

Wireless Technologies

COMP476

Multiple Standards and Services

- There are many wireless systems that differ in
 - Data rate
 - Range
 - Frequency
 - Ability to penetrate barriers
 - Cost
- The federal government licenses and regulates the use of the radio spectrum

Taxonomy of Wireless Networks

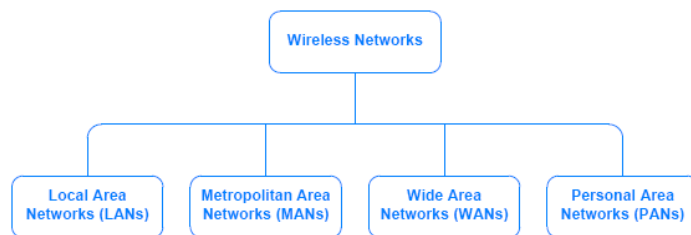
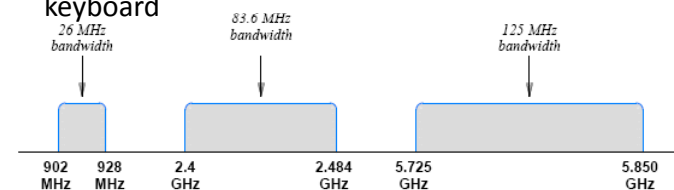


Figure 16.1 A taxonomy of wireless networking technologies.

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Personal Area Networks (PANs)

- A PAN technology provides communication over a short distance
- It is intended for use with devices that are owned and operated by a single user. For example
 - between a wireless headset and a cell phone
 - between a computer and a nearby wireless mouse or keyboard



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- Wireless protocol utilizing short-range communications technology
- 2.4 GHz short-range radio frequency
- 3 Mbits/second

Class	Maximum Power	Range (approximate)
Class 1	100 mW	~100 meters
Class 2	2.5 mW	~10 meters
Class 3	1 mW	~1 meter

Wireless Sensor Networks



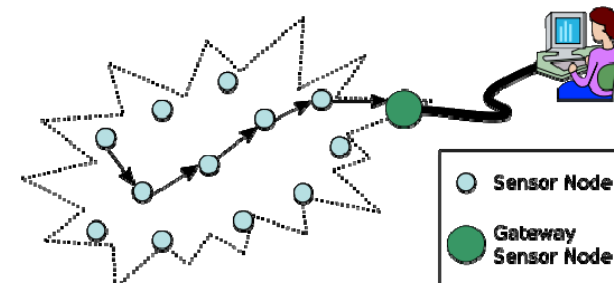
- Small sensors contain
 - Processor
 - Memory
 - Wireless communication
 - Battery
- There are several sensor programming systems
- Sensors can include light, temperature, motion and almost anything else

Sample Applications

- Detect forest fires
- Building environment monitoring
- Detect troop movement
- Farm soil monitoring
- Supply chain management
- Pollution monitoring

Ad Hoc Networks

- Sensor networks frequently communicate by forwarding messages to other nearby sensors



Batteries Not Included

- Wireless sensors run on batteries.
- Batteries (especially small batteries) have limited power and life span.
- About 1000 times more power is usually spent in communication than computation.

ZigBee

- ZigBee is a low-cost, low-power, wireless mesh networking standard
- Based on the IEEE 802.15.4-2006 standard
- Intended to be simpler and cheaper than other WPANs such as Bluetooth
- Uses 902-928 MHz in North America at 20 Kbits/sec
- Uses 2.4 GHz at 250 Kbits/sec

RFID

- An RFID chip replies with its ID information when requested by a reader
- Passive RFID chips contain no battery and get their power from their antenna
- Active RFID chips have batteries which gives them greater range and ability to penetrate



Wireless LAN

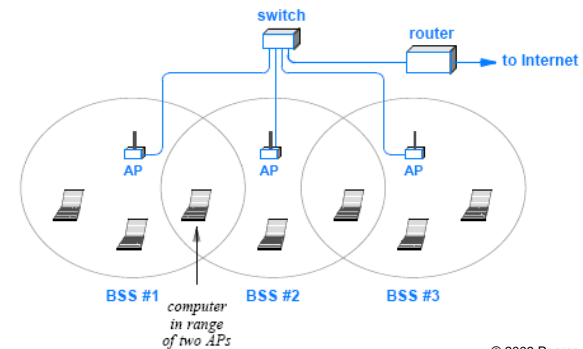
- Wireless LANs are defined by the IEEE 802.11 standards
- They are often referred to as WiFi
- Wireless LANs usually connect to an access point although they can connect in ad hoc networks

IEEE 802.11 Standards

std	Introduced	Data Rate (Mb/s)	Distance (feet)
-	June 1997		66
a	Sept 1999	6 to 54	115
b	Sept 1999	5.5 and 11	125
g	June 2003	22 and 54	125
n	Oct 2009	15 to 150	230

Access Points

- Computers can be in the range of one or more access points
- There can be dead zones with no coverage



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Cellular Communication Systems

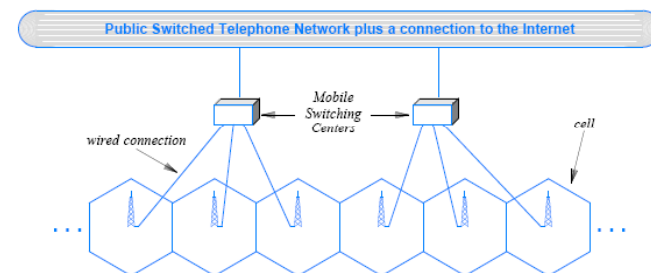
- Cellular systems were originally designed to provide voice services to mobile customers
- Currently, cellular systems are being used to provide data services and Internet connectivity
- In terms of architecture
 - each cell contains a tower
 - a group of (usually adjacent) cells is connected to a Mobile Switching Center (MSC)
- The center tracks a mobile user and manages handoff as the user passes from one cell to another.



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Cellular Communication Systems

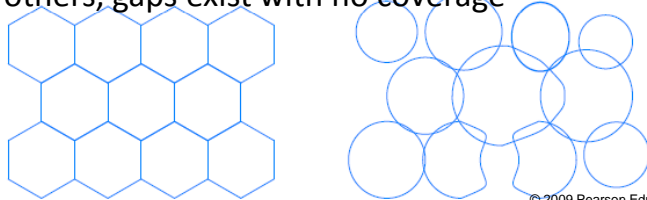
The center tracks a mobile user and manages handoff as the user passes from one cell to another.



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Cells

- Perfect cellular coverage occurs if each cell is a hexagon
- Most cell towers use omnidirectional antennas that transmit in a circular pattern
- Obstructions and electrical interference can attenuate a signal or cause an irregular pattern. In some cases, cells overlap and in others, gaps exist with no coverage



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Generations of Cellular Technologies

Telecommunications industry divides cellular technologies into four generations

- 1G
 - Began in the late 1970s, and extended through 1980s
 - Originally called cellular mobile radio telephones used analog signals to carry voice
- 2G and 2.5G
 - Began in the early 1990s and continues to be used
 - The main distinction between 1G and 2G arises because 2G uses digital signals to carry voice
 - The label 2.5G is used for systems that extend a 2G system to include some 3G features

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Generations of Cellular Technologies

- 3G and 3.5G
 - Began in the 2000s
 - Focuses on the addition of higher-speed data services
 - A 3G system offers download rates of 400 Kbps to 2 Mbps, and is intended to support applications such as web browsing and photo sharing
 - 3G allows a single telephone to roam across the world
- 4G
 - Began around 2008
 - Focuses on support for real-time multimedia such as a television program or high-speed video
 - They include multiple connection technologies at any time, the phone automatically chooses the best connection technology available

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Global Positioning System

- Global Positioning System (GPS) provides accurate time and location information
- Location information is increasingly used in mobile networking, location-based services
- The key features are:
 - Accuracy between 2-20 meters
 - (military ones have higher accuracy)
 - 24 total satellites orbit the earth
 - Satellites arranged in 6 orbital planes

