Technology in Action

Chapter 5
Networking:
Connecting Computing Devices
Chapter Topics

• Networking Fundamentals
• Network Architectures and Components
• Connecting to the Internet
• Installing and Configuring Home Networks
• Securing Wireless Networks
How Networks Function

- Networking Fundamentals
- Network Architectures and Components
- Connecting to the Internet
Networking Fundamentals

- Computer network
- Node
  - Computer
  - Peripheral
  - Network device
Networking Fundamentals

• Benefits to Networking Computers:
  • Resource sharing
    – High-speed Internet connection
    – Peripheral devices
    – Files
  • Common communications
Networking Fundamentals

Jackie watches a video she took while on vacation

Mom watches a lecture from her online course while she prepares a snack

Andy plays PlayStation online and uploads a video he made for school

Dad watches a streaming movie and checks fantasy football scores on his iPad

Andrea takes pictures of her dog and uploads them directly to Facebook
Networking Fundamentals

• Drawbacks of large networks
  – Purchase of equipment
  – Network administration

• Benefits usually outweigh disadvantages
Networking Fundamentals

• Data transfer rate (bandwidth)
  – Maximum rate of data transfer possible

• Throughput
  – Maximum rate achieved

• Measured in megabits per second (Mbps) or gigabits per second (Gbps)
Network Architectures

• Classified by:
  – Distance between nodes
  – How they are managed
  – Rules used to exchange data between nodes
  – Communications medium used
Network Architectures: Defined by Distance

- Distance between nodes
Network Architectures: Defined by Distance

- **WAN**: Wide Area Network
- **MAN**: Metropolitan Area Network
- **HAN**: Home Area Network
- **LAN**: Local Area Network
- **PAN**: Personal Area Network
Network Architectures: Defined by Level of Administration

- Central Administration
- Local Administration

Client/Server Network

Peer-to-Peer (P2P) Network
Network Architectures: Ethernet Protocols

• Ethernet network
  – Ethernet protocol for communication
  – Developed by the Institute of Electrical and Electronics Engineers (IEEE)
    – 802.3: Wired
    – 802.11: Wireless

• Backward compatibility
Network Architectures: 
Ethernet Protocols

• Gigabit Ethernet Standard
  – Most commonly used wired Ethernet standard for home networks
  – Up to 1 gigabit per second (Gbps) data transfer rate
  – 10 gigabit Ethernet is available, but mostly used for business
Network Components

- Computer
- Printer
- Router
- Tablet
- Networking software running on each computing device
- Network adapter inside each node
- Radio waves
- Network navigation device (used in some networks)
- Transmission media (wireless or wired) connecting nodes
Network Components:
Transmission Media

• Communications channel between nodes
  – Wireless networks
    • Radio waves
  – Wired networks
    • Cables
Network Components: Transmission Media

- UTP cable
- Types of UTP cable
  - Cat 5E
  - Cat 6
  - Cat 6a
Network Components:
Transmission Media

• Decreased throughput in wireless networks
  – Magnetic and electrical sources
  – Other wireless networks
  – Buildings and metal
  – Distance
  – Signal coding
Network can be both wireless and wired
  – Portable devices: wireless
  – Stationary devices: usually wired
Wired connections are faster
Network Components: Basic Network Hardware

- Network adapter
- Network interface card (NIC)
- Broadband Modem
  - Cable or DSL
  - Translates the broadband signal
Network Components:
Basic Network Hardware

• Packets
  – Communication
  – Flow between network nodes
Network Components:
Basic Network Hardware

- Router
- Switch
Network Components:
Network Software

• Operating software for P2P networking
• Client/server network
  – Communicate through centralized server
  – Specialized network operating system (NOS) software
Connecting to the Internet

• Home network
  – Share an Internet connection

• Must purchase Internet access from ISP
  – Specialized providers
  – Companies that provide other services

• Broadband

• Dial-Up
Connecting to the Internet
Broadband Connections

• Broadband
  – High-speed Internet
  – Data transmission rate of 5 Mbps or greater

• Standard broadband technologies
  – Cable
  – Digital subscriber line (DSL)
  – Fiber optic service

• Satellite broadband

• Mobile broadband
Connecting to the Internet: Wired Broadband Connections

- Cable Internet
- DSL (Digital Subscriber Line)
- Fiber optic service

<table>
<thead>
<tr>
<th>Broadband Type</th>
<th>Transmission Medium</th>
<th>Speed Considerations</th>
<th>Average and Maximum Download Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>Coaxial cable, similar to cable TV wire</td>
<td>Cable connections are shared, so speed can drop during high-usage periods</td>
<td>Average speed of 10 Mbps, with maximum of 30 Mbps</td>
</tr>
<tr>
<td>DSL (Digital Subscriber Line)</td>
<td>Copper wire phone line</td>
<td>Speed drops as distance from the main signal source increases</td>
<td>Average speed of 3.7 Mbps, with maximum of 15 Mbps</td>
</tr>
<tr>
<td>Fiber-Optic</td>
<td>Strands of optically pure glass or plastic</td>
<td>Transmits data via light signals, which do not degrade over long distances</td>
<td>Average speed of 50 Mbps, with maximum of 500 Mbps</td>
</tr>
</tbody>
</table>
Connecting to the Internet:
Wired Broadband Connections

• Satellite Internet
Connecting to the Internet: Wireless Internet Access

• Wireless Internet at home
  – Router with wireless capabilities
  – Built in WiFi on devices
  • Laptops, smartphones, game systems, and personal media players
Connecting to the Internet: Wireless Internet Access

- WiFi hotspot
- Wireless in-flight Internet
  - Gogo
- Mobile broadband
  - 3G or 4G
Connecting to the Internet:

Wireless Internet Access

• Mobile Broadband 3G
  – 3 Mbps

• 4G from a fixed location
  – 1 Gbps

• 4G LTE
  – Support less than 1 Gbps
Connecting to the Internet:
Dial-Up Connections

• High-speed
  – 70% of Internet users

• Dial-up connection
  – No high-speed service available
  – Least costly
  – Slow speed
Check Your Understanding

1. What is a network, and what are a network’s advantages and disadvantages?

A computer network is simply two or more computers that are connected using software and hardware so they can communicate. Advantages of networks include allowing users to:

• Share an Internet connection
• Share printers and other peripheral devices
• Share files
• Communicate with computers regardless of their operating system

Disadvantages for larger networks are that they require administration and that they may require costly equipment.
2. What are the different ways to classify networks?

Networks can be defined by the distance between nodes: (1) A personal area network (PAN) is used for communication among personal mobile devices using Bluetooth or WiFi wireless technologies. (2) A local area network (LAN) connects nodes that are located in a small geographic area. (3) A home area network (HAN) is a specific type of LAN located in a home. (4) A metropolitan area network (MAN) is a large network in a specific geographic area. (5) A wide area network (WAN) spans a large physical distance.

Networks are classified by administration: (1) Central: A client/server network contains two types of computers: a client computer on which users perform specific tasks and a server computer that provides resources to the clients and central control for the network. Most networks that have 10 or more nodes are client/server networks. (2) Local: Peer-to-peer (P2P) networks enable each node connected to the network to communicate directly with every other node. Most home networks are P2P networks.
3. Which type of network is most commonly found in the home?

Ethernet networks are the most common networks used in home networking. Most Ethernet networks use a combination of wired and wireless connections, depending on the data throughput required. Wired connections usually achieve higher throughput than wireless connections. Wired Ethernet home networks use the gigabit Ethernet standard. Wireless Ethernet networks are identified by a protocol standard: 802.11 a/b/g/n/ac.

- 802.11ac is the newest standard.
- WiGig (802.11ad) is a new wireless link between devices.
- WiGig is similar to but faster than Bluetooth.
Check Your Understanding

4. What are the main components of every network?

To function, any network must contain a number of components: (1) a means of connecting the nodes on the network (cables or wireless technology); (2) special hardware devices that allow the nodes to communicate with each other and to send data; (3) software that allows the network to run.
5. What are my options for connecting to the Internet?

Wired networks use various types of cable to connect nodes. The type of network and the distance between the nodes determines the type of cable used. Broadband connections include the following types: (1) Cable transmits data over coaxial cable that is also used for cable television. (2) DSL uses twisted-pair wire, similar to that used for telephones. (3) Fiber optic cable uses glass or plastic strands to transmit data via light signals. (4) Satellite is a connection option for those who do not have access to faster broadband technologies. Data is transmitted between a satellite dish and a satellite that is in a geosynchronous orbit. (5) WiFi allows users to connect to the Internet wirelessly but is not as fast as a wired connection. (6) Mobile broadband is a 3G or 4G service delivered by cell-phone networks. Dial-up is the cheapest means of accessing the Internet, but it is also the slowest.
Your Home Network

• Installing and Configuring Home Networks
• Securing Wireless Networks
• Devices Connecting to Home networks
  – Smartphones
  – Gaming consoles
  – Tablets
  – Smart TVs
  – Computers
  – Printers
• Setting up a home network
  – Evaluate your devices
  – Use the latest wireless Ethernet standard
    • Current Ethernet standard: 802.11ac
Installing and Configuring Home Networks:
Planning Your Home Network
• Device Manager
Installing and Configuring Home Networks:
Connecting Devices to a Router
Installing and Configuring Home Networks:
Connecting Devices to a Router

• All 802.11n routers should work with Windows or OS X
• Routers for Apple computers
  – AirPort Extreme router
  – Windows machines can also connect
Installing and Configuring Home Networks: Connecting Devices to a Router
# Connecting Devices to a Router

<table>
<thead>
<tr>
<th>PC Name</th>
<th>Connection Type</th>
<th>IP Address</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPhone</td>
<td>Wireless</td>
<td>192.168.1.6</td>
<td>Active</td>
</tr>
<tr>
<td>MaryAnne_PC</td>
<td>Ethernet</td>
<td>192.168.1.7</td>
<td>Active</td>
</tr>
<tr>
<td>TIVO-74800019037AC64</td>
<td>Wireless</td>
<td>192.168.1.2</td>
<td>Active</td>
</tr>
<tr>
<td>Ted_iPad</td>
<td>Wireless</td>
<td>192.168.1.3</td>
<td>Active</td>
</tr>
<tr>
<td>MaryAnne_Laptop</td>
<td>Wireless</td>
<td>192.168.1.8</td>
<td>Inactive</td>
</tr>
<tr>
<td>Enabled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mary-Anne-GVH_iPad</td>
<td>Wireless</td>
<td>192.168.1.4</td>
<td>Active</td>
</tr>
</tbody>
</table>
Installing and Configuring Home Networks: Network-Attached Storage Devices

- NAS devices
- Time Capsule
• Home network server
• Configured with Windows Home Server
• Connect directly as a node
Installing and Configuring Home Networks: Digital Entertainment Devices on a Network

- Network-ready devices
  - Wired or wireless connection
  - Blu-ray players, DVRs, and smart TVs
- Connecting entertainment
  - Access and share digital data
  - Access Internet entertainment content
  - Play multiplayer games
Installing and Configuring Home Networks: Digital Entertainment Devices on a Network

- Blu-ray players
  - Integrated wireless
- LG Smart TV Upgrader
- Apple TV
- Google Chromecast
Installing and Configuring Home Networks: Digital Entertainment Devices on a Network

• TiVo Premiere
• PlayStation 4
Installing and Configuring Home Networks: Specialized Home-Networking Devices

• New digital picture frames
  – Built-in wireless
  – Access network and online photos
  – Receive pictures via e-mail

• Security
  – Wireless monitoring cameras
Installing and Configuring Home Networks: Configuring Software for Your Home Network

• Before configuring your home network
  – Make sure all nodes have network adapters
  – Check wired connections
  – Connect the modem to the router and to the Internet
  – Turn on your equipment
  – Open the Network and Sharing Center
Installing and Configuring Home Networks: Configuring Software for Your Home Network

Networks panel opens to display network options.

Checkbox for automatic connection to WiFi after initial connection.

Click Connect to a network.
Installing and Configuring Home Networks: Configuring Software for Your Home Network

- Homegroup

Creating a Homegroup in Windows 8

Creating a Homegroup in Windows 8

Step 1: Click Create a homegroup in the HomeGroup window.

Step 2: Choose the sharing options for computers that belong to the homegroup. You can choose to share pictures, music, videos, documents, and printers with other Windows computers that belong to the homegroup. Although these are global settings, this is only shared with other homegroup members.

Step 3: Windows generates a password. All other computers added to the network will need this password to join the homegroup. Once you've created the homegroup on the first computer, it will belong to that homegroup. You can then begin connecting other Windows computers to the network and join them to the homegroup you created.

Password: Ue2R1Ur3s
Installing and Configuring Home Networks: Configuring Software for Your Home Network

- Computers with various versions of Windows can coexist on same network
- Connecting mobile devices to a wireless network
  - NIC detects available networks
Installing and Configuring Home Networks: Troubleshooting Wireless Network Problems

- Maximum range of 802.11n or 801.11ac is 350 feet
  - Dual-band N router
    - Simultaneous support for both 2.4 GHz and 5 GHz
  - Wireless range extender
Securing Wireless Networks

• Secure computers connected to Internet
  – Firewall

• Wireless networks have special vulnerabilities
Securing Wireless Networks

- Wired networks are more secure
- Wireless networks can extend beyond the walls of a residence
  - Piggybacking
Securing Wireless Networks

• Precautions to secure a wireless network
  – Change your network name (SSID)
  – Disable SSID broadcast
  – Change the default password on your router
  – Turn on security protocols
Securing Wireless Networks

• Precautions to secure a wireless network
  – Create a passphrase
  – Implement media access control
  – Limit your signal range
  – Apply firmware upgrades
## Securing Wireless Networks

### Wireless Status

<table>
<thead>
<tr>
<th>Security Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Enabled</td>
<td>Yes</td>
</tr>
<tr>
<td>SSID</td>
<td>GMV05</td>
</tr>
<tr>
<td>Channel</td>
<td>Automatic</td>
</tr>
<tr>
<td>Security Enabled</td>
<td>Yes</td>
</tr>
<tr>
<td>WEP 64-bit</td>
<td>Yes, N/A</td>
</tr>
<tr>
<td>WEP 802.1x</td>
<td>N/A</td>
</tr>
<tr>
<td>WPA</td>
<td>1063$Y79UedsV#ag421L$t641</td>
</tr>
<tr>
<td>SSID Broadcast</td>
<td>Enabled</td>
</tr>
<tr>
<td>MAC Authentication</td>
<td>Disabled</td>
</tr>
<tr>
<td>Wireless Mode</td>
<td>Mixed acceptor</td>
</tr>
<tr>
<td>Received Packets</td>
<td>27098228</td>
</tr>
<tr>
<td>Sent Packets</td>
<td>32954062</td>
</tr>
</tbody>
</table>

- **Unique SSID name**: Create a hard to guess passphrase for extra protection.
- **Security protocol in use**: Select the appropriate security protocol for use.
- **Disable for extra protection**: Consider disabling certain features for enhanced security.
Check Your Understanding

6. How do I tell if my home network is up to date, and how do I identify the devices on the network?

Most home network routers should support both wireless and wired access to the Internet. For a home network to run efficiently, all nodes such as NICs and routers should use the same Ethernet standard. The Device Manager utility in Windows lists all adapters installed on your computer.
7. Besides computers, what other devices can I connect to a home network?

All devices are connected to your router, either wirelessly or with a wired connection. Wired connections deliver better throughput than wireless. To add ports to your network, you can connect a switch to your router. Network-attached storage (NAS) devices let you store and share data files such as movies and music, as well as provide a central place for file backups. Home network servers can be used instead of an NAS device if your needs require more sophisticated functionality than NAS devices. Connecting digital entertainment devices (such as gaming consoles) lets you stream movies and other entertainment directly from the Internet.
8. How do I configure the software on my computer and set up the devices required to get my network up and running?

All devices are connected to your router, either wirelessly or with a wired connection. Wired connections deliver better throughput than wireless. To add ports to your network, you can connect a switch to your router. Network-attached storage (NAS) devices let you store and share data files such as movies and music, as well as provide a central place for file backups. Home network servers can be used instead of an NAS device if your needs require more sophisticated functionality than NAS devices. Connecting digital entertainment devices (such as gaming consoles) lets you stream movies and other entertainment directly from the Internet.
9. What problems might I encounter when setting up a wireless network?

You may not get the throughput you need through a wireless connection. Therefore, you may need to consider a wired connection for certain devices. Distance from the router, as well as walls, floors, and large metal objects between a device and the router, can interfere with wireless connectivity. To solve connectivity problems, dual-band N routers allow for simultaneous support for devices running on both the 2.4 GHz and 5 GHz frequency bands for 802.11n standards. Wireless range extenders can amplify signals to improve connectivity in areas of poor signal strength.
10. Why are wireless networks more vulnerable to security risks than wired networks, and what special precautions are required to ensure my wireless network is secure?

Wireless networks are even more susceptible to hacking than wired networks because the signals of most wireless networks extend beyond the walls of your home. Neighbors may unintentionally (or intentionally) connect to the Internet through your wireless connection, and hackers may try to access it. To prevent unwanted intrusions into your network, you should change the default password on your router to make it tougher for hackers to gain access, use a hard-to-guess SSID (network name), disable SSID broadcasting to make it harder for outsiders to detect your network, enable security protocols such as WPA or WEP, create a network passphrase, implement media access control, limit your signal range, and apply firmware upgrades.