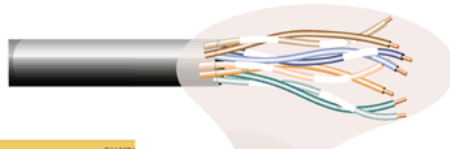
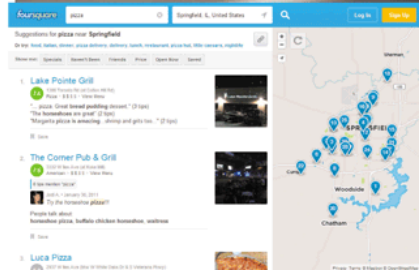


6 | Understanding Internet Technologies and Security

(Lecture 09)



```
C:\WIN...
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Jennifer>tracert www.cengage.com

Tracing route to www2.cengage.com [69.32.208.74]
over a maximum of 30 hops:
 0  1 ms  1 ms  1 ms  192.168.1.1
 1  10 ms  11 ms  9 ms  L100.BSTNNA-UFTP-86.verizon-gni.net [98.110.150.1]
 2  9 ms  17 ms  8 ms  60-10-3-6.BSTNNA-LCA-22.verizon-gni.net [130.81.212.180]
 3  32 ms  69 ms  8 ms  ae0-0.BOS-BB-RT22.verizon-gni.net [130.81.209.94]
 4  16 ms  16 ms  16 ms  0.ae11.XLA.NYC1.ALTER.NET [152.63.20.117]
 5  15 ms  15 ms  16 ms  0.xe-9-0-0.BRI1.NYC1.ALTER.NET [152.63.19.213]
 6  *
    Request timed out.
 7  47 ms  48 ms  52 ms  vian51.ebr1.NewYork2.Level3.net [4.69.138.222]
 8  52 ms  51 ms  53 ms  ae-38-38.ebr2.Washington1.Level3.net [4.69.201.0]
 9  52 ms  54 ms  47 ms  ae-62-62.csw1.Washington1.Level3.net [4.69.134.1]
10  54 ms  51 ms  83 ms  ae-61-61.ebr1.Washington1.Level3.net [4.69.134.1]
```

Discovering the Internet, 5th Edition

Objectives

- Discuss basic networking technologies
- Describe 2-tier and 3-tier models

Networking Basics

- A network connects two or more computers, printers, or other devices together with cables or wireless media allowing users to share
 - Data
 - Peripheral devices
 - Software and apps
 - Other network resources (such as an Internet connection)

Networking Basics

- Local, Metropolitan, and Wide Area Networks
 - Modern networks can be categorized by the physical area they cover
 - Local area network (LAN) - home, office, building, or several buildings
 - Metropolitan area network (MAN) - region
- Wide area network (WAN) - across the country or around the world
- Local Area Networks
 - Local area networks are configured in one of two basic structures
 - Peer-to-peer
 - Client/server

Networking Basics

➤ Local Area Networks (continued)

– Peer-to-peer LAN

- 10 or fewer personal computers connected
- One or more of the computers may also have a printer, scanner, or external storage device
- Each node must have built-in networking capabilities or a **network interface card (NIC)**
- Each node may be connected to a single cable or may be connected at a common connection point using a **hub**
- Users can access files stored on any computer and any peripheral device connected to a computer on the network
- Simple to configure and inexpensive to use

Networking Basics



Networking Basics

➤ Local Area Networks (continued)

- **Client/server network** consists of multiple personal computers and devices or workstations (clients), one or more servers, and other devices such as printers
- Uses a network operating system to manage data, printer access, communications, Internet connections, security, and network administration
- Examples include Microsoft Windows Server, OS X Server, Novell NetWare, Cisco IOS, UNIX, and Linux

Networking Basics

- Local Area Networks (continued)
 - Advantages over a peer-to-peer network
 - Supports shared data storage
 - Provides network maintenance tools
 - Promotes more efficient data backups
 - Disadvantages compared to a peer-to-peer network
 - More expensive
 - More difficult to configure
 - Requires more technical expertise to manage

Networking Basics

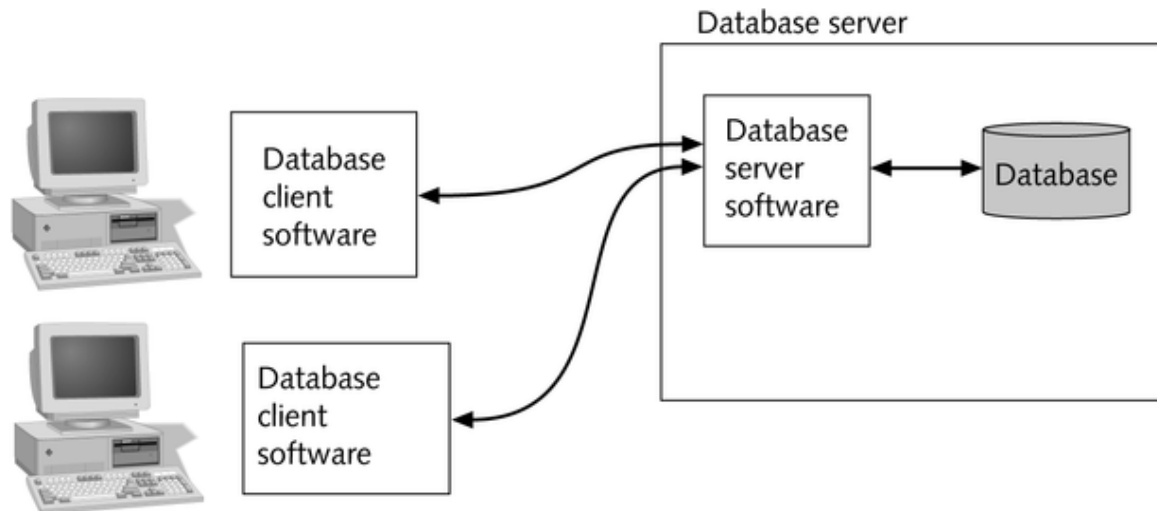
Network Operating System Services

Service	Benefit
File Services	Permit the centralized storage of files on a file server, which can be accessed by any authorized user on the network. Maintain backup copies of critical files and protect against accidentally deleted files, damaged files, or files lost to natural or man-made disasters. Files stored centrally on a file server are backed up more easily than files stored on individual computers or devices.
Print Services	Enable users to share printers across a network. Replacing multiple individual printers with one or two high-speed networked printers can reduce equipment costs and increase productivity.
Mail Services	Manage the sending, receiving, routing, and storage of email messages. Email is a critical component of any organization's communications with employees, clients, and vendors. Enable email communications to flow smoothly.
Communications Services	Allow authorized users to connect to the network when out of the office. Communications services permit remote users to connect to the network.
Internet Services	Manage internal web-based services, external Internet access, and other Internet-based services such as web servers, web browsers, and email. Organizations use email to send and receive messages from clients or vendors outside the organization. Many organizations also use internal webpages to support internal business operations. External webpages are used to sell products and services and provide customer support. Internet services help manage these critical operations.
Management Services	Enable network administrators to manage the security and operation of the network by determining the level of network activity, monitoring network access and activity, detecting and solving network hardware and software problems, and distributing software to users.

Client/Server Database Model

➤ 2-tier model (client and server)

- Some database management software is on the client, some is on the server that contains the database
- Used in most Internet applications today

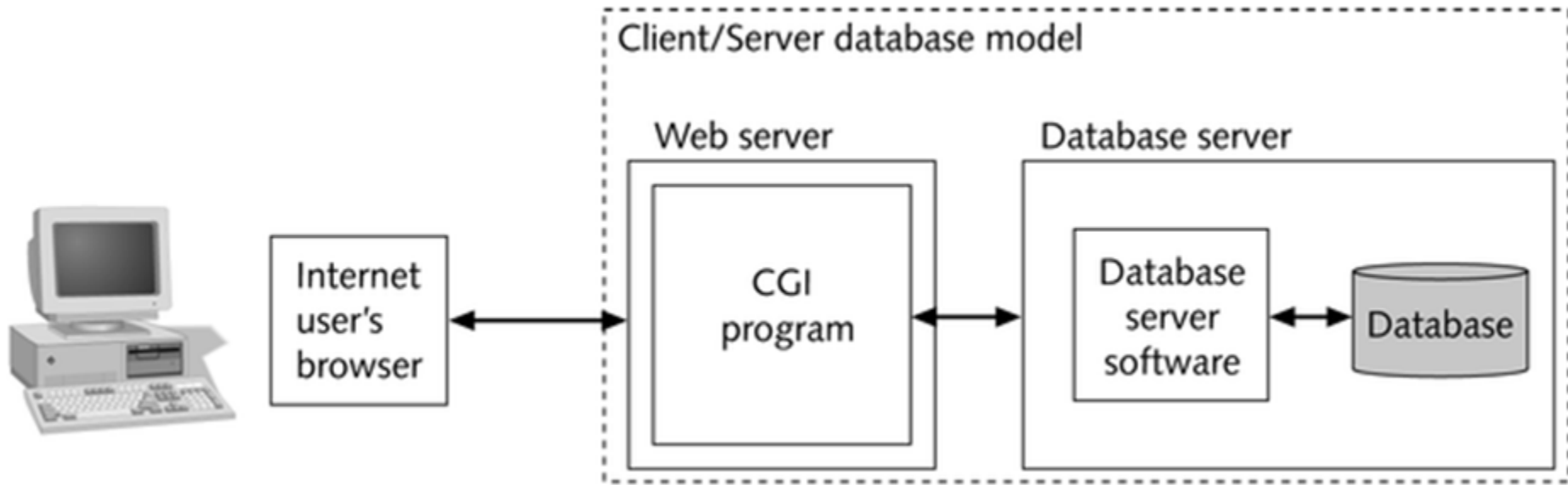


Internet Client/Server Database Model

- **3-tier model** (browser or client, Web server and database server)
 - Differs from traditional client/server model:
 - Neither client nor server portions of database software are on the PC of the Internet user
 - The browser on the user's PC accesses a database via the client/server model (client is on the web site and server has direct access to the database)
 - Advantage
 - Client PC does not need to contain database management software

Internet Client/Server Database Model

- **3-tier model (cont'd)**



Networking Basics

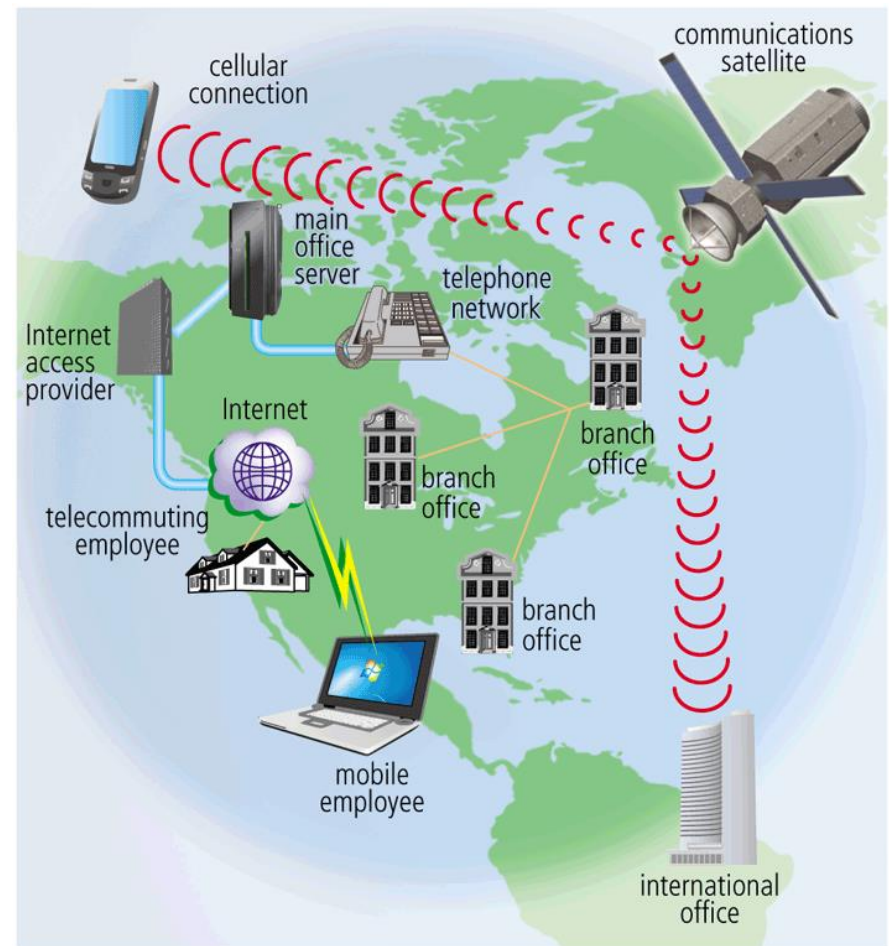
➤ Metropolitan Area Networks (MANs)

- Connects clients and servers in a region that is larger than a single office or building
 - Multiple buildings across a city or multiple educational, research, or government facilities across a state
- Generally are owned by a consortium of users of a single network provider that sells high-speed network services to multiple users

Networking Basics

➤ Wide Area Networks (WANs)

- Cover a very wide geographical area
 - Can be a single network or multiple connected LANs located across the country or around the world
 - Most WANs are private, corporately owned networks
 - The Internet is the world's largest public WAN



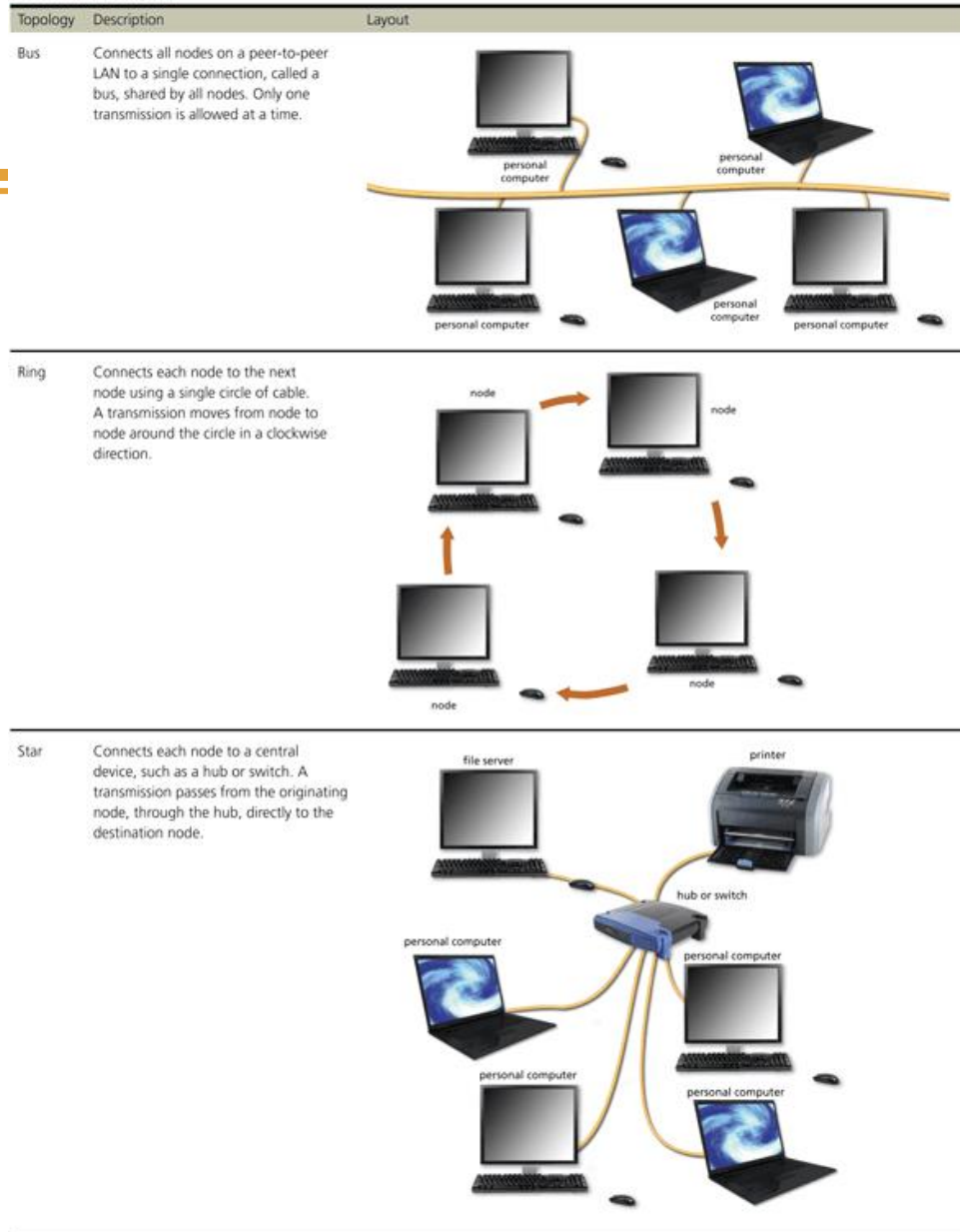
Networking Basics

- Network Topologies, Access Methods, and Transmission Media
 - **Physical topology** is the arrangement of a network's computers, printers
 - **Access method** is how data is transmitted from node to node across the network
 - **Transmission media** – are the physical or wireless communication media used to carry transmissions
 - These three characteristics define the **throughput**, which is the amount of data that can travel node to node in a specified amount of time

Networking Basics

- Network Topologies, Access Methods, and Transmission Media (continued)
 - Three basic LAN physical topologies
 - Bus
 - Ring
 - Star
 - Today, many LANs use a hybrid physical topology that combines some elements of these three topologies

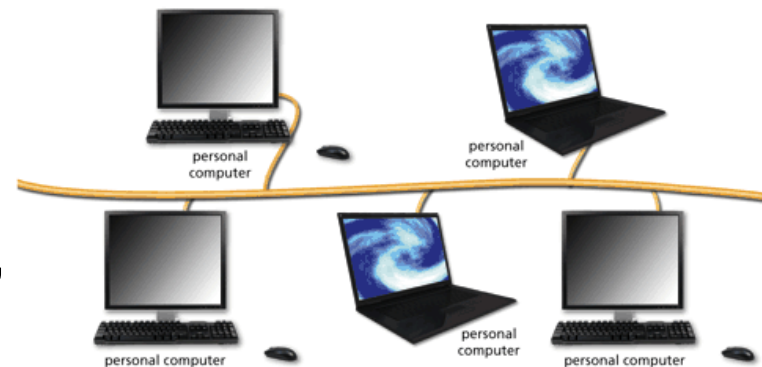
Network Topologies



Networking Basics – Network Topologies

➤ Bus topology

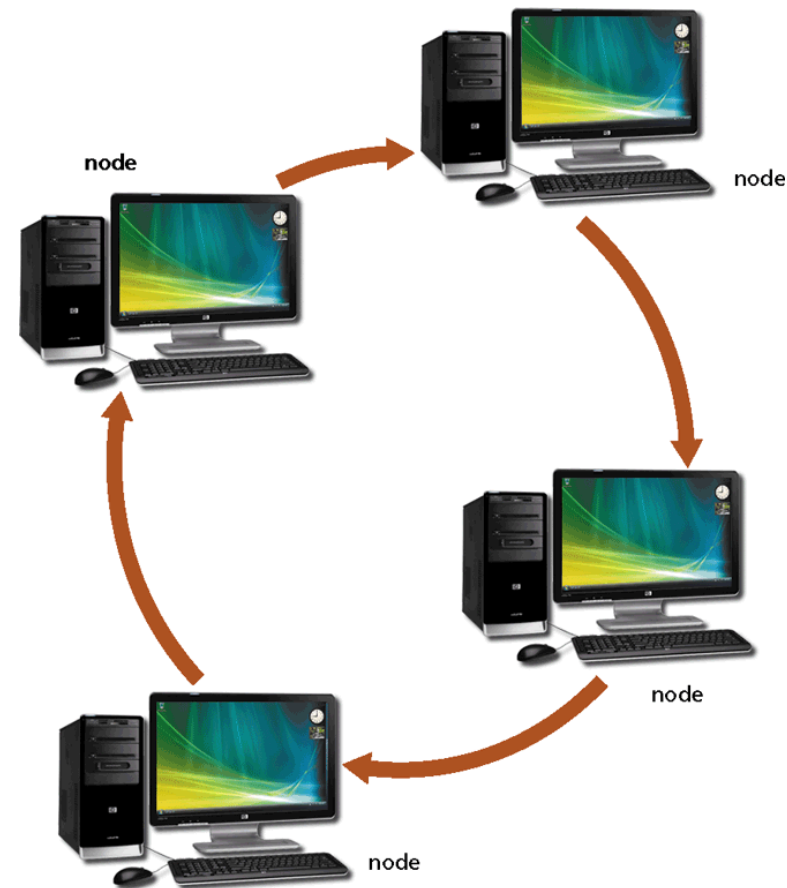
- Connects all nodes on a peer-to-peer LAN with a single cable called a bus
- Only one transmission allowed at a time
- A node announces to the entire network when it is ready to send a transmission
- All nodes except the destination node ignore the transmission
- If a problem occurs with the bus, the entire network becomes inoperable



Networking Basics – Network Topologies

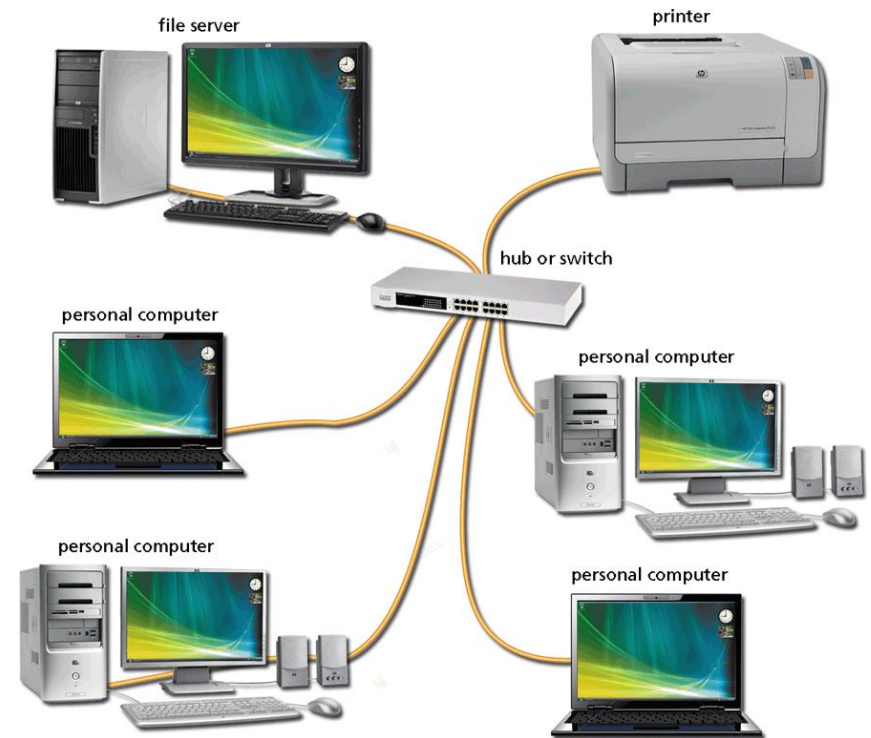
➤ Ring topology

- Connects each node to the next node via a single circle of cable
- A transmission moves from node to node around the circle clockwise
- Each node accepts any data addressed to it and then forwards the transmission to the next node
- Failure of one node can affect all the nodes following it



Networking Basics – Network Topologies

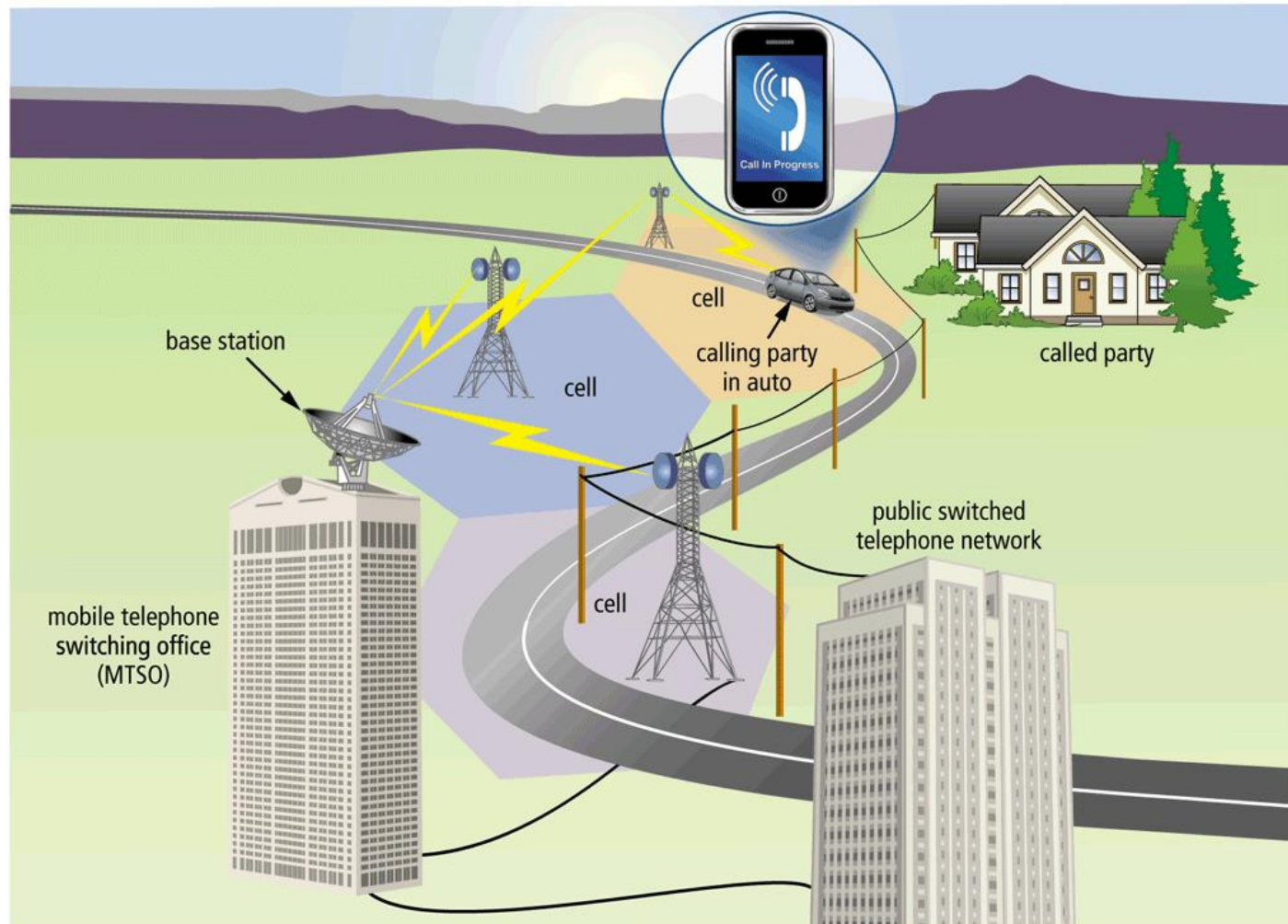
- **Star topology**
 - Connects each node to a central device, such as a hub or switch
 - A transmission passes from the originating node, through the hub, directly to the destination node
 - Failure of a single node does not make the entire network inoperable



Networking Basics

- Network Topologies, Access Methods, and Transmission Media (continued)
 - Access Methods
 - Sometimes called **logical topology**
 - **Ethernet** – a node attempting to transmit data first must determine whether or not another node is sending a transmission
 - **Token ring** – passes **tokens**, small packets of data, clockwise in a circle from node to node
 - Transmission Media
 - **Cellular transmissions** travel wirelessly over land cells using transceivers, or cell sites; cellular networks can transfer voice and data over a large, almost limitless area

Networking Basics



Networking Basics

➤ Network Topologies, Access Methods, and Transmission Media (continued)

– Transmission Media (continued)

- **Infrared (IR) transmissions** use infrared light-wave signals as short-range transmission medium; require line-of-sight transmissions
- **Near field communication (NFC) transmissions** use radio waves to connect devices that are touching or nearby (generally within 10 centimeters)



Networking Basics

➤ Network Topologies, Access Methods, and Transmission Media (continued)

– Transmission Media (continued)

- **Radio frequency (RF) transmissions** use broadcast radio waves to transmit data over short distances; some wireless devices use **transceiver**, a single component and receives transmissions
- **Bluetooth** is a short-range RF technology
 - Designed for **wireless personal area networks (WPANs)**, which have a range of approximately 33 feet (10 meters)
 - To enable two Bluetooth devices to work together, **pair** them



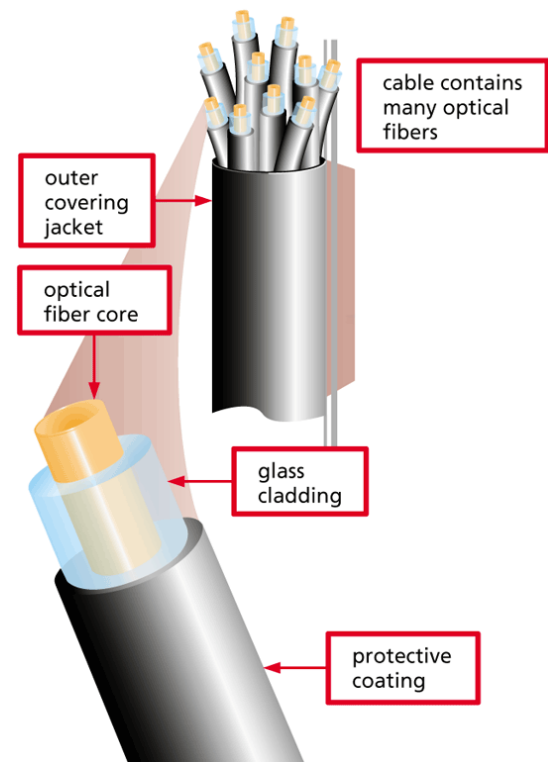
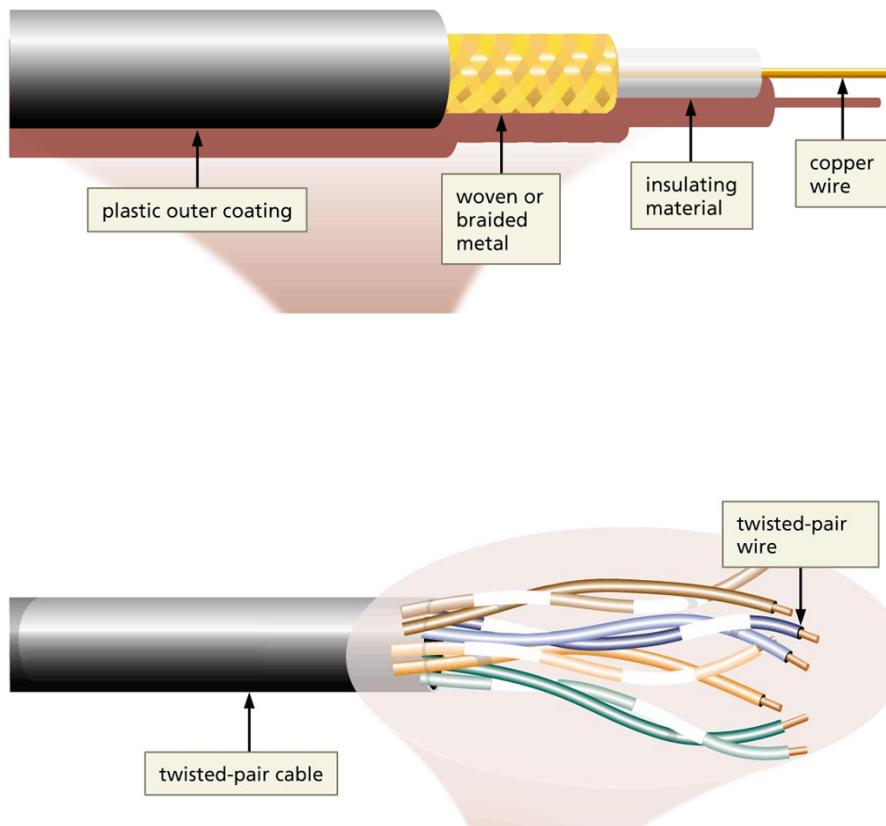
Networking Basics

➤ Network Topologies, Access Methods, and Transmission Media (continued)

– Transmission Media (continued)

- A **Wi-Fi network**, or **wireless LAN (WLAN)** uses a wireless medium — such as radio frequency transmissions — to connect computers and mobile devices, printers, and other devices
- Physical transmission media
 - **Coaxial cable** (pronounced KO-ax); although was the choice for many early networks, not used in most modern networks because it does not transmit data as fast as other media
 - **Twisted-pair cable** commonly used as a LAN transmission medium
 - **Fiber-optic cable** commonly used as a MAN or WAN transmission medium

Networking Basics



Networking Basics

➤ Connectivity Hardware and Software

- Hardware connectivity devices connect nodes on the same network, connect nodes across multiple networks, and forward packets between nodes
- **Segments** are multiple groups of computers or devices that share a common function
- Hubs
 - Hub – inexpensive hardware device used to connect multiple nodes on the same network

Networking Basics

➤ Connectivity Hardware and Software (continued)

– Bridges

- **Bridge** – intelligent connectivity device with one input port and one output port that connects two segments on the same LAN or two separate LANs
- Each node on the network has a **MAC (Media Access Control Address)**
- Bridge creates a database of all the MAC addresses for nodes on its segment or LAN

– Data Switches

- **Data switch** – intelligent device that also interprets MAC addresses and filters and forwards data packets to network segments
- Can be a less-expensive choice than a bridge for networks with a large number of nodes

Networking Basics

➤ Connectivity Hardware and Software (continued)

– Routers

Route packets over specific paths between nodes

- **Router** is an intelligent device with multiple ports; a specialized computers that connect LAN segments, two LANs, or multiple LANs on a WAN
 - Determines the best route for packets
 - Fall into three categories: wireless, mobile, or broadband
 - Use **static routing** or **dynamic routing**
 - Internet routers are complex, fast, expensive devices that send packets from one router to another in a series of **hops** until they reach their destination network

Allows a router to determine the best route between two nodes automatically and then store this information in a routing table

Networking Basics

➤ Connectivity Hardware and Software (continued)

— Gateways

- A **gateway** is a hardware or software that runs on a mainframe computer, server, individual workstation or router; connects two or more networks or network segments that use different packet formatting, different communication protocols, and different access methods

Types of Gateways

Name	Description
Cloud gateway	Integrates standard networking protocols with cloud services to connect to the cloud.
Email gateway	Converts email messages created by one type of email system so that they can be read by a different type of email system.
Internet gateway	Allows LAN users to access the Internet. Can be used to define which users have Internet access or to restrict access to certain Internet services or websites.
LAN gateway	Connects LAN segments that use different access methods and communication protocols.
SMS gateway	Enables a computer to send SMS (short message service) messages, such as text messages. Many include the capability to convert text messages to email.
Voice/data gateway	Allows data packets to be sent over a voice network or voice to be sent over a data network by translating between voice circuit switching and data packet switching.
Wireless gateway	Integrates wireless devices such as laptops, PDAs, and cell phones with a wired network.