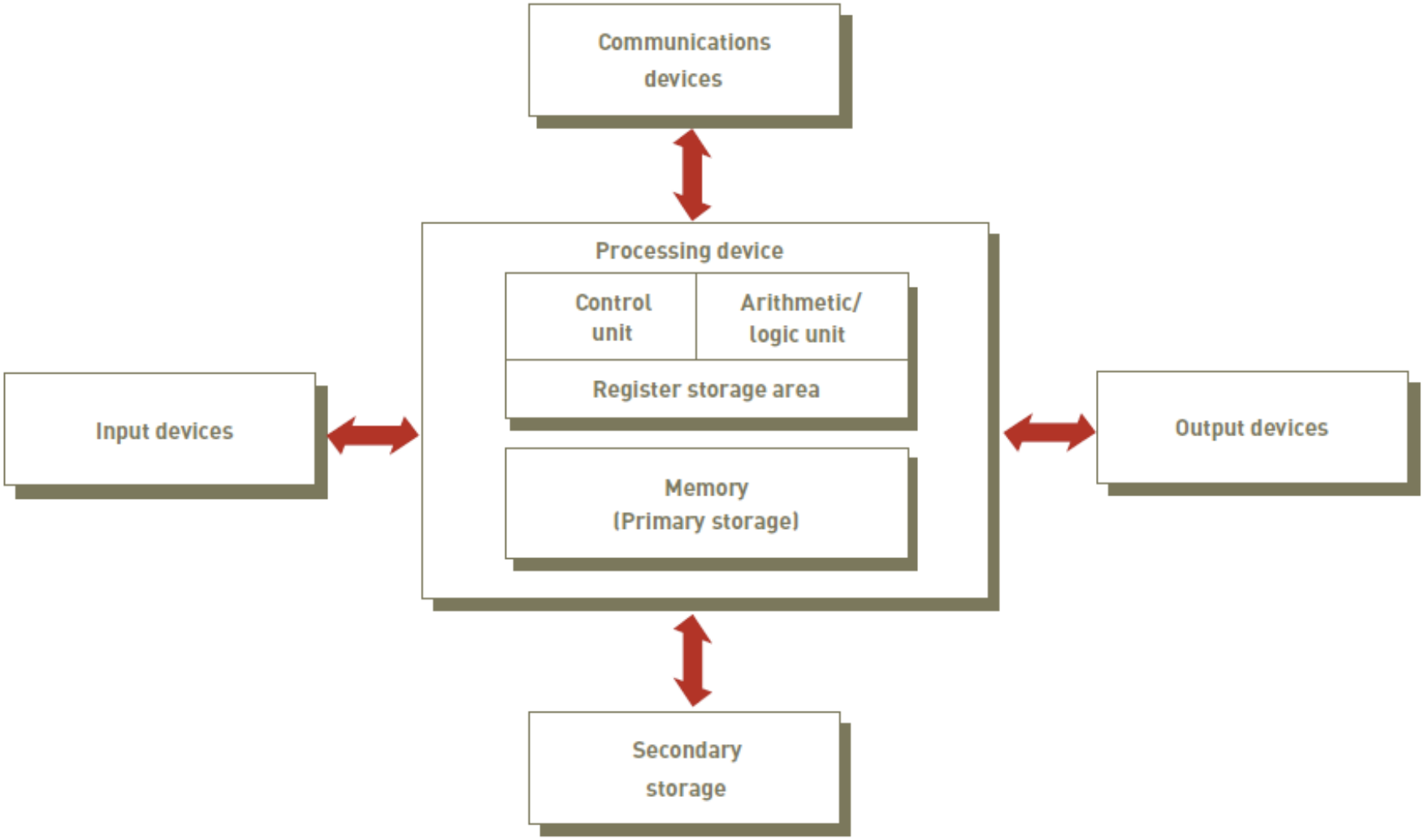
ACS-1803
Introduction to Information Systems

Instructor: Victor Balogun

Networked Computing & The Internet

Lecture Outline 9-2

Computer Components -Architecture



Network Computing

What word comes to your mind when you think about the word Networking?

What words fit or does not fit into Computer Networks?

Networked Computing

- Uses telecommunications technology
- Why learn about telecommunications and networks?
  - Need to access data that may be located in different places
  - Need to communicate, share information, upload/download data and software
  - Very important for supply chain management
    - Cooperation and communications among workers in inbound logistics, warehouse and storage, production, outbound logistics, and customers, suppliers and shippers
  - Different areas of the organization communicate with people internal and external to the organization

Components of a Simple Network

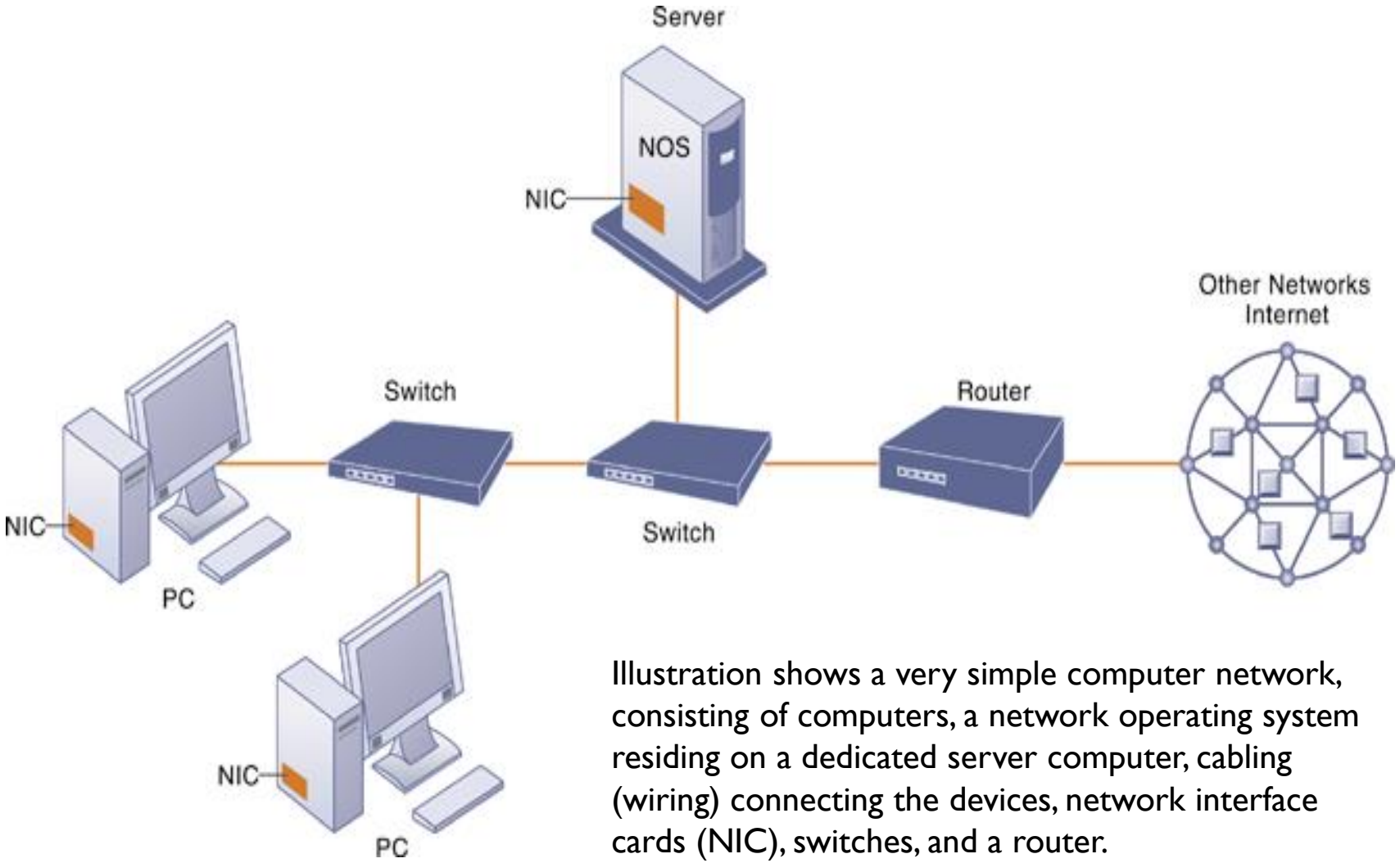


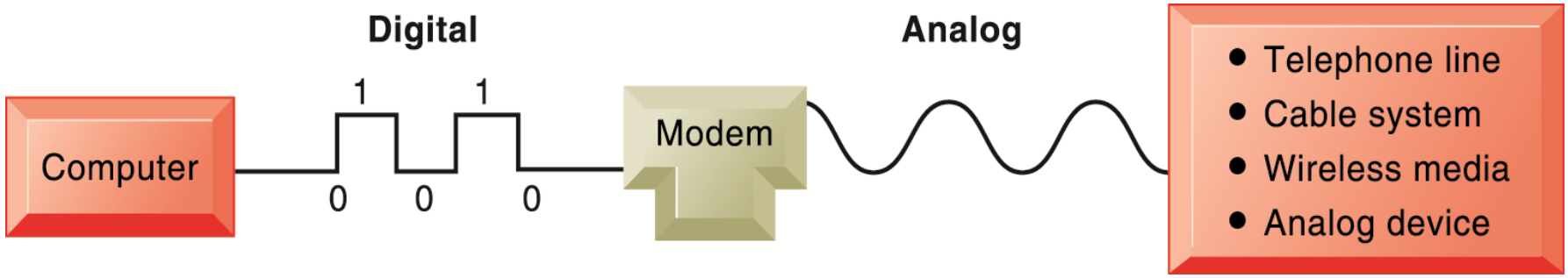
Illustration shows a very simple computer network, consisting of computers, a network operating system residing on a dedicated server computer, cabling (wiring) connecting the devices, network interface cards (NIC), switches, and a router.

Computer network

- Consists of communications media, devices, and software needed to connect two or more computer systems or devices
- Can transmit and receive information to improve organizational effectiveness and efficiency

Network Hardware

Modem (Modulator/Demodulator)
Enables computers to **connect** and **transmit data** over **phone lines** by converting the sending computer's **digital signals** to **analog** and back again for the receiving computer



Speed of Transmission

- Measures in bits per second (bps)
- Thousands of bite per second - Kbps
- Millions - Mbps
- Billions - Gbps
- **Broadband** telecommunication : rate of exchange of data > 1.5 Mbps

Transmission Media

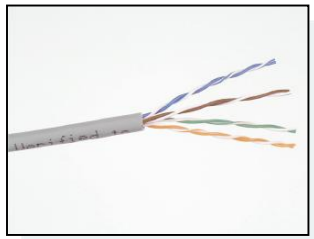
- Physical pathways between network members
- Computers send *bits* to each other (+ / -)
- Different media chosen to make up pathways
- Cables: twisted pair, coaxial, fibre optic
- Wireless: infrared line of sight, high frequency radio, microwave
- **Bandwidth** refers to the transmission capacity of a communications channel or computer.

Transmission media

- Wi-Fi network:

Transmission Media – Guided transmission

- Twisted-pair wire
  - Shielded or unshielded twisted pairs of copper wire
  - Used for telephone service
  - There are transmission and distance limitations

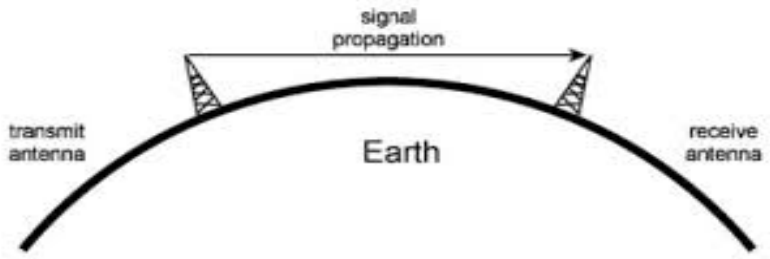


- Coaxial Cable
  - Inner conductor wire surrounded by insulation
  - Cleaner and faster data transmission than twisted-pair wire
  - More expensive too

- Fiber Optic
  - Thin strands of glass bound together in a shell, uses light beams to transmit signals
  - Smaller diameter than coaxial, less signal distortion, capable of high transmission rates
  - Even more expensive to purchase and install

Wireless Media (Unguided)

- Infrared Line of Site (LOS):
  - like TV remote control



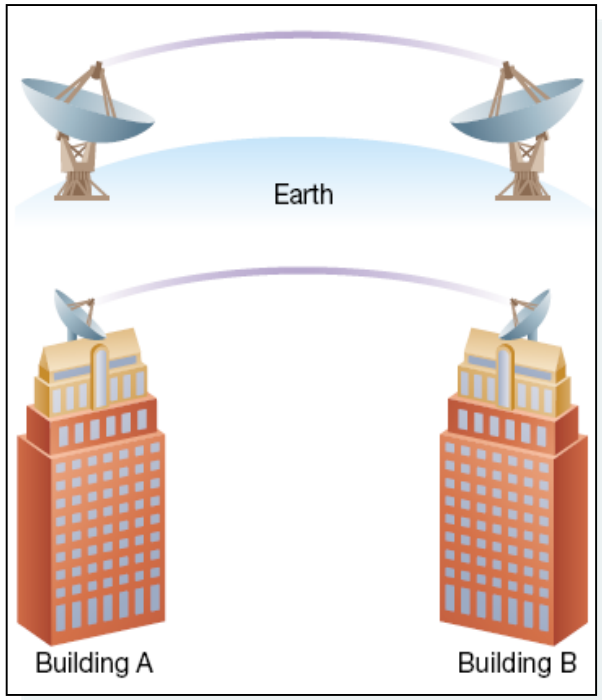
(c) Line-of-sight (LOS) propagation (above 30 MHz)

- High-frequency radio:
  - needs antenna towers; used in pagers, cellular phones, police / taxi radio in cars

- Microwave: long distances
  - Terrestrial: antennas every e.g., 30 miles
  - Satellite: signals from antennas on Earth to Satellites in space and back down

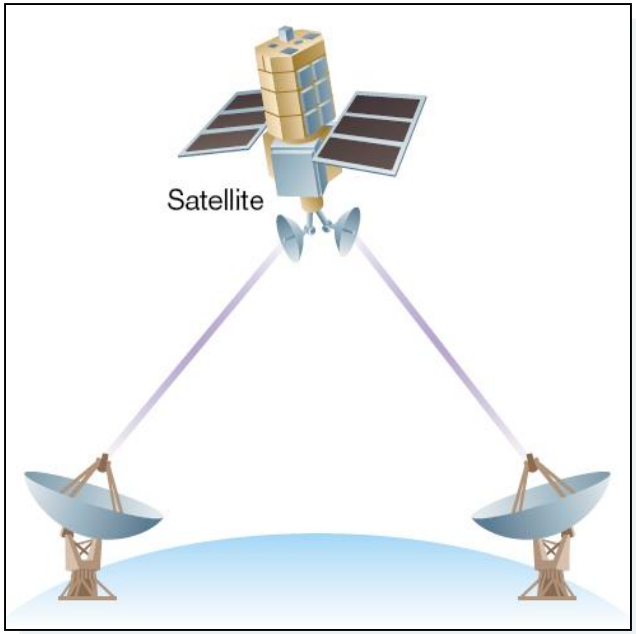
Wireless Media (Microwave)

Microwave
A high frequency radio signal that is sent through the air using either terrestrial (earth-based) or satellite systems



Terrestrial Microwave
A **line-of-site technology** (unobstructed) used to cross **inaccessible terrain** or to connect buildings where cable installation would be expensive. **Attenuation is low** over **short distance** but **higher** over **longer distances**, and **high winds**, **heavy rain**, **EMI** and **eavesdropping** are also problems

Wireless Media (Satellite)



Satellite Microwave
A **line-of-site** technology that uses **relay stations** to **transfer signals** between **antennae** located **on earth** and a **satellite orbiting the earth**. It can be used to **access very remote locations** and, like a terrestrial microwave, **attenuation**, **EMI** and **eavesdropping** are also **problems**

Wireless Media

Cellular Phone
A two-way wireless communication that assigns unique frequencies to calls and can transmit in analog or digital

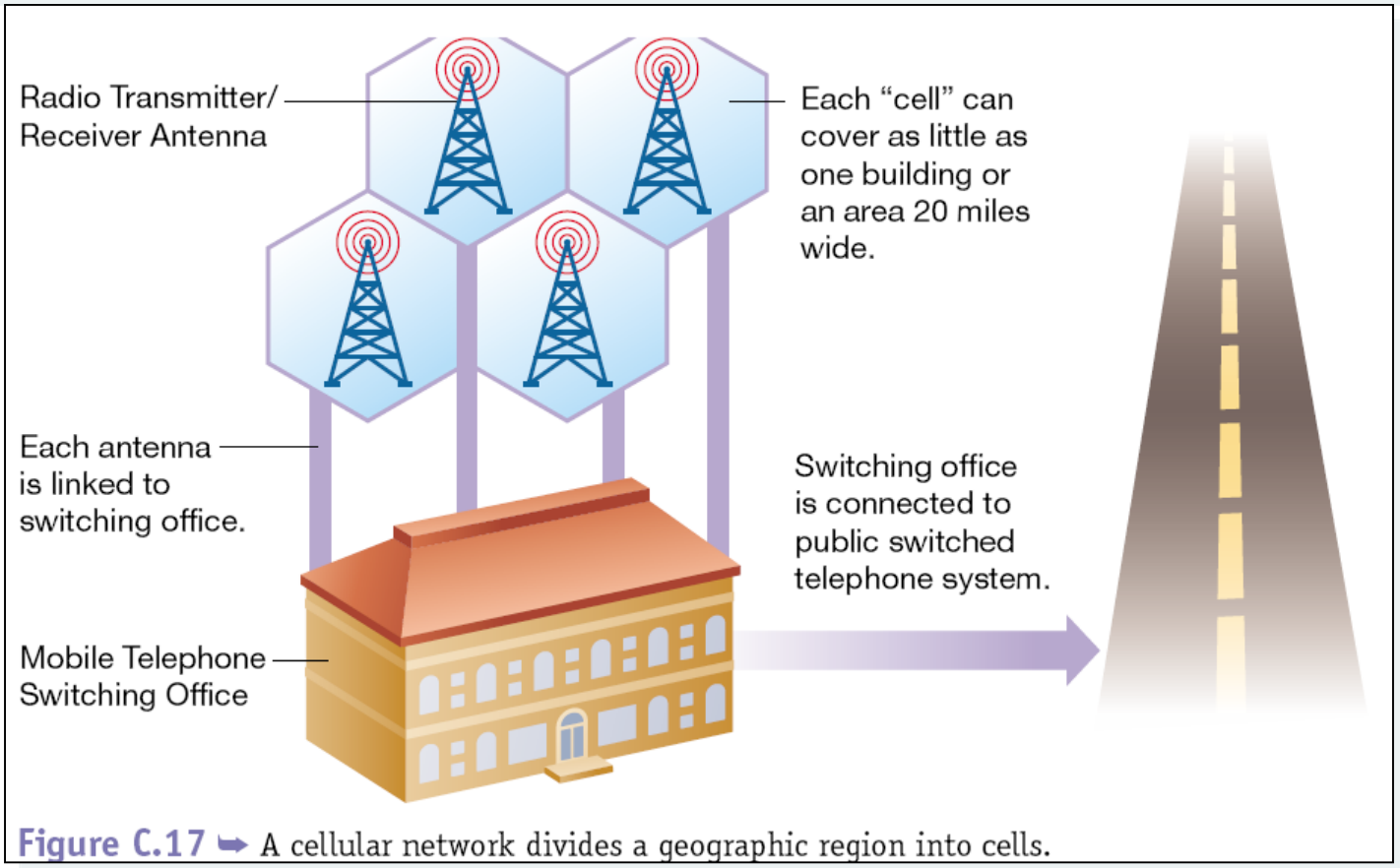


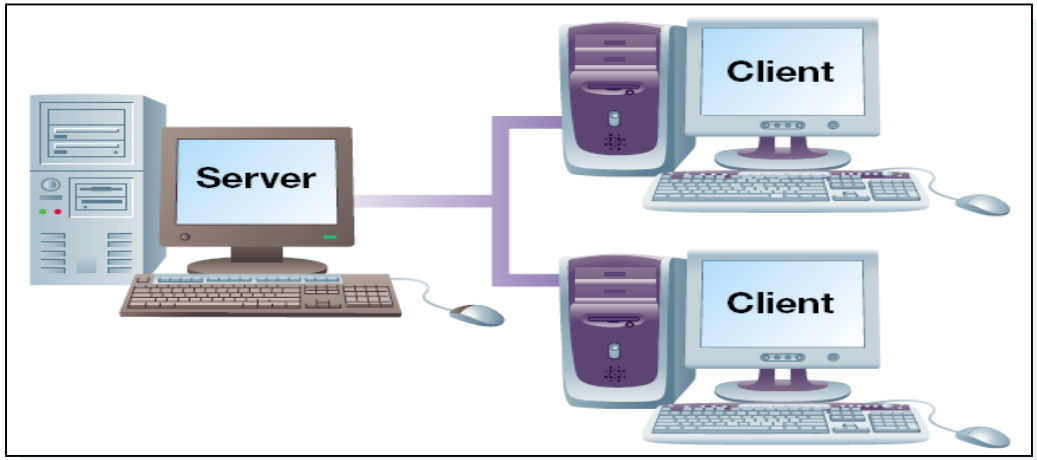
Figure C.17 ➥ A cellular network divides a geographic region into cells.

Wireless Media

- 3G wireless communications:
  - Supports wireless voice and broadband speed data communications in a mobile environment
- 4G wireless communications:
  - 4G will also provide increased data transmission rates in the 20–40 Mbps range
  - LTE – Long Term Evolution

Networking Types - Network Services

Client/Server model
Peer-to-peer



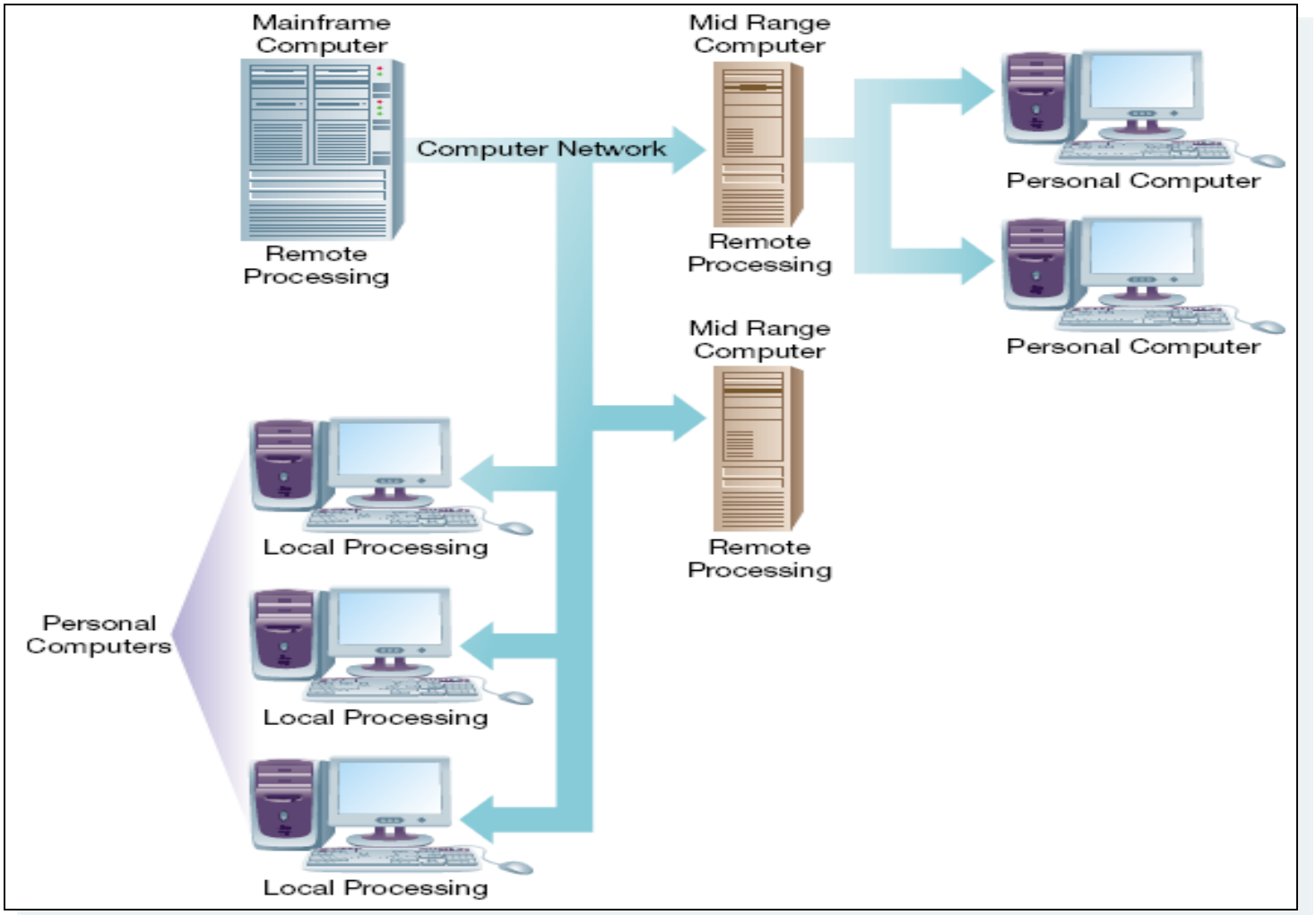
Server
Any computer on a network that makes access to files, printing, communication, and other services available to users on the network

Client
Any computer, such as a user's workstation or a PC on the network, or software application such as word processing program that uses services provided by the server. A client only requests service and usually has only one user

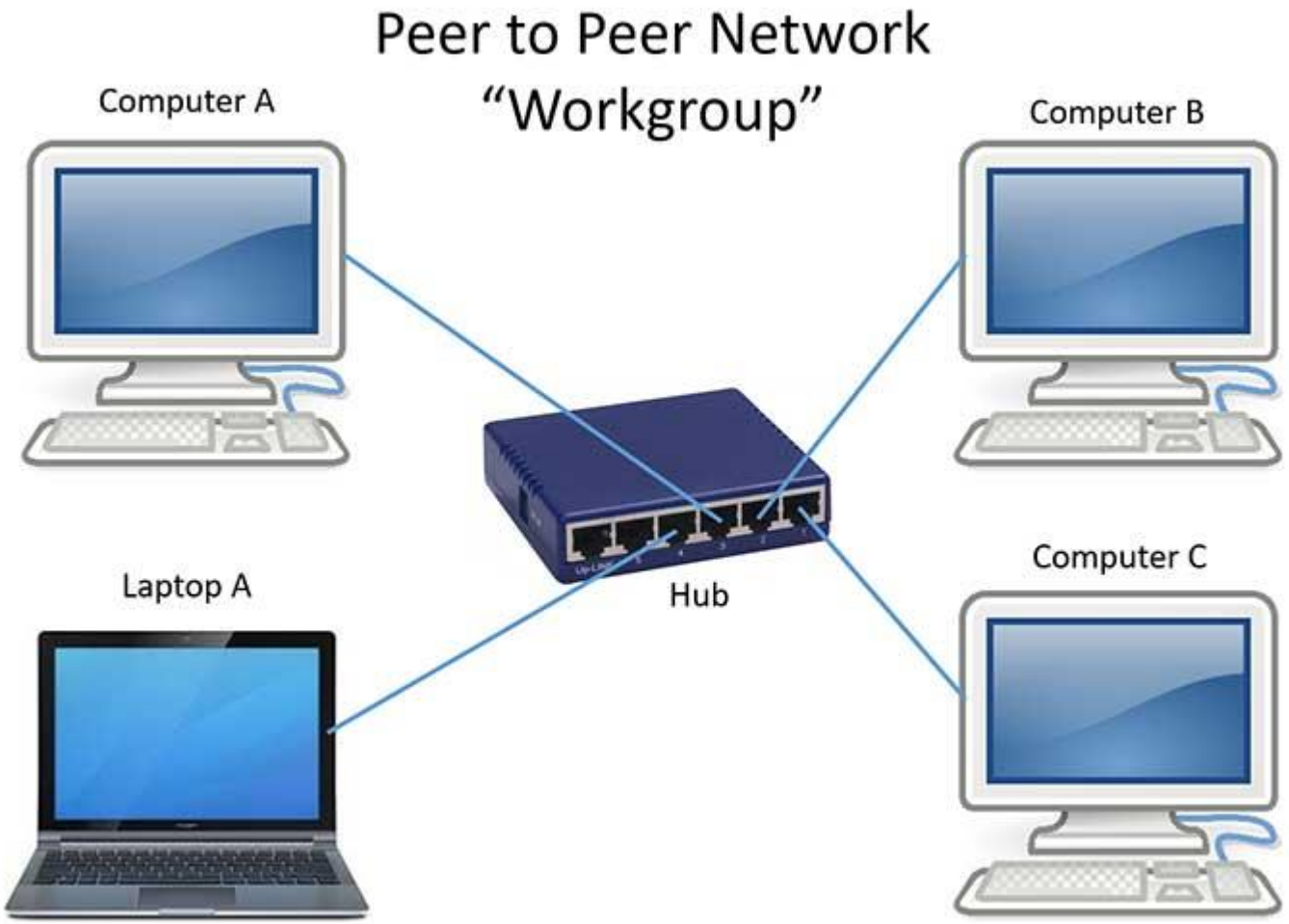
Client/Server Systems

- Client/server architecture:
  - Multiple computer platforms are dedicated to special functions
- Server:
  - It is the "captain" of the network
  - It has more advanced CPU, more memory, more disk storage
  - It 'serves' other computers (clients) on the network as they request them including data files, software, access to peripherals (printers)
  - Runs a network operating system (NOS)

Client/Server Systems



Peer-to-Peer Architecture



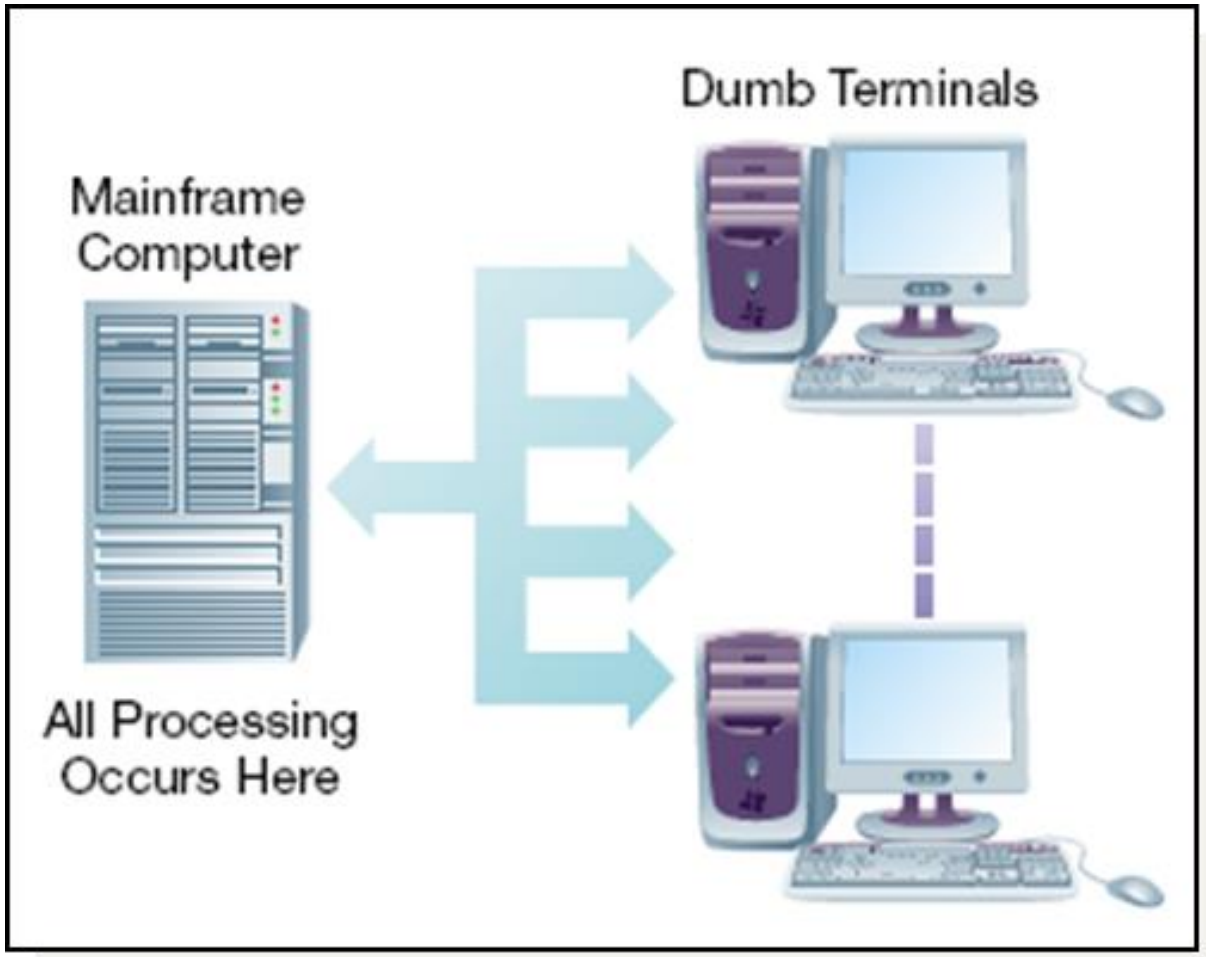
Network Types – Geographical Coverage

- Personal area networks:
  - Support interconnection of information technology within a range of about 33 feet
- Local area networks:
  - Connect computer systems and devices within a small area (e.g., office or home)
- Wide area networks:
  - Connect large geographic regions

Types of Computer Processing

- Centralized processing:
  - All processing occurs in a single location or facility
- Distributed processing:
  - Processing devices are placed at remote locations but are connected to each other via a network
- Cloud Computing
  - Software and storage provided as an internet service and accessed within a web browser

Centralized Computing



Distributed Computing

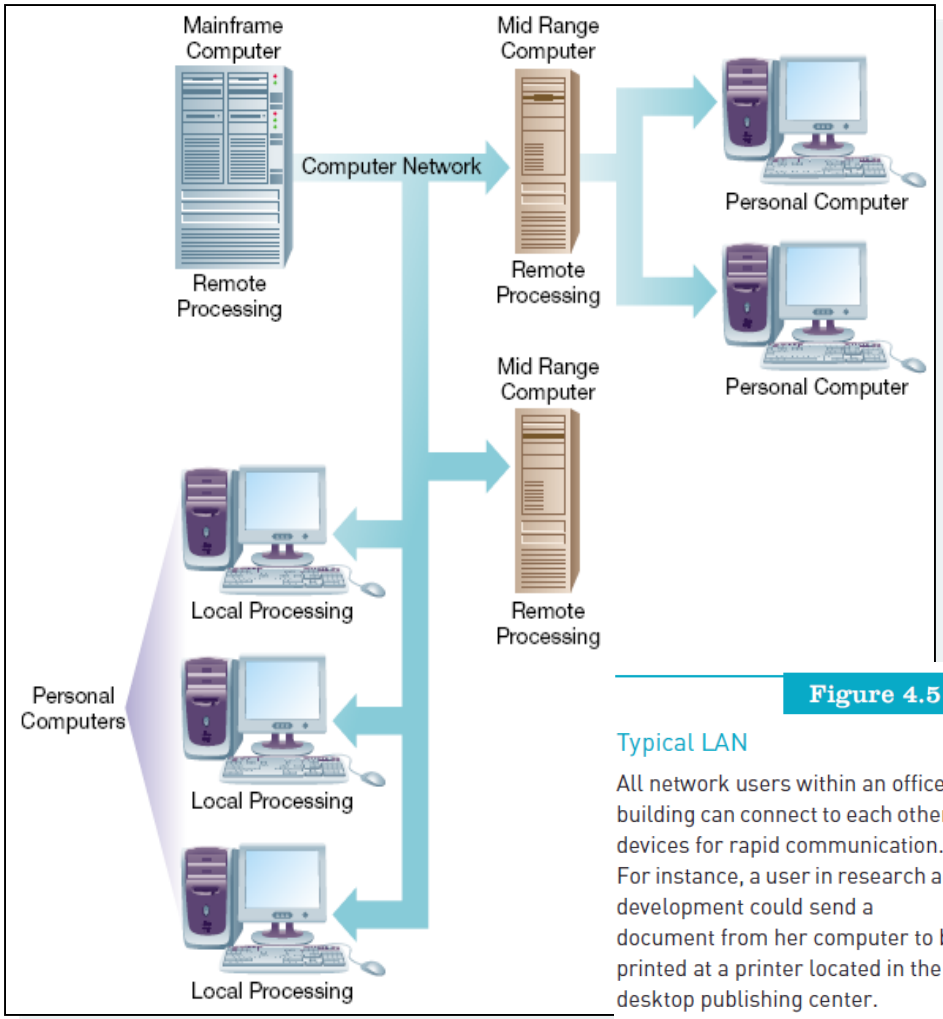
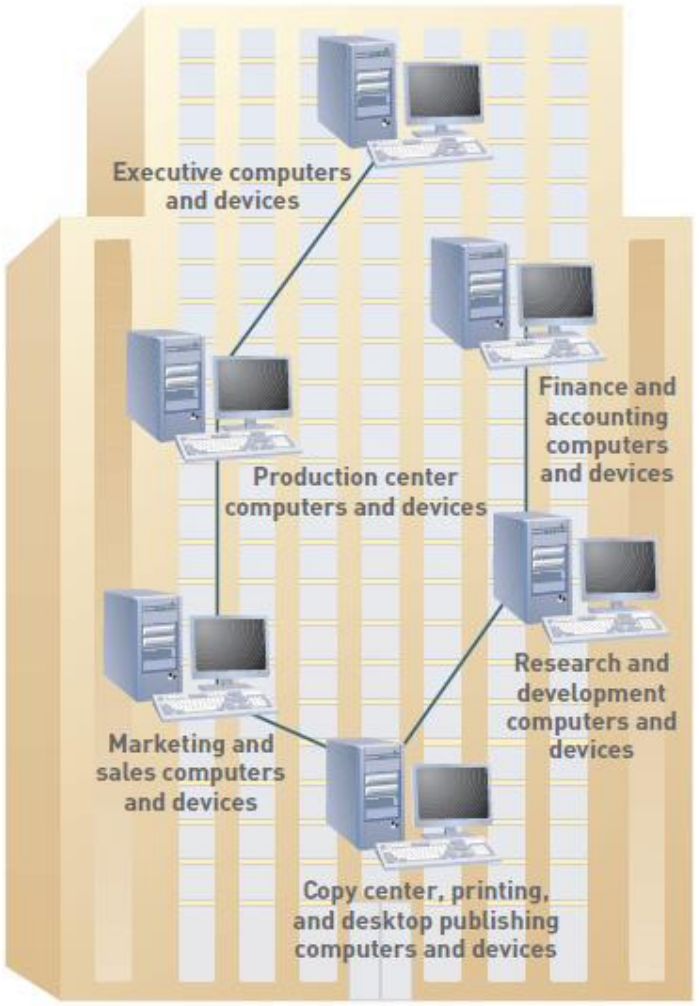


Figure 4.5

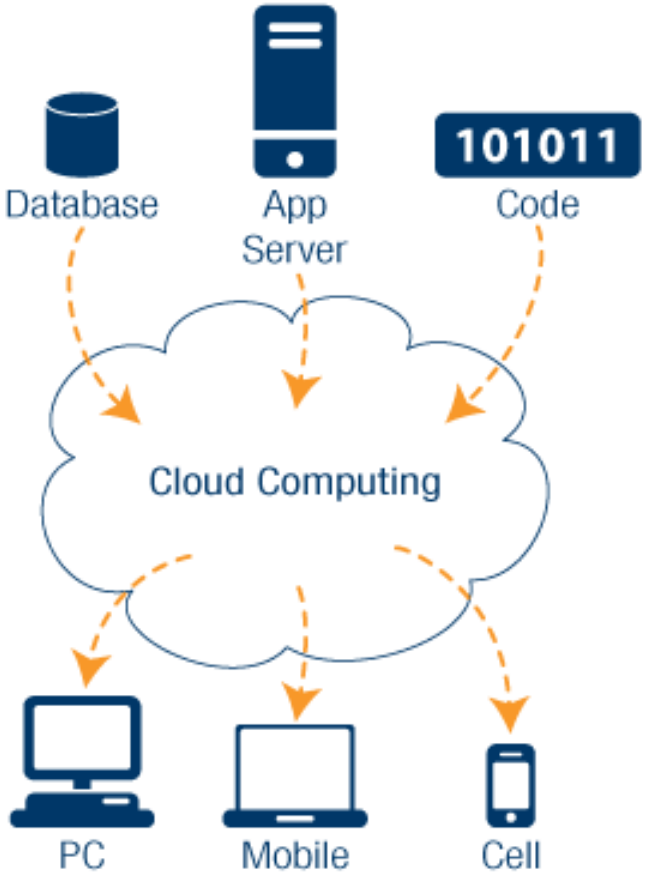
Typical LAN

All network users within an office building can connect to each other's devices for rapid communication. For instance, a user in research and development could send a document from her computer to be printed at a printer located in the desktop publishing center.



Cloud Computing

- Software and storage provided as an internet service and accessed within a web browser
- Example: Email, Data storage, skydrive, tax software, flicker, facebook.
- Soon most computing will take place on the internet



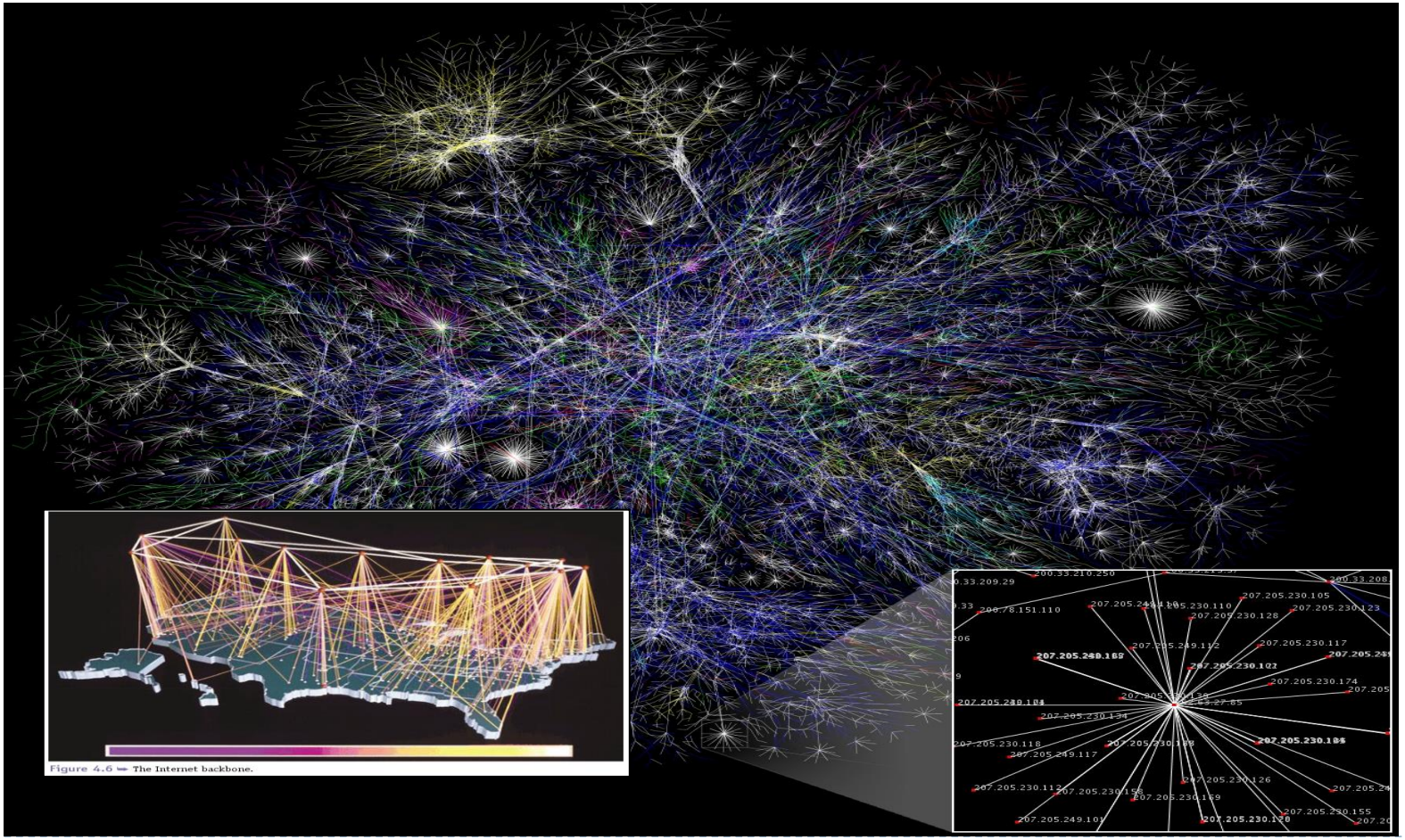
Cloud Computing – Advantages to Businesses

- Outsourcing Resources – Saves on system design, installation, and maintenance
- Provides an ability to access corporate systems from any Internet-connected device
- Increases the data storage capabilities of the firm
- Data safeguarding responsibility of service provider

The Internet

The Internet "Network of Networks"

- Large, worldwide collection of networks that use a common protocol to communicate with each other



JAN 2016

GLOBAL DIGITAL SNAPSHOT

A SNAPSHOT OF THE WORLD'S KEY DIGITAL STATISTICAL INDICATORS

TOTAL POPULATION	INTERNET USERS	ACTIVE SOCIAL MEDIA USERS	UNIQUE MOBILE USERS	ACTIVE MOBILE SOCIAL USERS
7.395 BILLION	**3.419 BILLION**	**2.307 BILLION**	**3.790 BILLION**	**1.968 BILLION**
URBANISATION: 54%	PENETRATION: 46%	PENETRATION: 31%	PENETRATION: 51%	PENETRATION: 27%
FIGURE REPRESENTS TOTAL GLOBAL POPULATION, INCLUDING CHILDREN	*FIGURE INCLUDES ACCESS VIA FIXED AND MOBILE CONNECTIONS*	*FIGURE BASED ON ACTIVE USER ACCOUNTS, NOT UNIQUE INDIVIDUALS*	*FIGURE REPRESENTS UNIQUE MOBILE PHONE USERS*	*FIGURE BASED ON ACTIVE USER ACCOUNTS, NOT UNIQUE INDIVIDUALS*

Sources: Population: UN, US Census Bureau; Internet: ITU, InternetWorldStats, CIA, national government ministries and industry associations; Social & Mobile Social: Facebook, Tencent, VKontakte, LiveInternet.ru, Nikkei, VentureBeat, Niki Aghaei; Mobile: GSMA Intelligence.

How the Internet Works – Connecting to the Internet

ARPANET (Advanced Research Project Agency Network)
- Created in the 1960s by **DARPA** (Defense Advance Research Projects Agency)
- Used by **government** and **universities** for **research purposes**

Modem (stands for Modulate/Demodulate)
- A **modem** converts signals back and forth from **digital to analog** for transmission and receipt between computers
- A computer requires a modem to get access to the Internet

Internet Service Provider (ISP)
- These companies provides access to the **Internet** for a fee *(i.e. MTS, Shaw)*
- A computer is connected to an **ISP** through a **modem** to allow **Internet** access

Network Access Points (NAPs)
- NAP's connect ISPs together
- They serve as Internet **access points** for the ISPs and serve as **exchange points** for Internet traffic

Internet Backbone
- Collection of main **network connections** and **telecommunications lines** that make up the Internet

Network Protocols

- In general:
  - Protocol – set of rules on HOW to do something
- Here:
  - *agreed upon formats for transmitting data between connected computers*
- How to arrange data packets, how to signal end of message, how to specify destination address etc.

TCP/IP & Routers

TCP/IP Approach

TCP – Transmission Control Protocol

- Breaks information into small chucks called data packets
- Manages the transfer of the packets from computer to computer
- Reassembles data packets into a message at the destination

IP – Internet Protocol

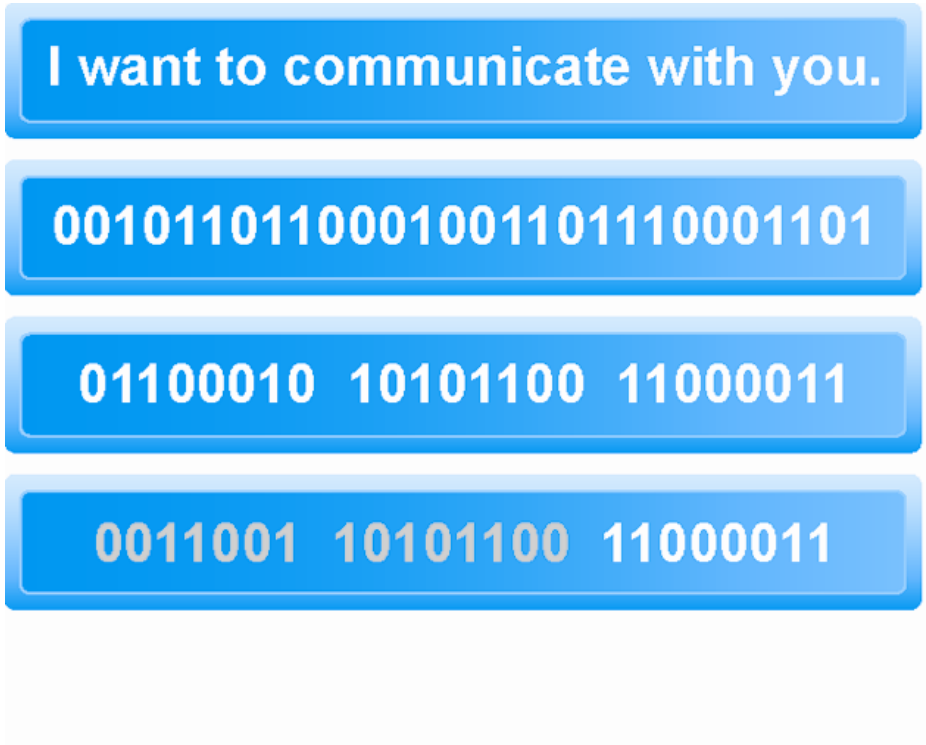
- Controls how data packets are formed
- Addresses each packet with the source and destination address
- A data packet conforming to the IP spec is called an **IP datagram**

Routers

Connect one network to another

- Identify each device on a network as unique using IP protocol
- Serve as the “Traffic Cop” directing packets to their destination

Packet Switching



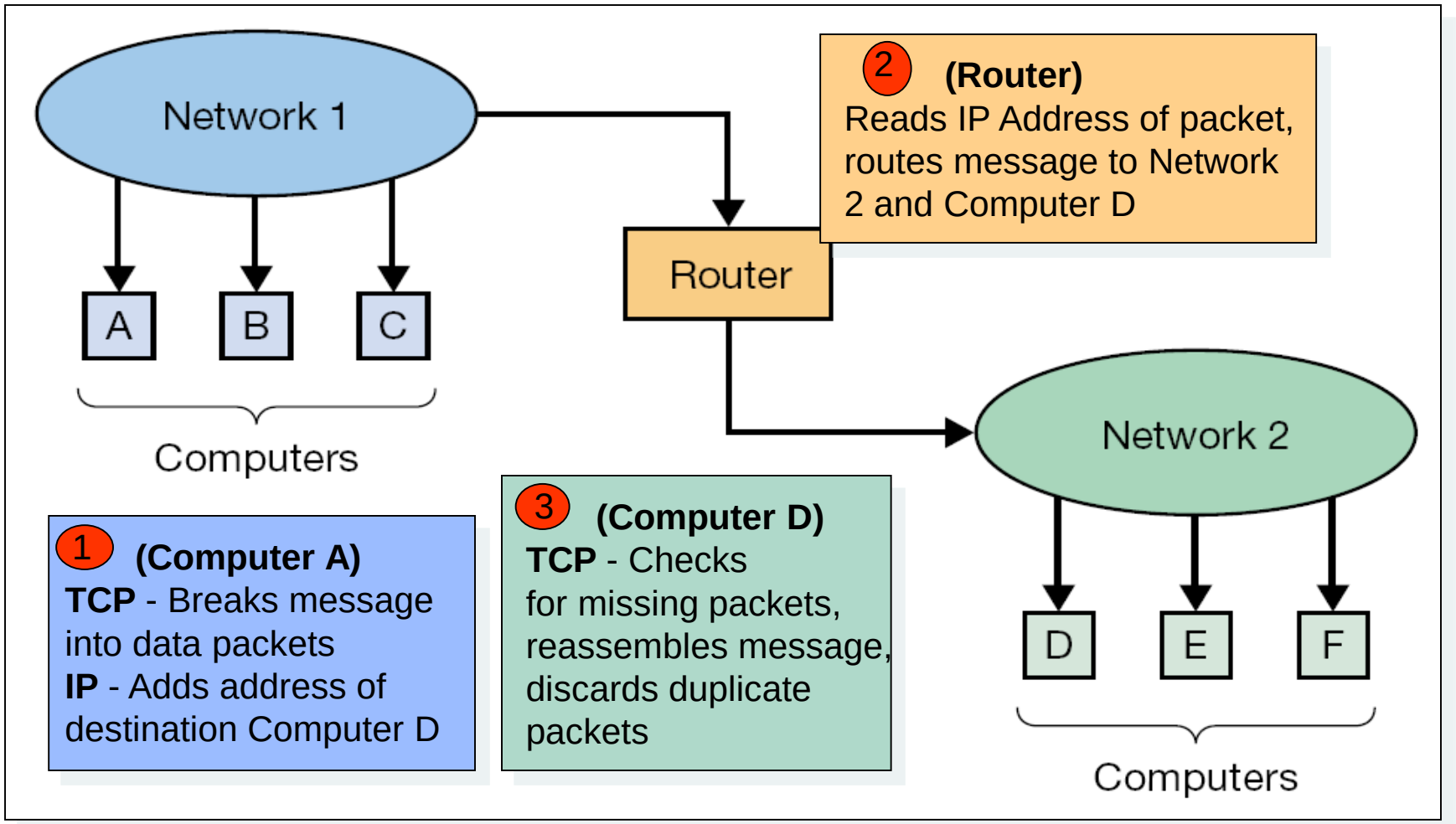
Original text message

Text message digitized into bits

Digital bits broken into packets

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

Sending Message from Computer A to D



Popular Uses of Internet

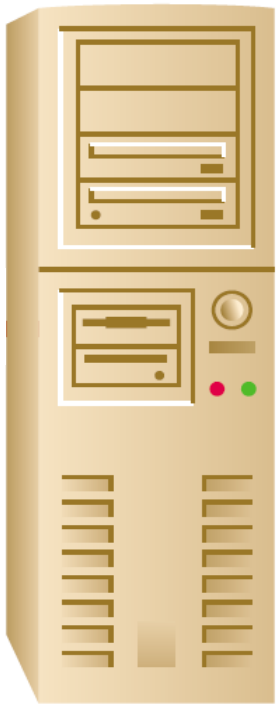
- Telnet – use remote CPU
- File Transfer Protocol (FTP): download file from remote computer
- Internet telephone calls (VoIP)
- E-mail
- Chat messengers
- World Wide Web

The World Wide Web

The World Wide Web

- Developed by Tim Berners-Lee at CERN (c. 1980)
- Originally conceived of as an internal document-management system
- The Web has grown to become:
  - A primary source of news and information
  - An indispensible conduit for commerce
  - A popular hub for social interaction, entertainment, and communication

World Wide Web



Web Server

Web Servers

- A **special** computer that is specifically designed to **store** and **“serve up”** Web pages
- This machine contains special **hardware** and **software** to perform its many specialized functions

World Wide Web

Web Browser

Hypertext

- A Web page stored on a Web server
- Contains **information** and **links** to other related information (hyperlinks)

HTML (Hypertext Markup Language)

- A standard method used to **specify the format** of Web pages
- Uses **codes/tags** which stipulate how the content should appear to the user

Web Browser

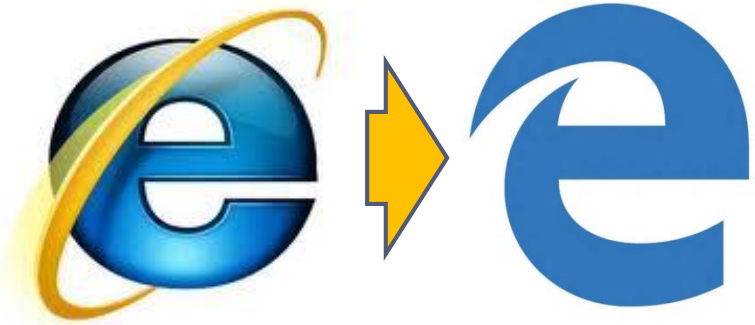
- A software program used to **locate** and **display** Web pages
- Includes **text, graphics,** and **multimedia** content

Web Browsers

- A software program used to locate and display Web pages
- Includes text, graphics, and multimedia content



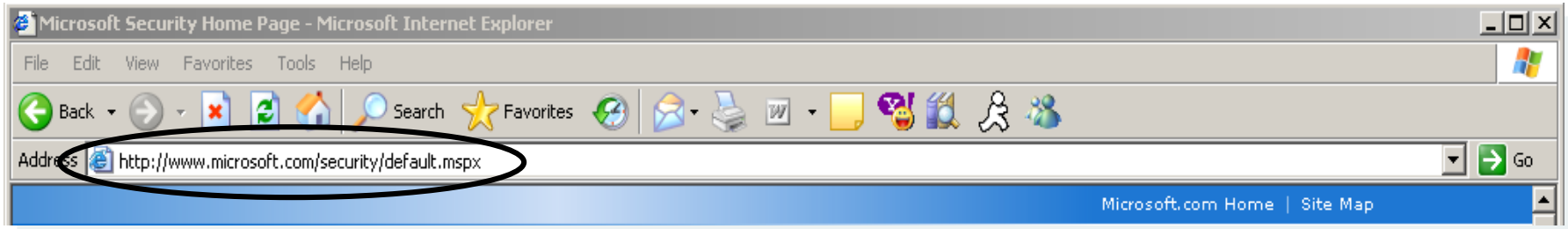




A Website

- Collection of interlinked web pages created by the same author(s) for common purpose
- Respond to requests over the Internet from browsers according to the hypertext transfer protocol (http)
- URL (Uniform Resource Locator)
  - Each site has a URL address
  - http://www.uwinnipeg,ca

How the Internet Works – Web Addresses & Domains



Domain
- Identifies the Website (host)
- Comes in many **suffixes** such as:
  - .edu (educational institutions)
  - .org (organizations; non-profit)
  - .mil (military)
  - .net (network organizations)

Example: microsoft.com
uwinnipeg.ca

IP Address
- Each **domain** is associated with one or more **IP addresses**
- Format: a 32-bit address written as 4 numbers (from 0-255) separated by periods

Example: 1.160.10.240

(URL) Uniform Resource Locator
- Identifies particular Web pages within a domain
  Example: http://www.microsoft.com/security/default.mspx

Web addresses

- Website: http://www.yyy.zz
- Page on that site: http://www.yyy.zz/xx
- Domain name: yyy.zz
- Prefix: *yyy* e.g. *uwinnipeg*
- Suffix: zz
- e.g.
  - *.com* – business
  - .org – nonprofit organization
  - .ca - Canada

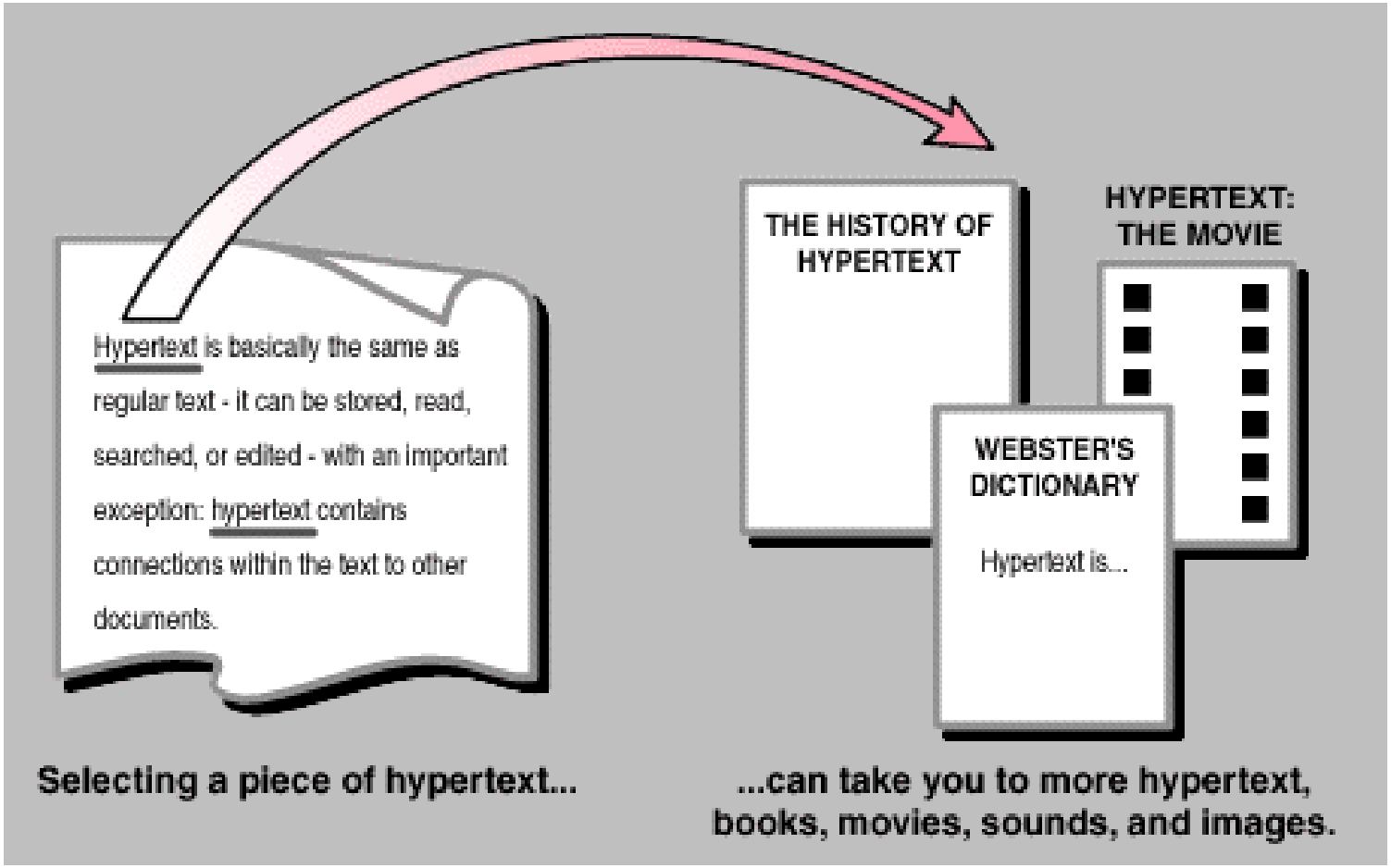
Internet Protocol (IP) Addresses

- Each domain name
  - uwinnipeg.ca
- is associated with an IP Address
  - Number assigned to each device (e.g., computer, printer) participating in a network that uses the internet protocol (IP)
  - 32-bit numeric address (4.29 Billion IP addresses)
  - written as 4 numbers separated by periods (IPv4)
  - Domain name is translated to IP Address by a special server on the Internet
  - e.g.. 1.160.10.240

IPv6

- June 6, 2012, Internet Society launched IPv6
- 128-bit addresses, able to handle up to 1 quadrillion addresses
- written as 6 sets of numbers marked by colons
- e.g.. 2001:db8:85a3::8a2e:370:7334

Web Browser and Hypertext



HTML (Hypertext Markup Language

```
<html>
<head>
<link rel=File-List href="Index_files/filelist.xml">
<title>ACS 1803 Introduction to Information Systems</title>
</head>
<body lang=EN-CA link=blue vlink=purple style='tab-interval:36.0pt'>
   <h1><Welcome to Section 053</h1>
…
</body>
</html>
```

Internet email address

john@uwinnipeg.ca
e-mail address has @ symbol

user name @ domain name
Domain names (general areas):
.com commercial organization
.edu educational organization
.gov government organization

.ca Canada
.us U.S.
.hk Hong Kong

Types of Websites

1. Static: collection of static documents created in HTML and tied together with links
2. Static with forms: 90% is pure document delivery, but also has fill-in forms to collect information from the user
3. Dynamic Data Access: via a Web page, users can search a catalogue or perform queries on the contents of a database, e.g. University Course Registration
4. Web-based Software Applications: facilitate business processes beyond voiding information; have a business information system on a Web-site, e.g., inventory tracking, sales force automation

Search Engines

- Search engines are programs that search documents for specified keywords and returns a list of the documents (web pages) where the keywords were found
- Biggest application on the web
- Web Search is such a profitable business (Google $15.5 billion annual revenue) because it is an application that is of use to everybody
- Search engines are an important contributor to the development of the Web and the Internet
- Today businesses build their websites using `*Search Engine Optimization (SEO)*`

The Future Internet

- The Internet2 Project
  - Consortium of 350+ institutions collaborating to facilitate revolutionary Internet technologies
  - Guaranteed service levels and lower error rates
    - Ability to purchase the right to move data through network at guaranteed speed in return for higher fee
  - Declining costs
- The Internet of Things (IoT)
  - Objects connected via sensors/RFID to the Internet