- **Also serve as:**
  - ❖ Shopping tools
  - ❖ Advertising vehicles (search engine marketing)
  - ❖ Tool within e-commerce sites

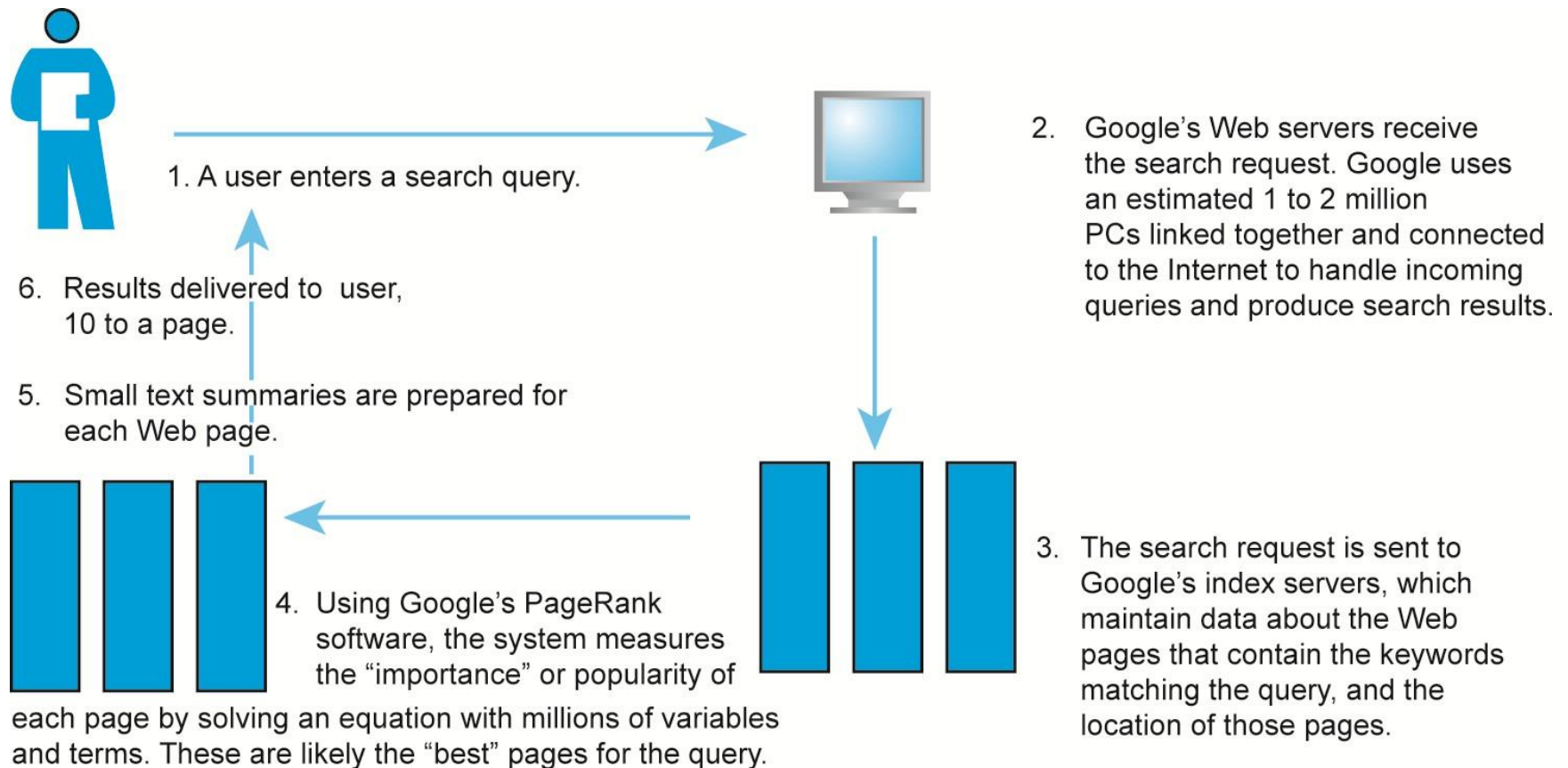- **Outside of e-mail, most commonly used Internet activity**

How Google Works

1. A user enters a search query.

2. Google's Web servers receive the search request. Google uses an estimated 1 to 2 million PCs linked together and connected to the Internet to handle incoming queries and produce search results.

3. The search request is sent to Google's index servers, which maintain data about the Web pages that contain the keywords matching the query, and the location of those pages.

4. Using Google's PageRank software, the system measures the "importance" or popularity of each page by solving an equation with millions of variables and terms. These are likely the "best" pages for the query.

5. Small text summaries are prepared for each Web page.

6. Results delivered to user, 10 to a page.

Figure 3.19, Page 166

Online Forums

- **Enable Internet users to communicate with one another, although not in real time**
- **Members visit online forum to check for new posts**

Streaming Media

- **Enables music, video, and other large files to be sent to users in chunks so that the file can play uninterrupted**
- **Allows users to begin playing media files before file is fully downloaded**

Cookies

- **Small text files deposited by Web site on user's computer to store information about user, accessed when user next visits Web site**

- **Can help personalize Web site experience**

- **Can pose privacy threat**

Web 2.0 Features and Services

- **Online Social Networks**

  - Services that support communication among networks of friends, peers

- **Blogs**

  - Personal Web page of chronological entries

- **Really Simple Syndication (RSS)**

  - Program that allows users to have digital content automatically sent to their computers over the Internet

Web 2.0 Features and Services

- **Podcasting**
  - ❖ Audio presentation stored as an audio file and available for download from Web

- **Wikis**
  - ❖ Allows user to easily add and edit content on Web page

- **Music and video services**
  - ❖ Online video viewing
  - ❖ Digital video on demand

Web 2.0 Features and Services

- **Internet telephony (VoIP)**

  - Voice over Internet Protocol (VoIP) uses Internet   to transmit voice communication

- **Video conferencing, video chatting, and telepresence**

- **Intelligent personal assistants**

  - Interpret voice commands to interact with various Web services

  - Siri, Google Now

Mobile Apps

- **Use of mobile apps has exploded**
  - Over 80% of online shoppers are mobile shoppers as well

- **Increased use/purchasing from tablets**

- **Platforms**
  - iPhone/iPad (iOS), Android, Blackberry

- **App marketplaces**
  - Google Play, Apple's App Store, RIM's App World, Windows Phone Marketplace