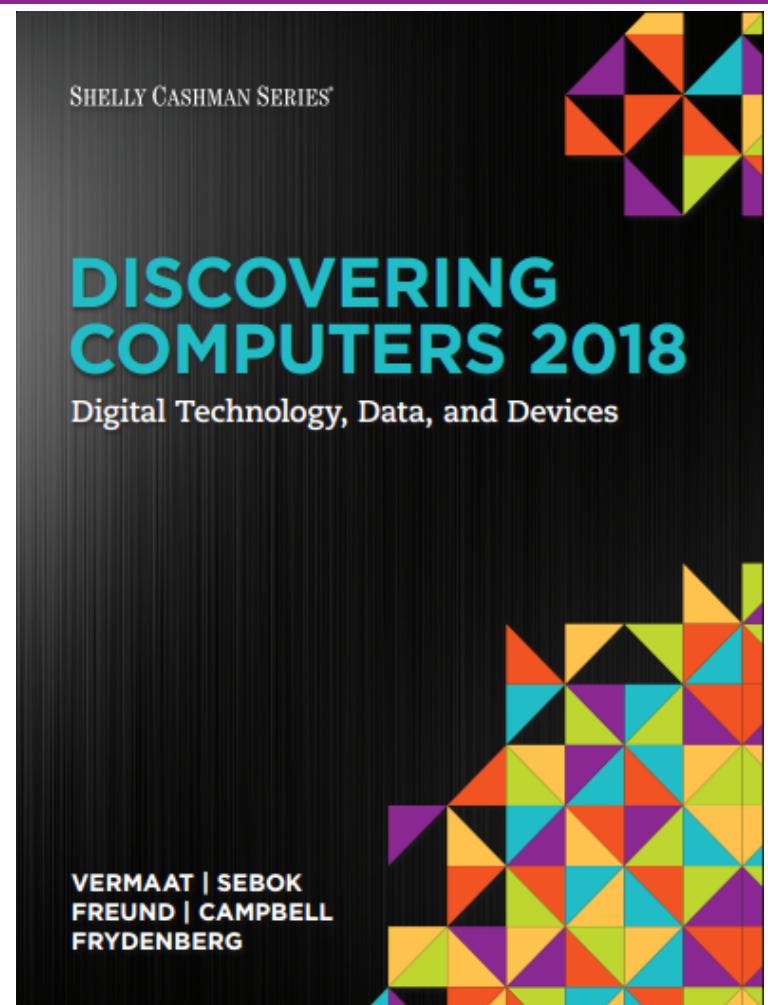


# DISCOVERING COMPUTERS 2018

## Digital Technology, Data, and Devices



## Module 10

# Communicating Digital Content: Wired and Wireless Networks and Devices

# Objectives Overview (1 of 2)

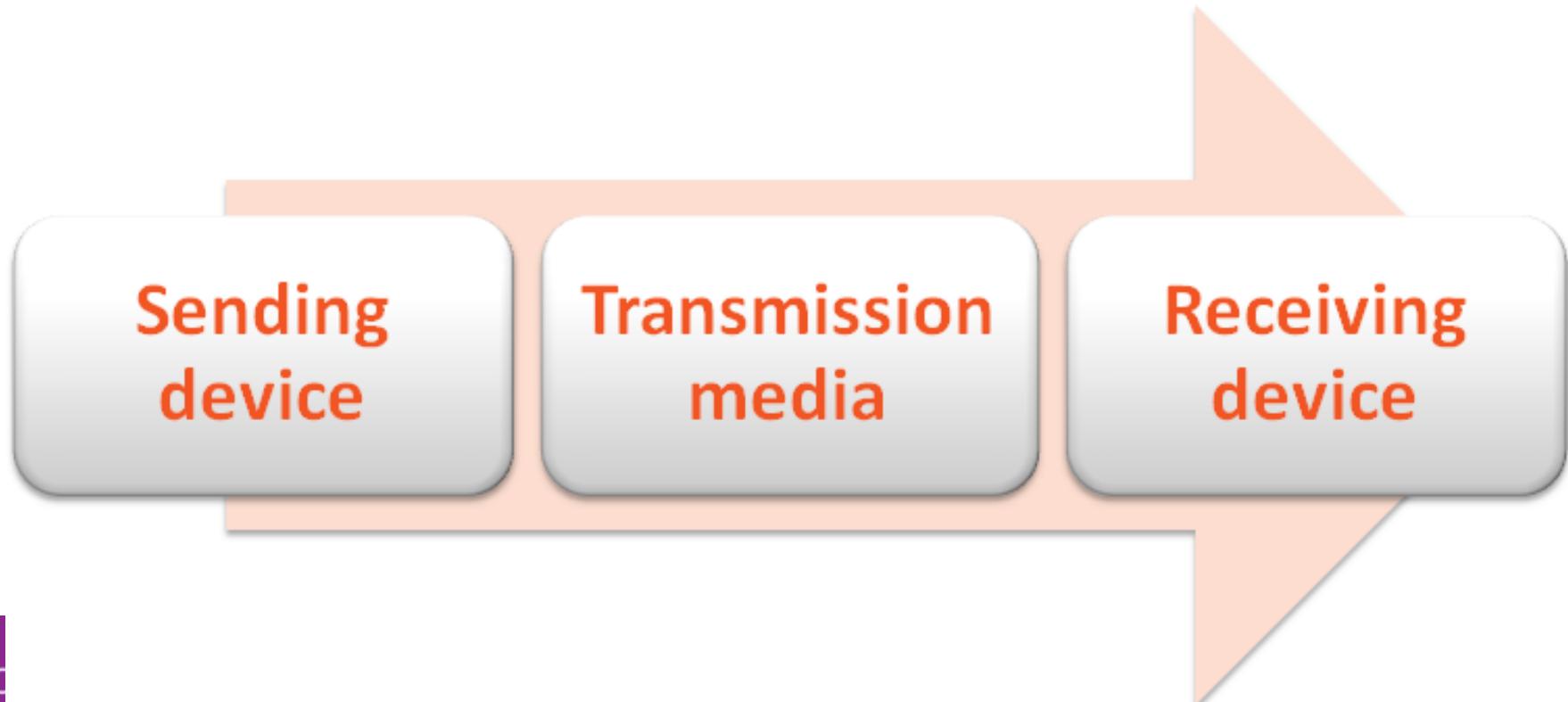
- Discuss the purpose of the components required for successful communications and identify various sending and receiving devices.
- Differentiate among Local Area Networks (LANs), Metropolitan Area Networks (MANs), Wide Area Networks (WANs), and Personal Area Networks (PANs).
- Differentiate between client/server and peer-to-peer networks.
- Explain the purpose of communications software.
- Describe the various network communications standards and protocols.

# Objectives Overview (2 of 2)

- Describe various types of communications lines.
- Describe commonly used communications devices.
- Discuss different ways to set up and configure a home network.
- Differentiate among physical transmission media.
- Differentiate among wireless transmission media.

# Communications (1 of 2)

- Digital communications describes a process in which two or more computers or devices transfer data, instructions, and information.



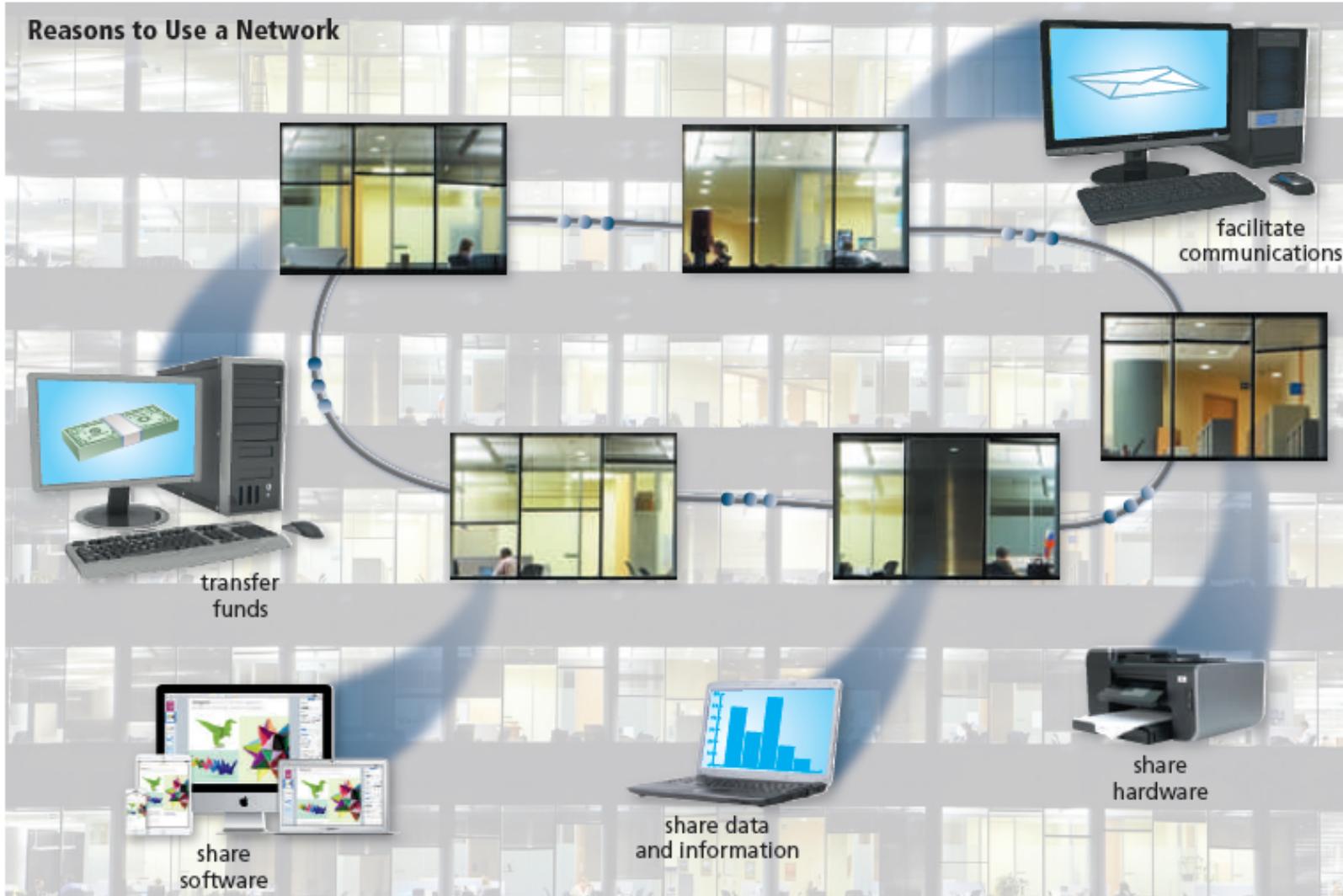


**Figure 10-1** A simplified example of a communications system. Some devices that serve as sending and receiving devices are (a) servers, (b) desktops, (c) laptops, (d) tablets, (e) smartphones and headsets, (f) portable media players, (g) handheld game devices, and (h) Global Positioning System (GPS) receivers in vehicles. Transmission media consist of phone and power lines, cable television and other underground lines, microwave stations, and satellites.

# Networks (1 of 9)

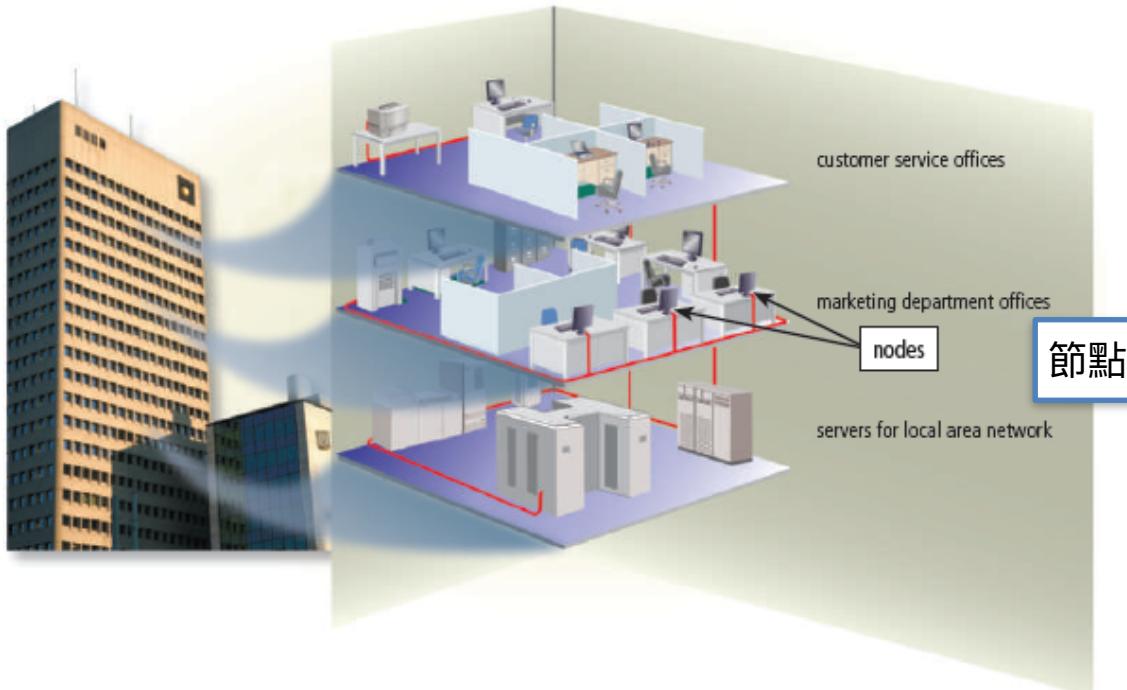
- A **network** is a collection of computers and devices connected together via communications devices and transmission media
- Advantages of a network include:
  - Facilitating communications
  - Sharing hardware
  - Sharing data and information
  - Sharing software
  - Transferring funds

## Reasons to Use a Network



**Figure 10-2** Networks facilitate communications; enable sharing of hardware, data and information, and software; and provide a means for transferring funds.

- A **Local Area Network (LAN)** is a network that connects computers and devices in a limited geographical area.
- A **Wireless LAN (WLAN)** is a LAN that uses no physical wires.



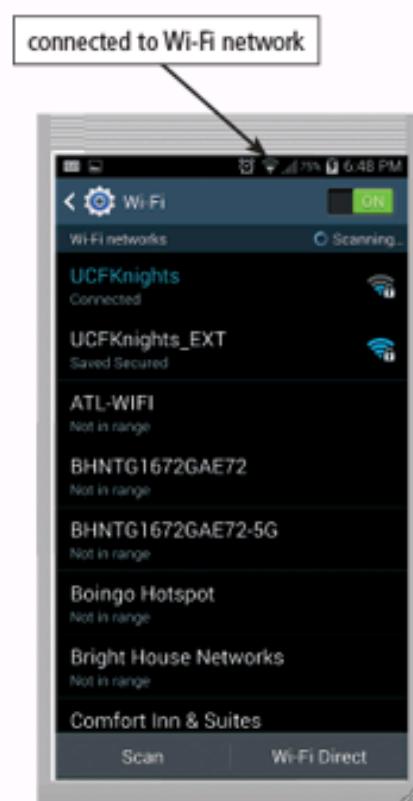
**Figure 10-3** Computers and devices on different floors access the same LAN in an office building. Computers and devices on the network often are identified as nodes. Xtuv Photography / Shutterstock.com



**Figure 10-4** Computers and mobile devices on a WLAN may communicate via a wireless access point with a wired LAN to access its hardware, software, Internet connection, and other resources.

6. If desired, disconnect from the mobile network so that your device communicates using only the Wi-Fi network.
7. Run a browser and navigate to a webpage to verify that the device is connected to the network properly.

**Consider This:** What other reasons might you have for wanting to connect a mobile computer or device to a Wi-Fi network?



## Wi-Fi: Wireless Fidelity

# Networks (5 of 9)

- A Metropolitan Area Network (MAN) connects LANs in a metropolitan area.
- A **Wide Area Network (WAN)** is a network that covers a large geographic area.
- A **Personal Area Network (PAN)** is a network that connects computers and devices in an individual's workspace using wired and wireless technology.



**Figure 10-5** A simplified example of a WAN.

# Networks (7 of 9)

- The configuration of computers, devices, and media on a network is sometimes called the network architecture.

# Client/server network



**Figure 10-6** As illustrated by the communications in this simplified diagram, on a client/server network, one or more computers act as a server, and the client computers and mobile devices access the server(s). Connections can be wired or wireless and may occur through a communications device.

# Peer-to-peer network



**Figure 10-7** As illustrated by the communications in this simplified diagram, each computer or mobile device on a Peer-to-Peer (P2P) network shares its hardware and software with other computers and mobile devices on the network. Connections can be wired or wireless and may occur through a communications device.

# 客戶端/伺服器網路 和 對等網路 的比較

## Client/Server Network V.S. Peer-To-Peer Network



有沒有「專門的伺服器」負責管理與服務其他裝置

比較項目	Client/Server	Peer-to-Peer
是否有伺服器	有	無
管理方式	集中管理	分散式管理
安全性	較高	較低
成本	較高	較低
適合對象	公司、學校、大型機構	家用、小型群組
效能	能處理大量連線	多人時容易變慢

VoIP services, such as Skype and FaceTime, also provide voice and video calling services over the Internet. These often are much less expensive than making phone calls over a mobile service provider's network. It also is possible to make calls from a VoIP program to a mobile or landline phone. Voice and video calling require large amounts of bandwidth. As a result, some carriers prohibit the use of calling services over their networks, requiring users to connect via Wi-Fi to make these calls. Read **Ethics & Issues 10-2** to consider video calling and other issues associated with communications technologies and medical care.



© radub85 / Fotolia

<https://www.youtube.com/watch?v=lrY5RNolziA>



# Communications Software

- **Communications software** consists of programs and apps that:
  - Help users establish a connection to another computer, mobile device, or network
  - Manage the transmission of data, instructions, and information
  - Provide an interface for users to communicate with one another

# Network Communications Standards and Protocols (1 of 6)

- Ethernet
- Token ring
- TCP/IP: Transmission Control Protocol/Internet Protocol
- Wi-Fi: Wireless Fidelity
- LTE: Long-Term Evolution
- Bluetooth
- UWB: Ultra-Wide Band
- IrDA: Infra-red Data Association
- RFID: Radio Frequency IDentification
- NFC: Near-Field Communication

# Network Communications Standards and Protocols (2 of 6)

- **Ethernet** is a network standard that specifies no central computer or device on the network (nodes) should control when data can be transmitted.
- The **token ring** standard specifies that computers and devices on the network share or pass a special signal (token).
- **Transmission Control Protocol/Internet Protocol (TCP/IP)** is a network protocol that defines how messages (data) are routed from one end of a network to another.

## How Communications Standards Might Work Together



### Step 1: COMMUNICATIONS SOFTWARE

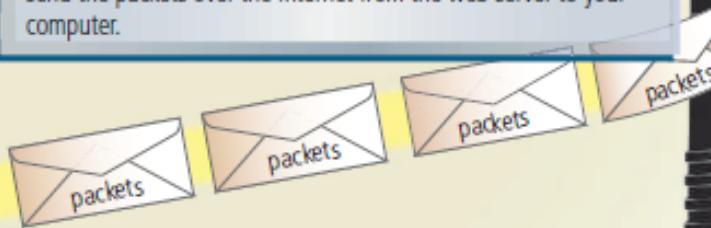
Using a browser, you request a webpage on a web server be displayed on your computer screen.



client  
(your computer)

### Step 2a: TCP/IP

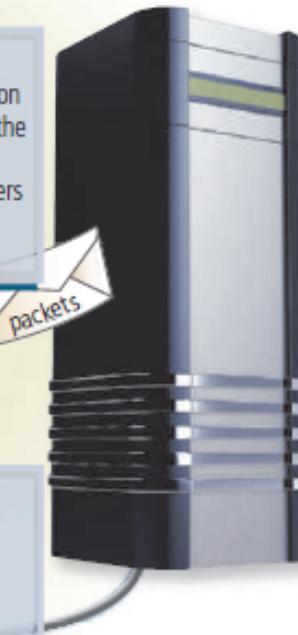
Your computer uses the TCP/IP standard to establish a connection with the web server that stores the requested webpage, divide the webpage into packets, provide an address for each packet, and reassemble the webpage once it arrives at your computer. Routers send the packets over the Internet from the web server to your computer.



web server

### Step 2b: ETHERNET

The Ethernet standard controls how devices (adapter cards, routers, modems, etc.) share access to the media (cables and lines) and how devices transmit data over the transmission media.



**Figure 10-8** This figure illustrates how Internet communications use TCP/IP and Ethernet to ensure that data travels correctly to its destination.

# Network Communications Standards and Protocols (4 of 6)

- **Wireless Fidelity (Wi-Fi)** identifies any network based on the **802.11** standard that specifies how two wireless devices communicate over the air with each other.
- **Long-Term Evolution (LTE)** is a network standard that defines how high-speed cellular transmissions use broadcast radio to transmit data for mobile communications.
- **Bluetooth** is a network protocol that defines how two Bluetooth devices use short-range radio waves to transmit data.
- **UWB (Ultra-Wide Band)** is a network standard that specifies how two UWB devices use short-range radio waves to communicate at high speeds with each other.
- **Infra-red Data Association (IrDA)** transmits data wirelessly via Infra-Red (IR) light waves.
- **Radio Frequency IDentification (RFID)** is a protocol that defines how a network uses radio signals to communicate with a tag placed in or attached to an object, an animal, or a person.

- Change the channel, pause a program, or schedule a recording using a Bluetooth-compatible or Bluetooth-enabled television and remote control.
- Track objects that include tags or nodes used to send wireless signals read by a real-time location system.

## Internet Research

What are future uses of Bluetooth?

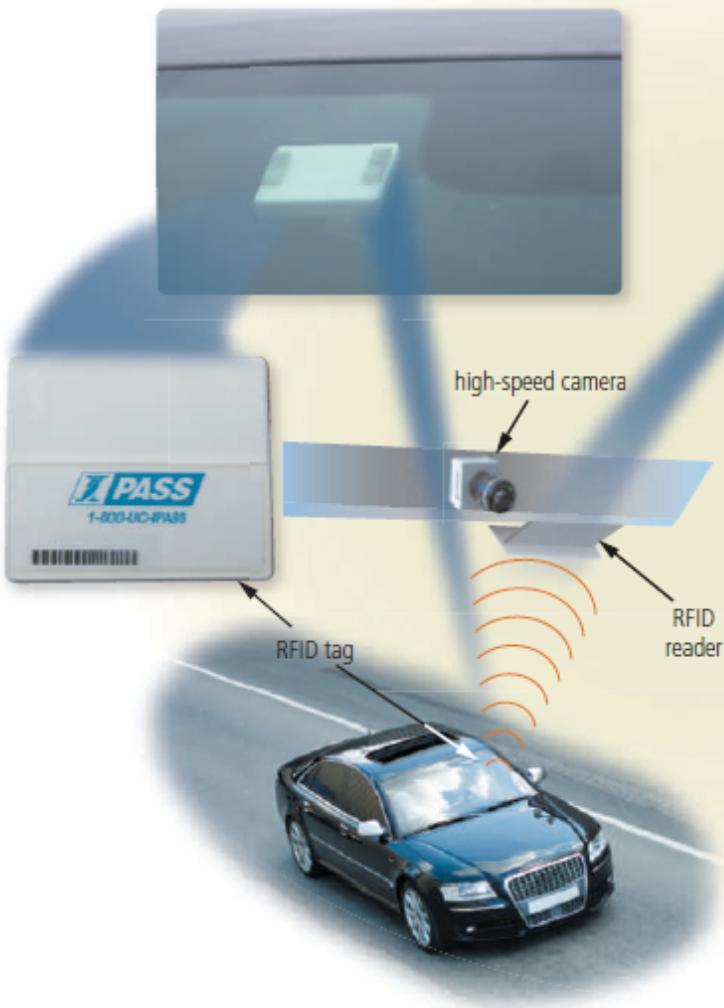
*Search for:* future bluetooth uses



## How Electronic RFID Toll Collection Works

### Step 1

Motorist purchases an RFID transponder or RFID tag and attaches it to the vehicle's windshield.



### Step 2

As the vehicle approaches the tollbooth, the RFID reader in the tollbooth sends a radio wave that activates the windshield-mounted RFID tag. The activated tag sends vehicle information to the RFID reader.



### Step 3

The RFID reader sends the vehicle information to the lane controller. The lane controller, which is part of a local area network, transmits the vehicle information to a central computer that subtracts the toll from the motorist's account. If the vehicle does not have an RFID tag, a high-speed camera takes a picture of the license plate and the computer prints a violation notice, which is mailed to the motorist.



**Figure 10-9** This figure shows how electronic RFID toll collection works.

- **NFC** (Near-Field Communication) is a protocol, based on RFID, that defines how a network uses close-range radio signals to communicate between two devices or objects equipped with NFC technology



**Figure 10-10** Some objects, such as credit cards, are NFC enabled. You also can program NFC tags yourself.

# Communications Lines (1 of 3)

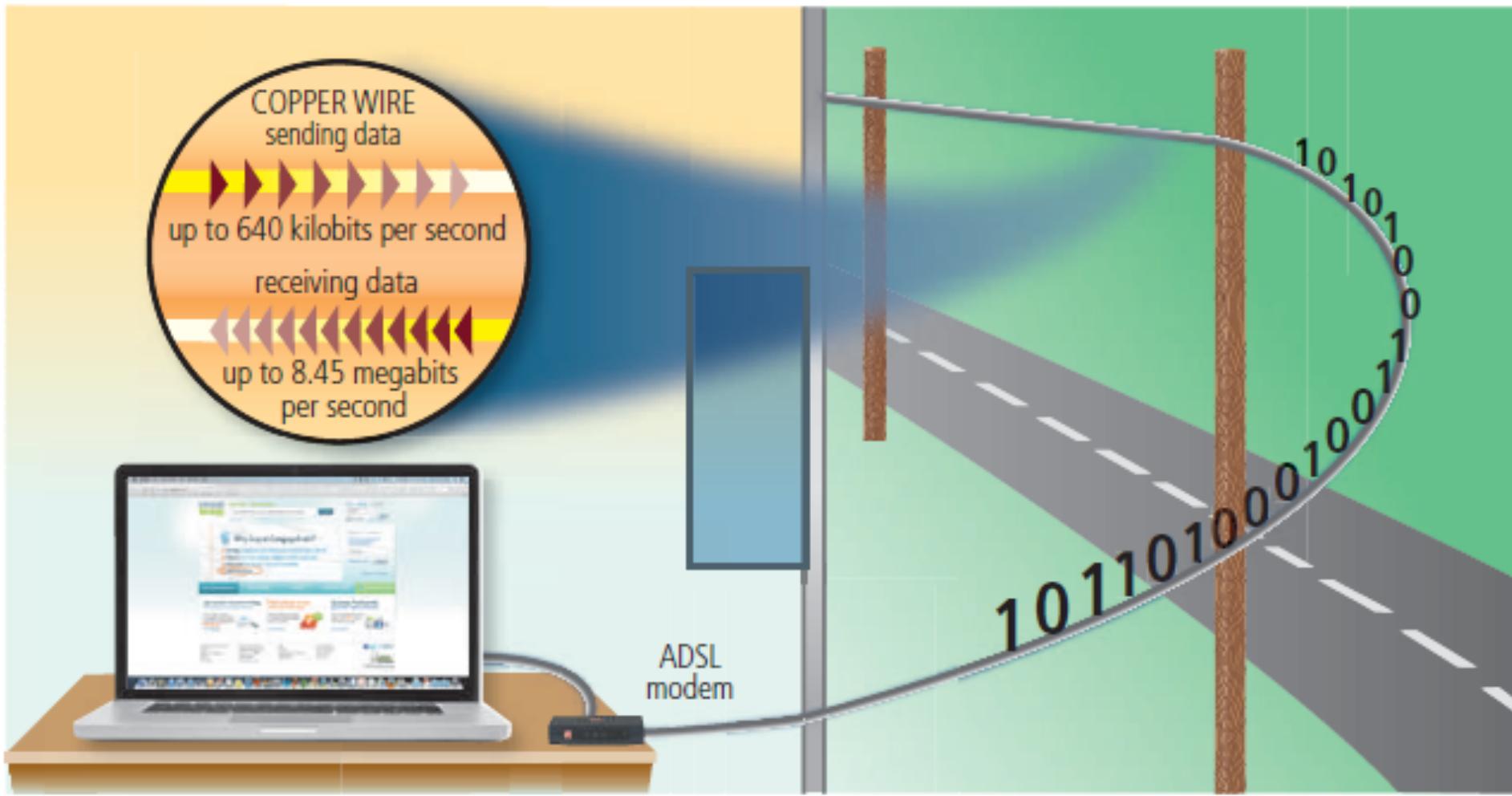
- Cable
- **DSL: Digital Subscriber Line**
- **FTTP: Fiber To The Premises**
- **T-Carrier**
- **ATM: Asynchronous Transfer Mode**

# Communications Lines (2 of 3)

Table 10-2 Speeds of Various Dedicated Digital Lines

Type of Line	Transfer Rates
Cable	256 Kbps to 100 Mbps or higher
DSL	256 Kbps to 8.45 Mbps
FTTP	5 Mbps to 300 Mbps
Fractional T1	128 Kbps to 768 Kbps
T1	1.544 Mbps
T3	44.736 Mbps
ATM	155 Mbps to 622 Mbps, can reach 10 Gbps

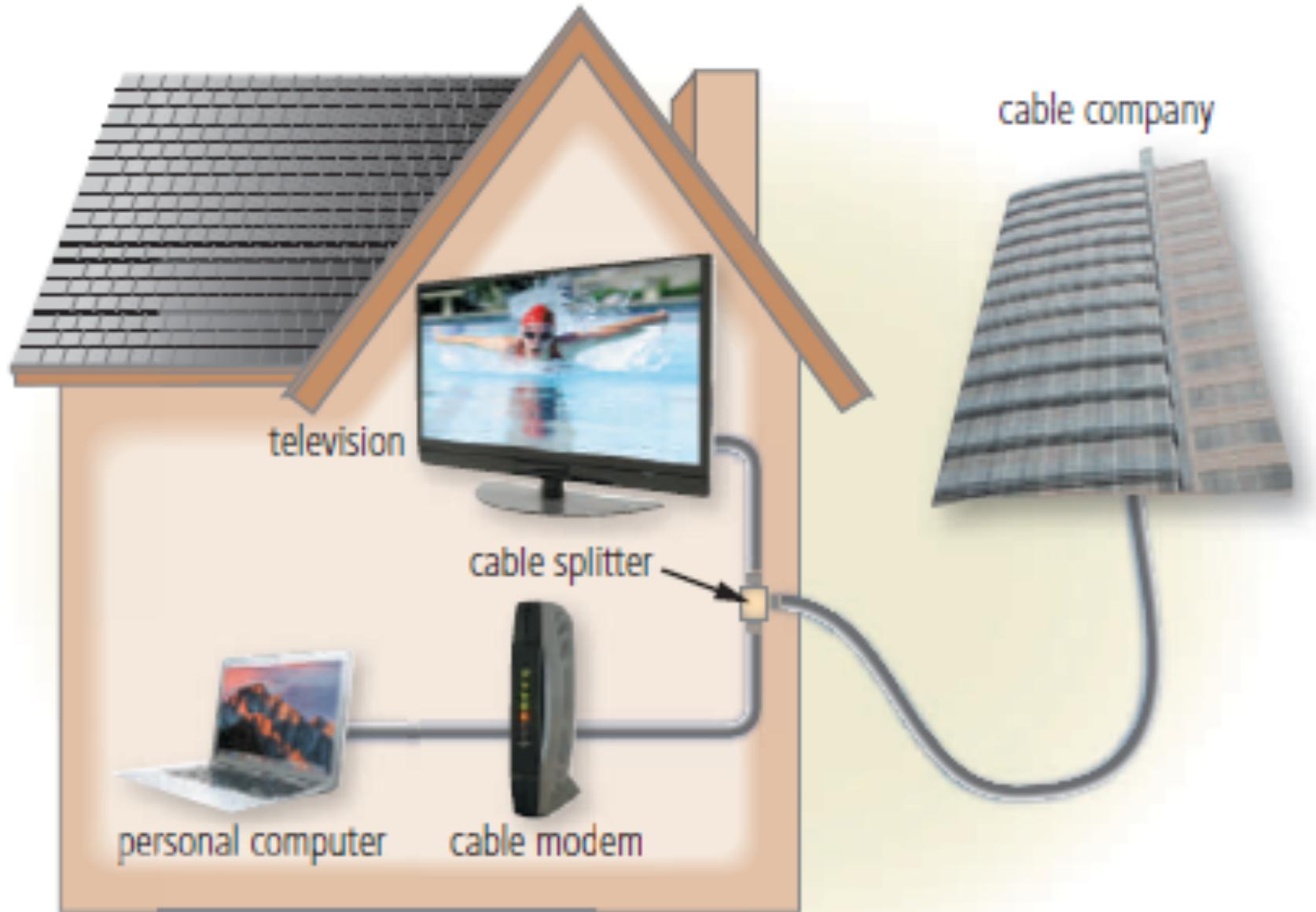
- Asymmetric Digital Subscriber Line (ADSL) is a type of DSL that supports faster downstream rates than upstream rates.



**Figure 10-11** ADSL connections transmit data downstream (receiving) at a much faster rate than upstream (sending).

# Communications Devices (1 of 10)

- A **communications device** is any type of hardware capable of transmitting data, instructions, and information between a sending device and a receiving device
- A broadband modem sends and receives data and information to and from a digital line
  - Cable modem
  - Digital Subscriber Line (DSL) modem



**Figure 10-12** A typical cable modem installation.

- A wireless modem uses a mobile phone provider's network to connect to the Internet wirelessly from a computer or mobile device.

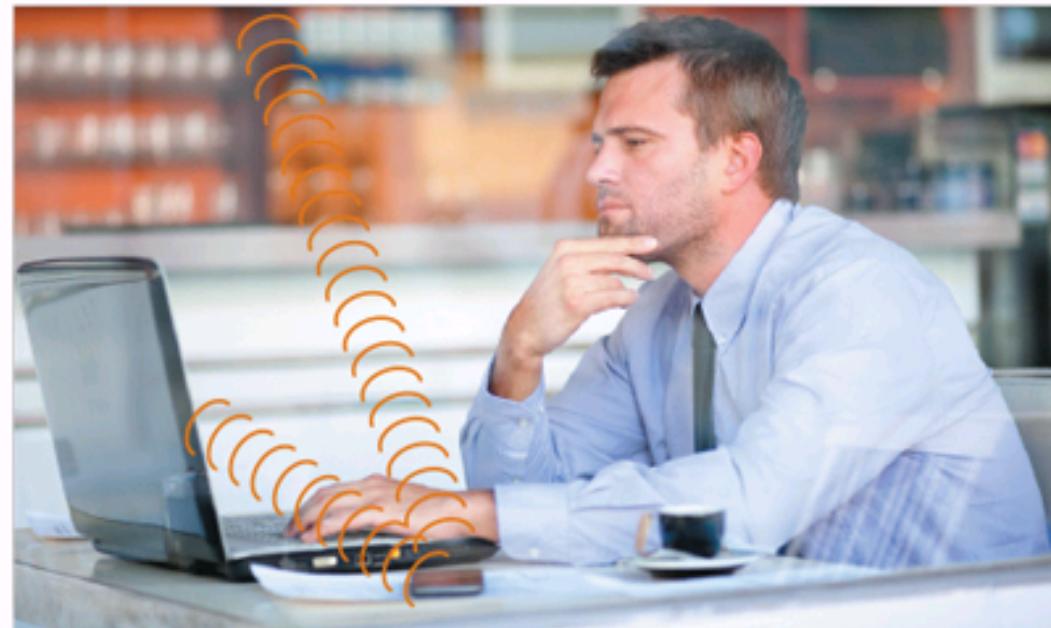


**Figure 10-13** Wireless modems allow users to access the Internet wirelessly using a mobile service provider's network. Some manufacturers refer to the type of wireless modem shown in this figure as a Universal Serial Bus (USB) modem.

4. Connect to the mobile hot spot on a computer or mobile device using the SSID and password displayed in the previous step.
5. When you are finished using the hot spot, disconnect from the wireless network on your computer and disable the hot spot feature on your phone.

## SSID: Service Set Identifier

**Consider This:** How can you determine how much data you are using on your smartphone's data plan?



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- A Wireless Access Point (WAP) is a central communications device that allows computers and devices to transfer data wirelessly among themselves or to a wired network



**Figure 10-14** Wireless access point.

- Purchase a range extender for your wireless router or wireless access point. Some range extenders are compatible only with specific wireless routers or wireless access points, and others are universal. Make sure the range extender you purchase is compatible with your device. Once installed, follow the range extender's instructions to enable it on your network.
- If you still experience problems with the strength of your wireless signal after following the suggestions above, consider replacing your wireless router or wireless access point with a newer model.

**Consider This:** What problems may arise if your wireless network's range extends beyond the confines of your home? How can you determine the range of your wireless network?



Copyright 2013 NETGEAR

- A router connects multiple computers or other routers together and transmits data to its correct destination on a network



**Figure 10-15** Through a router, home and small business networks can share access to a broadband Internet connection, such as through a cable or DSL modem.

# Communications Devices (6 of 10)

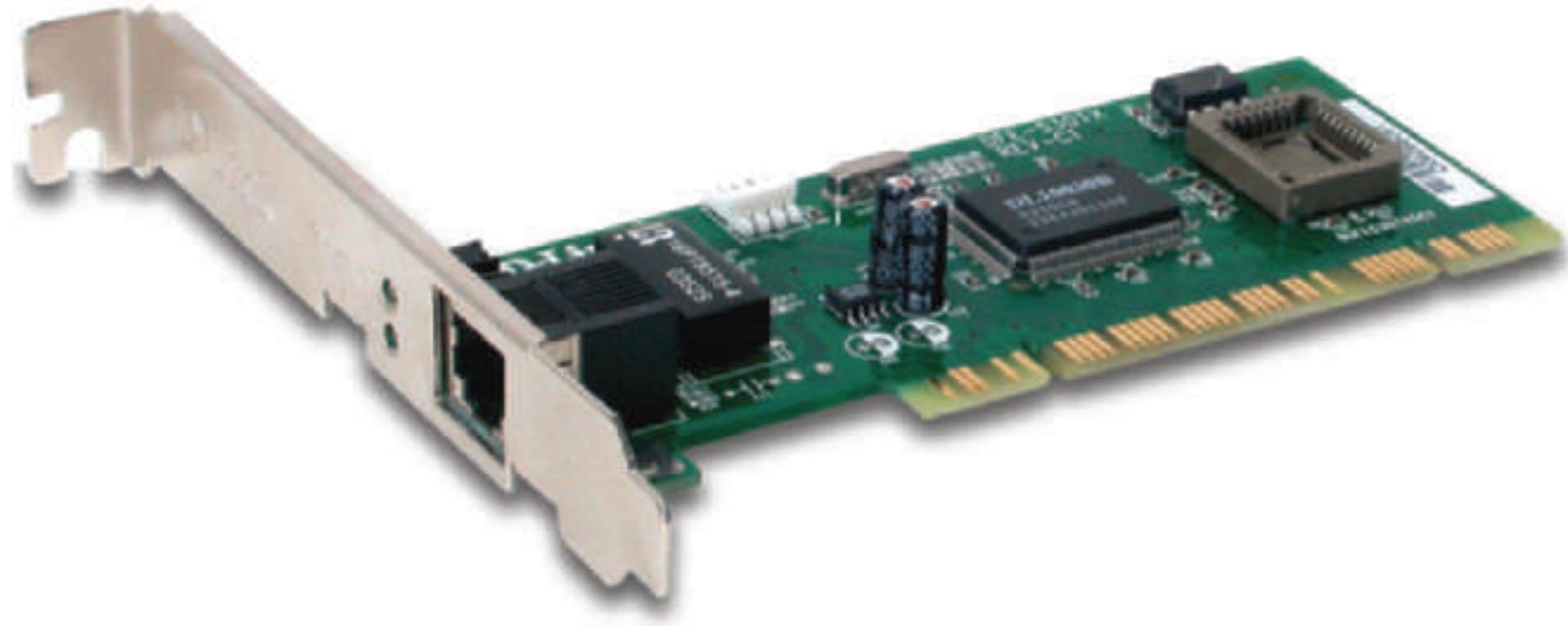
- Some routers provide additional functionality:
  - Wireless router
  - Broadband router
  - Broadband wireless router
  - Mobile broadband wireless router



**Figure 10-16** Through a mobile broadband wireless router, users can create a mobile hot spot via Third Generation (3G) or Fourth Generation (4G) mobile broadband Internet service.

# Communications Devices (8 of 10)

- A network card enables a computer or device that does not have built-in networking capability to access a network
- Available in a variety of styles



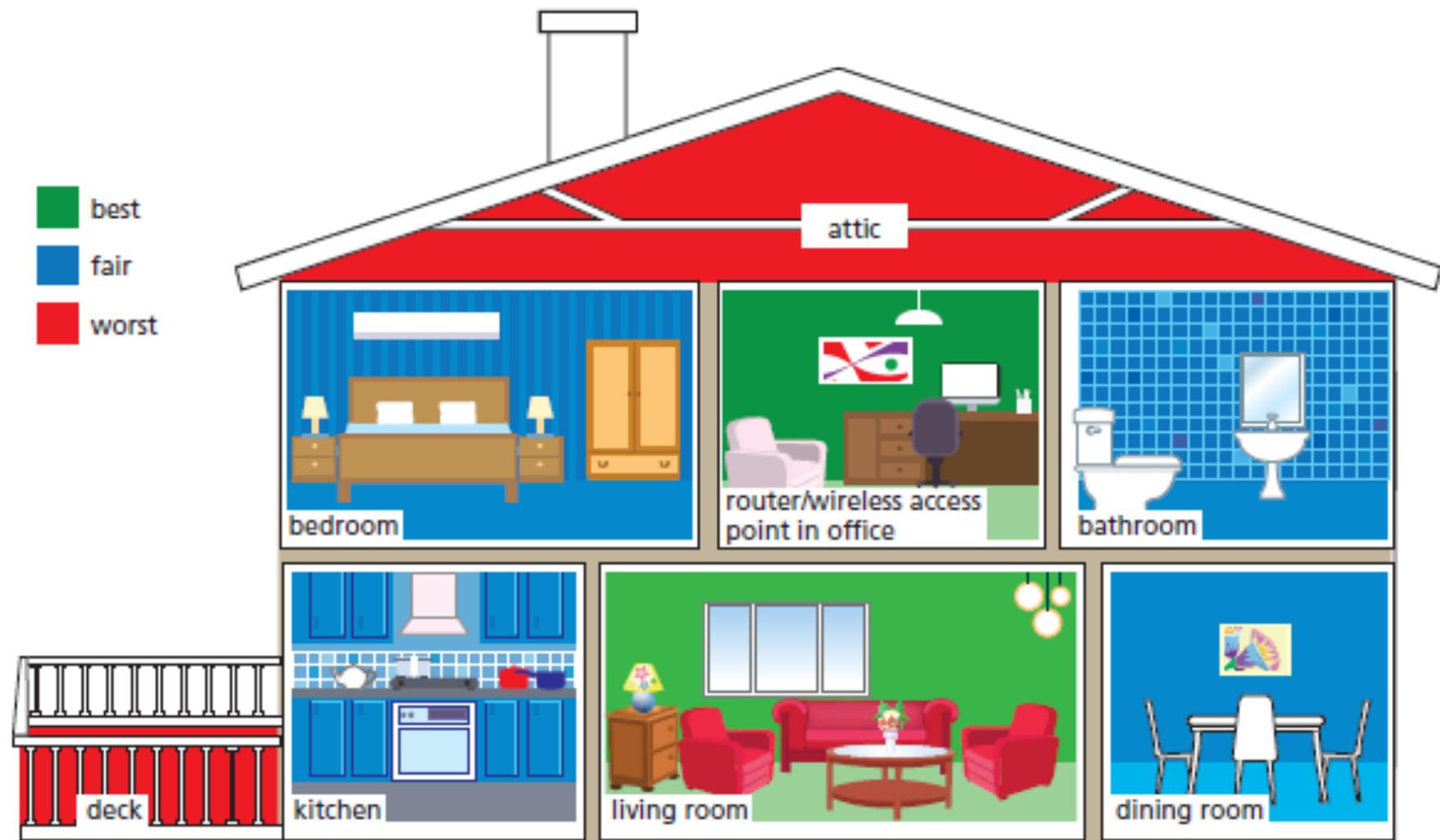
**Figure 10-17** Network card for a desktop computer.

- A hub or switch is a device that provides a central point for cables in a network.



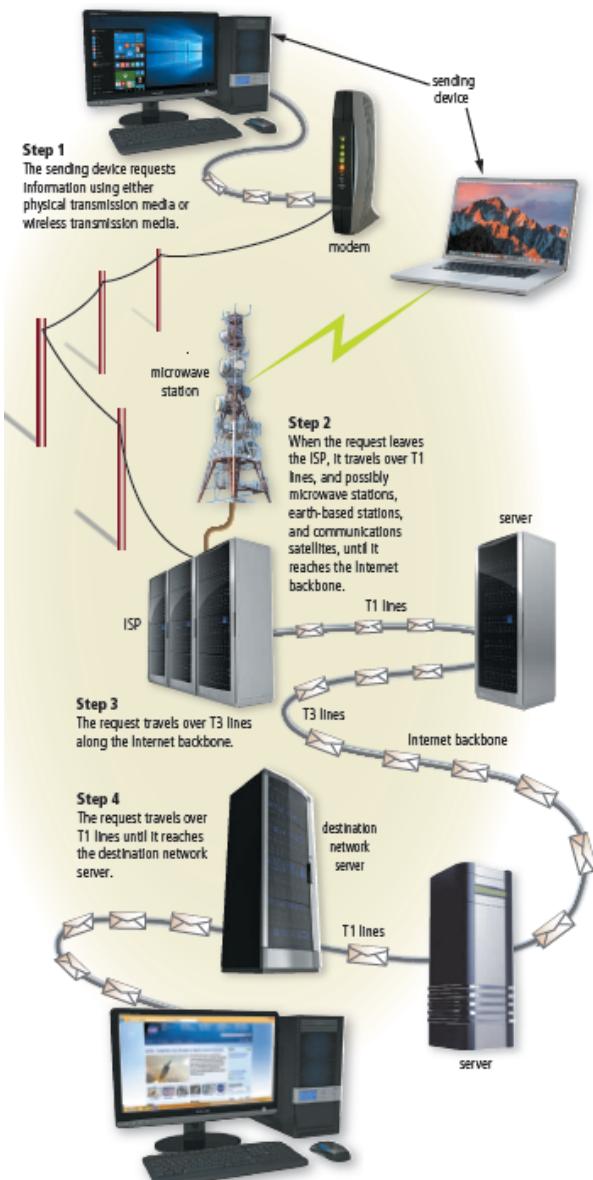
Figure 10-18 A hub or switch is a central point that connects several devices in a network together, as well as connects to other networks, as shown in this simplified diagram.

- Many home users connect multiple computers and devices together in a **home network**



# Transmission Media (1 of 2)

- Transmission media carries one or more communications signals
- **Broadband** media transmit multiple signals simultaneously
- The amount of data, instructions, and information that can travel over transmission media sometimes is called the **bandwidth**
- **Latency** is the time it takes a signal to travel from one location to another on a network



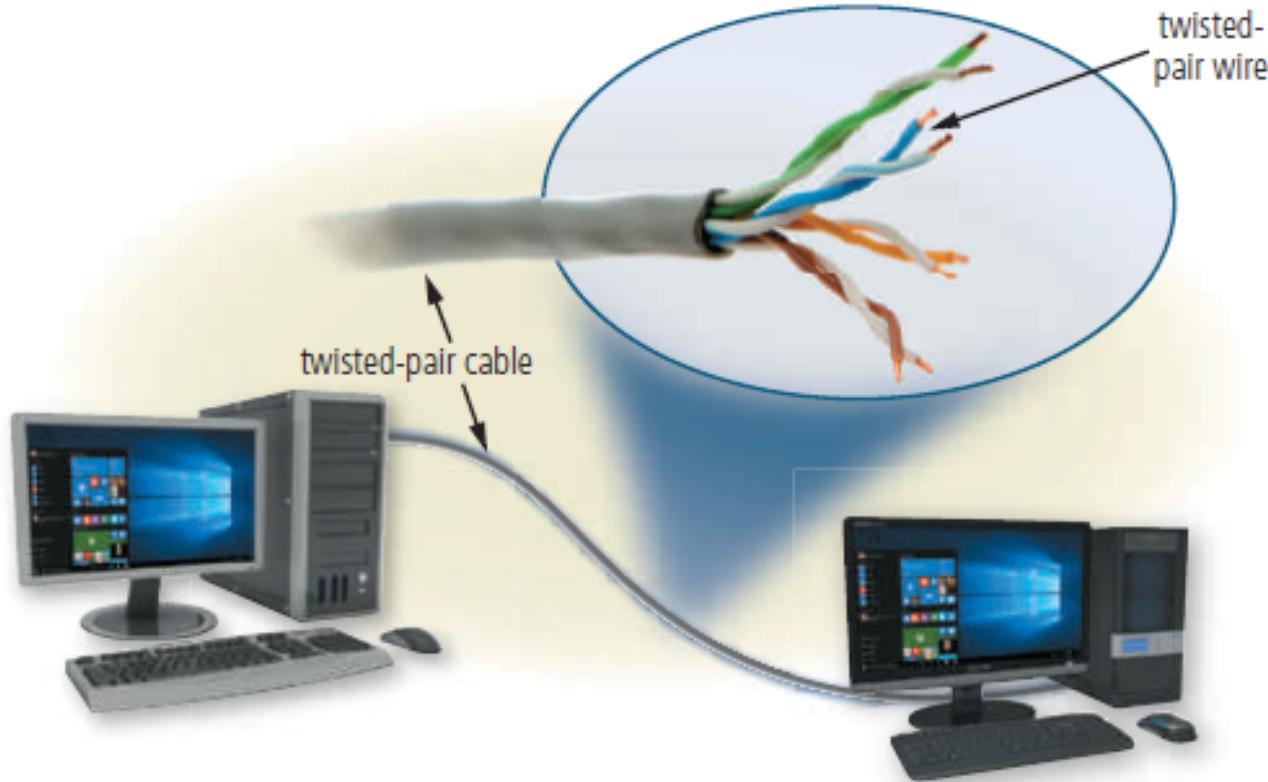
**Figure 10-19** This figure shows a simplified example of sending a request over the Internet using a variety of transmission media.

# Physical Transmission Media (1 of 4)

Table 10-3 Transfer Rates for Physical Transmission Media Used in Local Area Networks (LANs)

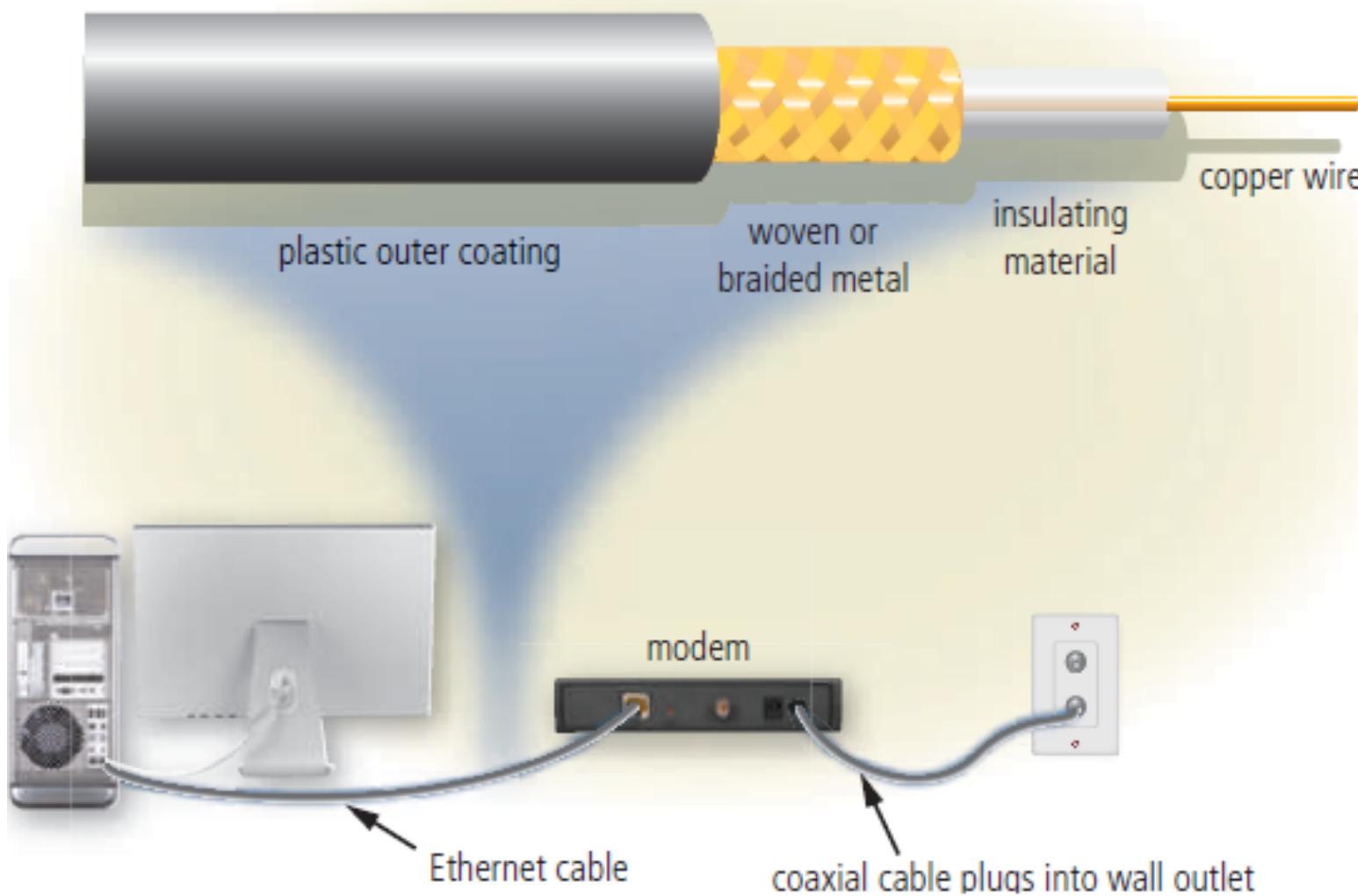
Type of Cable and LAN	Maximum Transfer Rate
<b>Twisted-Pair Cable</b>	
• 10Base-T (Ethernet)	10 Mbps
• 100Base-T (Fast Ethernet)	100 Mbps
• 1000Base-T (Gigabit Ethernet)	1 Gbps
• Token ring	4 Mbps to 16 Mbps
<b>Coaxial Cable</b>	
• 10Base2 (Thin Wire Ethernet)	10 Mbps
• 10Base5 (Thick Wire Ethernet)	10 Mbps
<b>Fiber-Optic Cable</b>	
• 10Base-F (Ethernet)	10 Mbps
• 100Base-FX (Fast Ethernet)	100 Mbps
• FDDI (Fiber Distributed Data Interface) token ring	100 Mbps
• Gigabit Ethernet	1 Gbps
• 10-Gigabit Ethernet	10 Gbps
• 40-Gigabit Ethernet	40 Gbps
• 100-Gigabit Ethernet	100 Gbps

# Twisted-pair cable



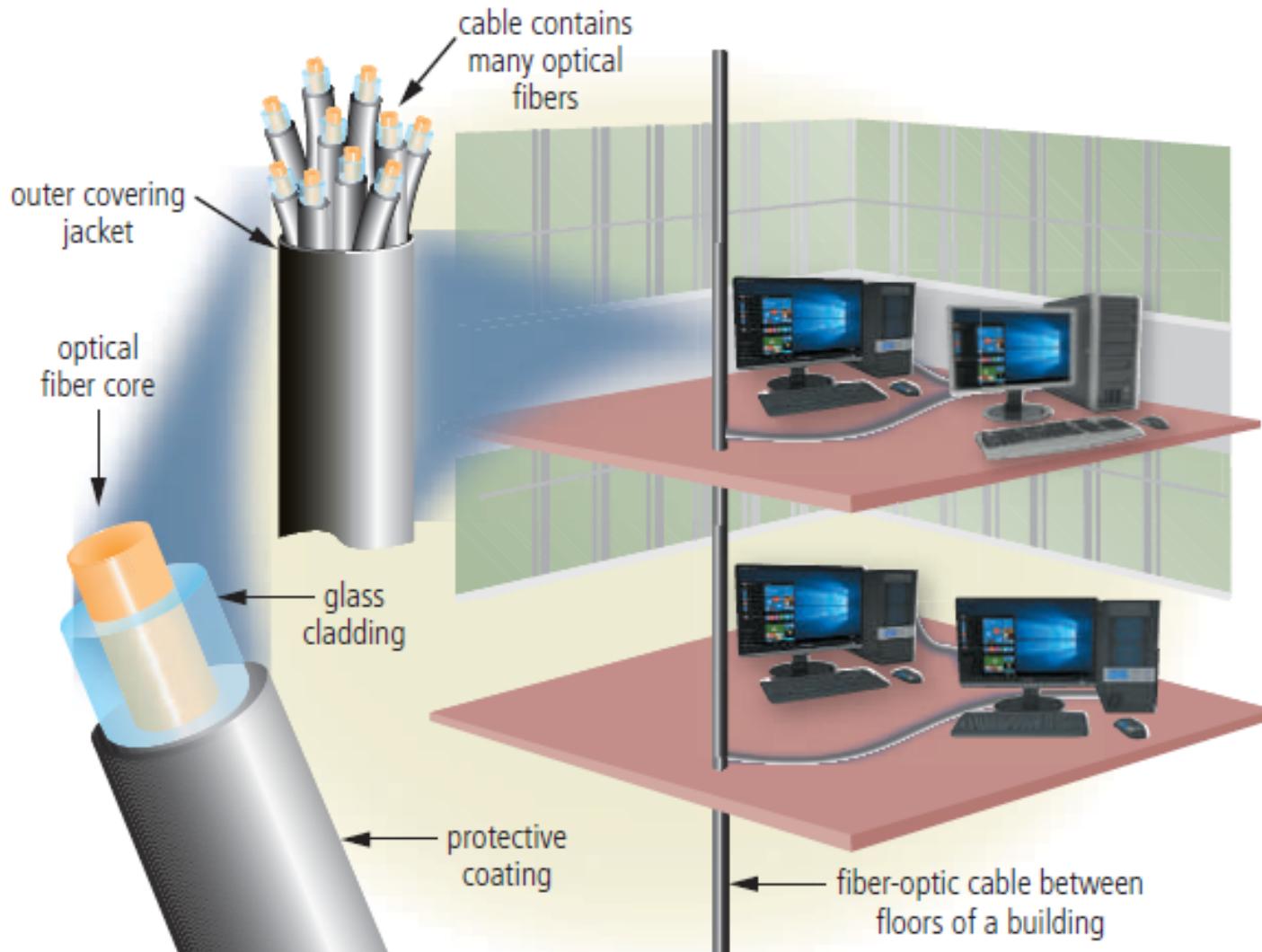
**Figure 10-20** A twisted-pair cable consists of one or more twisted-pair wires. Each twisted-pair wire usually is color coded for identification. Landline phone networks and LANs often use twisted-pair cable.

# Coaxial cable



**Figure 10-21** On coaxial cables, data travels through a copper wire. This simplified illustration shows a computer connected to a modem, which also is connected to the Community Access TeleVision (CATV) network through a coaxial cable.

# Fiber-optic cable



**Figure 10-22** A fiber-optic cable consists of hair-thin strands of glass or plastic that carry data as pulses of light, as shown in this simplified example.

6. Install the printer software on the computer(s) from which you want to print to the wireless printer. During the installation process, you will select the wireless printer that you have connected and configured. If the printer does not appear, return to Step 4 and try connecting the printer to the wireless network again. If the problem persists, consider contacting the printer's manufacturer.
7. Verify the computers are able to print successfully to the wireless printer.

**Consider This:** What are some ways to prevent some computers or mobile devices on your network from printing on your wireless printer?



© iStockphoto / btrenkel; © Cengage Learning

<https://www.youtube.com/watch?v=v8KZVaM3xEQ>

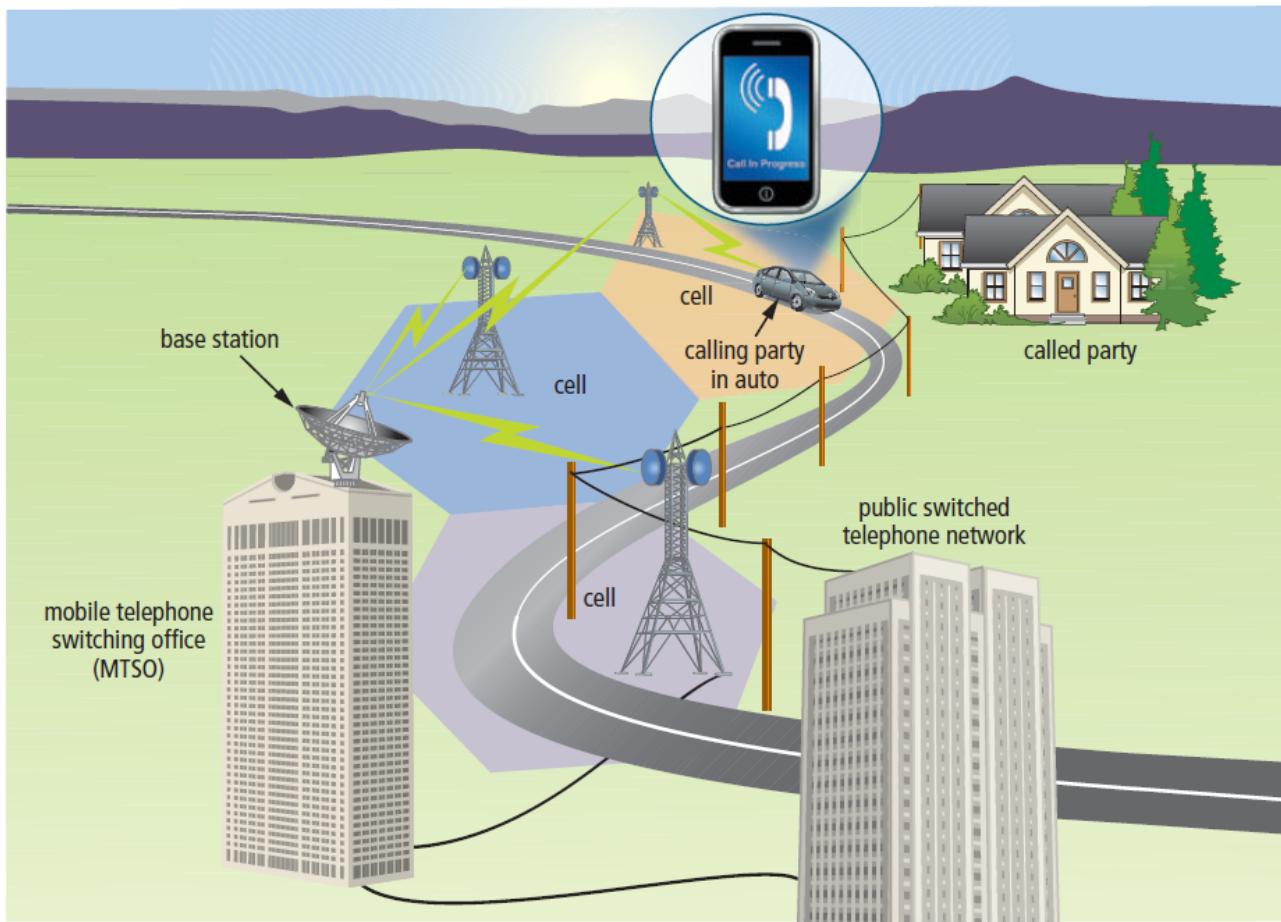


# Wireless Transmission Media (1 of 7)

Table 10-4 Wireless Transmission Media Transfer Rates

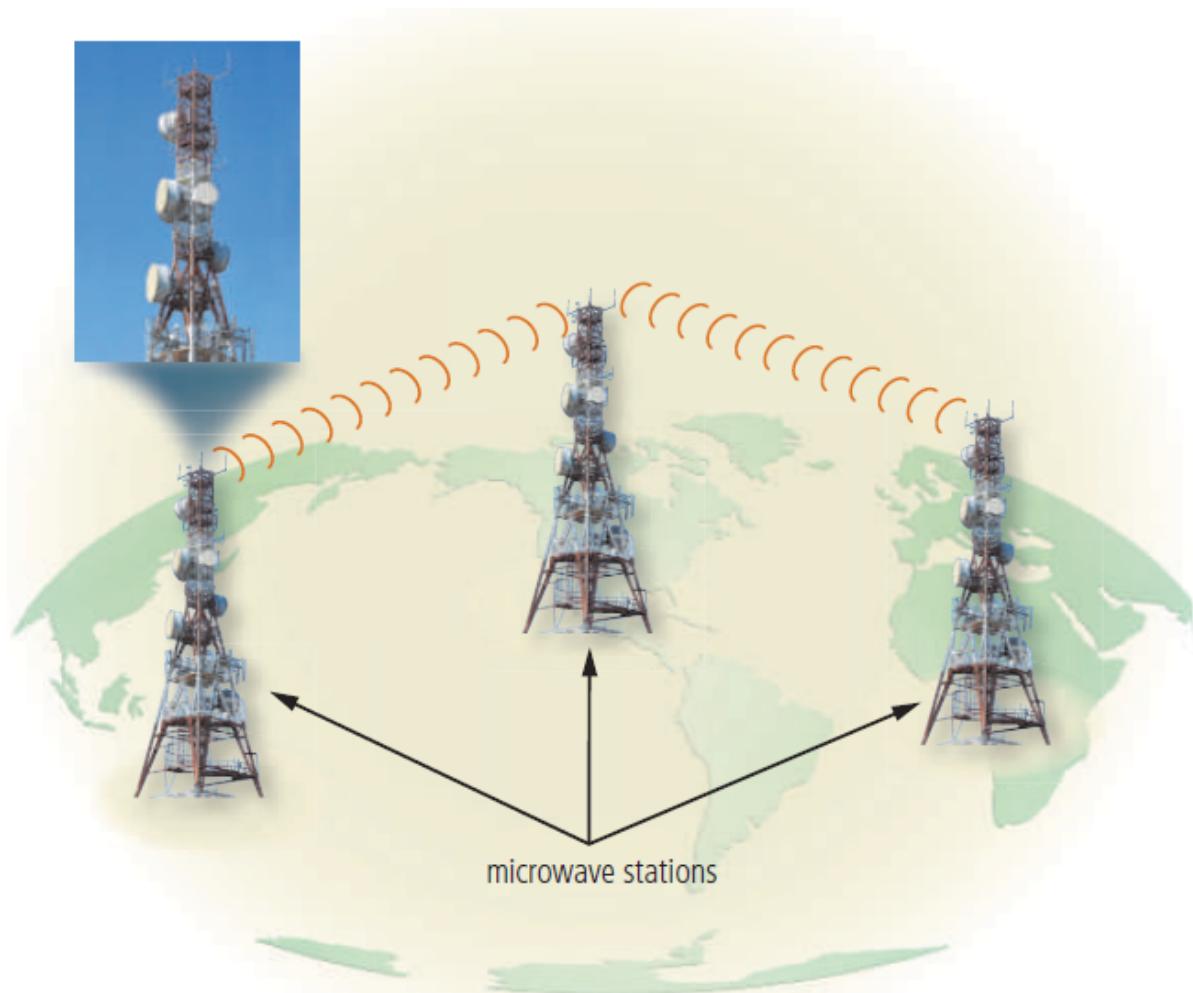
Medium		Maximum Transfer Transmission Rate
Infrared		115 Kbps to 4 Mbps
Broadcast radio	Bluetooth	1 Mbps to 24 Mbps
	802.11b	11 Mbps
	802.11a	54 Mbps
	802.11g	54 Mbps
	802.11n	300 mbps
	802.11ac	500 Mbps to 1 Gbps
	802.11ad	up to 7 Gbps
	UWB	110 Mbps to 480 Mbps
Cellular radio	2G	9.6 Kbps to 144 Kbps
	3G	144 Kbps to 3.84 Mbps
	4G	Up to 100 Mbps
Microwave radio		Up to 10 Gbps
Communications		Up to 2.56 Tbps (Tera bits per second)

- **Broadcast radio** is a wireless transmission medium that distributes radio signals through the air over long distances.
- **Cellular radio** is a form of broadcast radio that is in wide use for mobile communications.



**Figure 10-23** As a person with a mobile phone drives from one cell to another, the radio signals transfer from the base station (microwave station) in one cell to a base station in another cell.

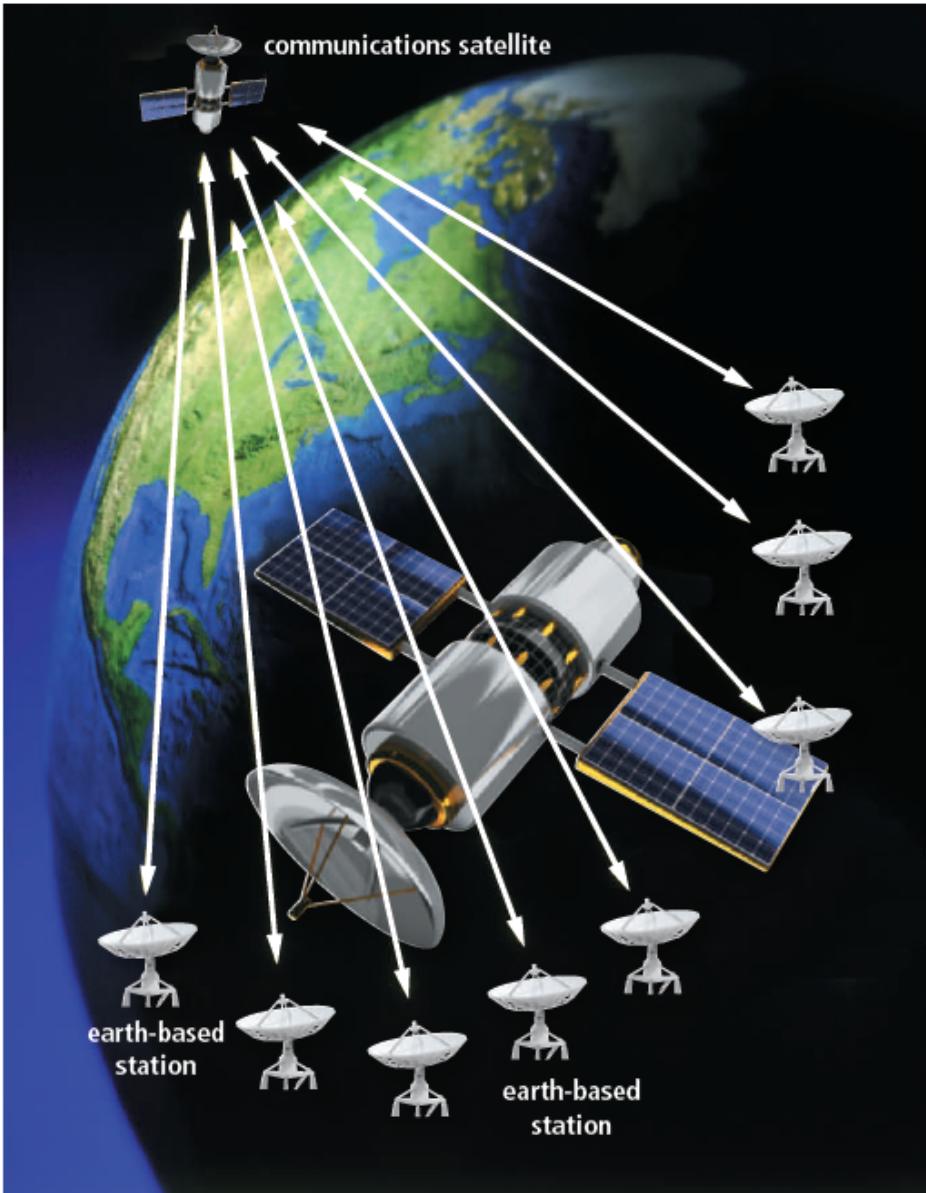
- **Microwaves** are radio waves that provide a high-speed signal transmission.



**Figure 10-24** A microwave station is a ground-based reflective dish that contains the antenna, transceivers, and other equipment necessary for microwave communications.

# Wireless Transmission Media (4 of 7)

- A **communications satellite** is a space station that receives microwave signals from an earth-based station, amplifies it, and broadcasts the signal over a wide area to any number of earth-based stations



**Figure 10-25** Communications satellites are placed about 22,300 miles above the Earth's equator.

# Wireless Transmission Media (6 of 7)

- A **GPS** (Global Positioning System) is a navigation system that consists of one or more earth-based receivers that accept and analyze signals sent by satellites in order to determine the receiver's geographical location.

## How a GPS Works



## Other Examples of GPS Receivers



Figure 10-26 This simplified figure shows how a GPS works.

Until recently, the lack of adequate cellular and wireless network signals in the fields made communications difficult for farmers. Mobile cellular antennas and amplifiers stretch mobile broadband coverage across entire farms, enabling farmers to receive wireless signals up to eight times farther from the cellular tower than they would without the antennas and amplifiers. Wireless access throughout the farm also allows farmers to monitor their farms and communicate with colleagues from remote locations.

The next time you take a bite of a delicious carrot or juicy cucumber, you can appreciate how technology has helped to maintain an ideal environment for these vegetables to grow and protected them from unwanted pests, all for a reasonable price when you purchase them from your local supermarket.

**Consider This:** How else might computers and technology be used in the agriculture industry?

**過去的問題：**因為農田太大，手機和網路訊號很差，農夫很難聯絡或監控狀況

**科技的介入：**安裝「行動天線」和「訊號放大器」

**產生的效果：**訊號覆蓋範圍擴大，傳輸距離增加了**8倍**。農夫可以遠端監控農場、隨時聯絡同事；消費者因為作物生長環境變好（防蟲害），能買到價格合理的美味蔬菜



# Summary

- Networks and communications technologies
- Various types of network architectures and standards and protocols
- Communications software
- Several types of communications lines and communications devices
- How to create a home network
- Variety of physical transmission media and wireless transmission media

# Project due Nov. 16

- Play the game of FreeCell.
  - small number on next larger number and alternating color
  - e.g. Heart Queen on Club King and Spade Jack on Heart Queen
  - goal: to throw all cards to destination pile
  - current smallest number of the suit: can be thrown to destination pile
  - any card can be moved to empty line (stack)
  - any card can be moved to temporary work space (TMP)
- Print every step.
- Your last two digits + 1000 are the game number you have to solve.
- Game #617:
  - HQ → CK, S2 → TMP, SJ → HQ, C10 → DJ, HK → TMP, HK → Line8,
  - SK → TMP, S10 → TMP, SQ → HK, HJ → SQ, S10 → HJ, H4 → TMP,
  - D5 → C6, H9 → S10, C3 → TMP, D9 → C10, C3 throw, S3 → TMP,
  - H4 → Line4, S3 → H4, D4 → TMP, D3 → TMP, D2 → S3, C10 → Line7,
  - H5 → TMP, DJ → CQ, S4 → D5, C4 throw, D3 → S4, CQ → DK,
  - C10 → DJ, S7 → TMP, SK → Line7, HQ → SK, D4 throw, S3 throw,
  - S4 throw, H5 → C6, CK → TMP, C9 → TMP, S9 → TMP, CK → Line4,
  - DQ → CK, CJ → DQ, C7 throw, H6 throw, S8 → H9, H7 → S8,
  - S6 → H7, D6 throw, S8 throw, S9 throw, CQ → Line2, DK → TMP,
  - H10 → TMP, D10 → TMP