

# Wireless# Guide to Wireless Communications

*Chapter 1*  
*Introduction to Wireless Communications*  
Jorge Olenewa – [jolenewa@georgebrown.ca](mailto:jolenewa@georgebrown.ca)  
Office: E425 ext. 6809

## Objectives

- Explain how the major wireless technologies are used today
- Describe various applications of wireless communications technology
- Explain the advantages and disadvantages of wireless communications technology
- List several different wireless technologies

## How Wireless Technology is Used

- **Wireless**
  - Describes devices and technologies that are not connected by a wire
- **Wireless communications**
  - Transmission of user data without the use of wires
- **Wireless data communications technologies include:**
  - Bluetooth
  - Wireless LAN and WAN
  - Satellite
  - Cellular
  - WiMedia, ZigBee, WiMax

## A Wireless World

- **Wireless LAN devices**
  - Distance: 300 feet (90 meters)
  - Bandwidth: 54 Mbps
  - Can also include Voice over IP (VoIP)
- **Wireless network interface card (Wireless NIC)**
  - Sends and receives data over radio waves
- **Smartphone**
  - Combination mobile phone and personal digital assistant (PDA)

## A Wireless World (continued)

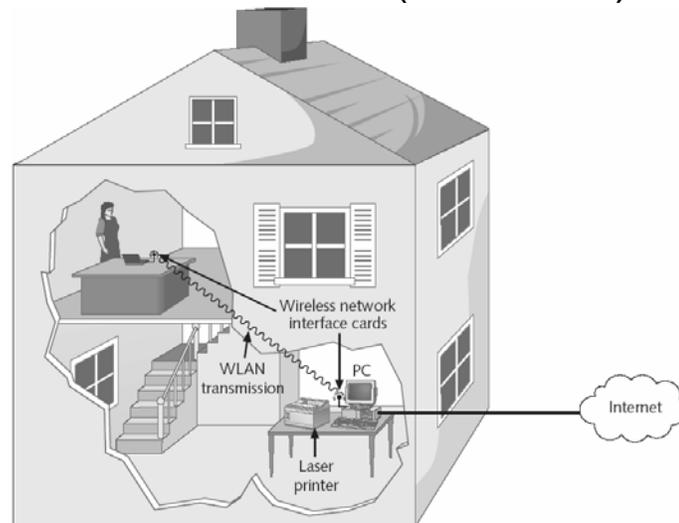


Figure 1-1 Home wireless network (WLAN)

Wireless# Guide to Wireless Communications - Jorge Olenewa

5 of 54

## Bluetooth and Ultra Wide Band

- Radio frequency identification device (RFID) tags
  - Small chips containing radio transponders
    - Can be used to track inventory
- Bluetooth and Ultra Wide Band (UWB)
  - Wireless standards designed for very short ranges
  - Communicate using small, low-power transceivers
- Link manager
  - Special software that helps identify other Bluetooth devices

Wireless# Guide to Wireless Communications - Jorge Olenewa

6 of 54

## Bluetooth and Ultra Wide Band (continued)



Figure 1-2 A Bluetooth headset

Wireless# Guide to Wireless Communications - Jorge Olenewa

7 of 54

## Bluetooth and Ultra Wide Band (continued)

- Bluetooth
  - Distance: up to 33 feet (10 meters)
  - Bandwidth: 1 Mbps
- Ultra Wide Band
  - Distance: 150 feet (50 meters)
  - Bandwidth: 100 Mbps to 2 Gbps
- Piconet
  - Wireless personal area network (WPAN)
  - Consists of two or more Bluetooth devices that are exchanging data with each other

Wireless# Guide to Wireless Communications - Jorge Olenewa

8 of 54

## Bluetooth and Ultra Wide Band (continued)



Figure 1-3 Bluetooth network (piconet) or WPAN

## Satellite Networks

- Used to transmit data over very long distance
- Repeater
  - Located in the satellite itself
  - Simply “repeats” the same signal to another location
  - Used to transmit data from one earth station to another
    - Transmission time is approximately 250 milliseconds

## Satellite Networks (continued)

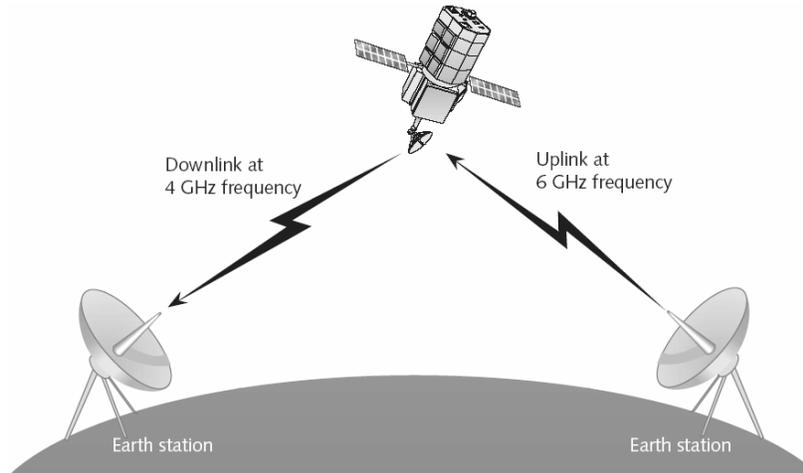


Figure 1-4 A satellite repeats a signal to another Earth station

Wireless# Guide to Wireless Communications - Jorge Olenewa

11 of 54

## Satellite Networks (continued)

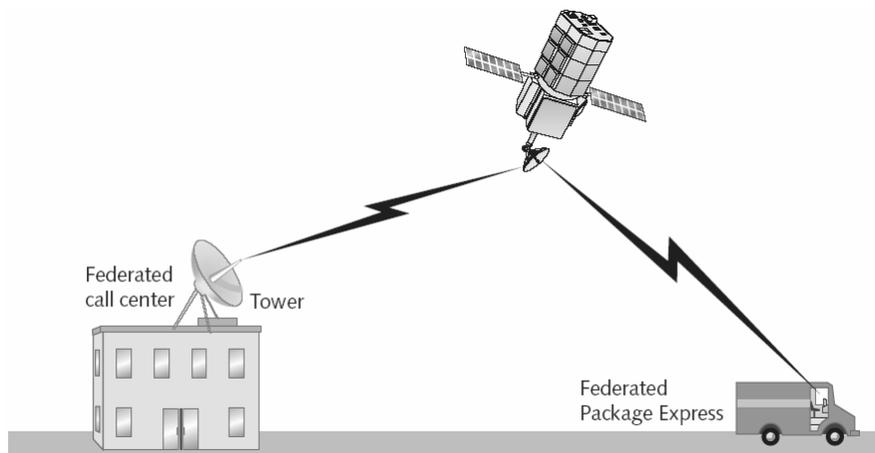


Figure 1-5 Satellite network

Wireless# Guide to Wireless Communications - Jorge Olenewa

12 of 54

## Cellular Networks

- Modern cellular telephone network
  - Built around the concept of low power transmitters
  - Each “cell” handles a number simultaneous users
  - Transmission towers are spread throughout a geographical are
  - The same radio frequency channels can be reused by another tower
    - Located a few miles away to avoid interference
    - Maximizes the use of a limited range of frequency channels

## Cellular Networks (continued)

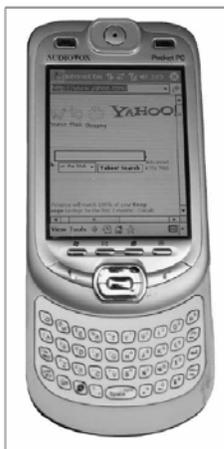


Figure 1-6 Smartphone—cellular telephone and PDA device

## Cellular Networks (continued)

- 3G (third generation) technology
  - Uses 100% digital transmission for both voice and data
  - Transmission speed
    - Up to 2 Mbps when stationary
    - 384 Kbps for slow-moving pedestrians
    - Up to 144 Kbps from a moving vehicle
- 2.5G has a maximum data transmission rate of up to 384 Kbps

## Cellular Networks (continued)

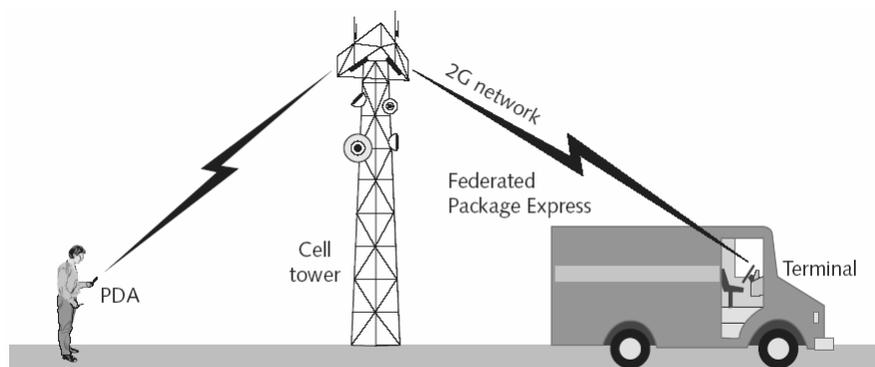


Figure 1-7 Digital cellular network

## Wireless Local Area Networks

- Wireless Local Area Network (WLAN)
  - Extension of a wired LAN
    - Connecting to it through a device called a wireless access point
- Access point (AP)
  - Relays data signals between all of the devices in the network
- Each computer on the WLAN has a wireless network interface card (NIC)
  - With an antenna built into it

## Wireless Local Area Networks (continued)



Figure 1-8 Access point (upper-left) and wireless NICs

## Wireless Local Area Networks (continued)

- Institute of Electrical and Electronic Engineers (IEEE) standards
  - 802.11a, 802.11b, 802.11g and soon 802.11n

## Wireless Local Area Networks (continued)

**Table 1-1** Wireless data communications technologies

Wireless Technology	Range (Transmission Distance)	Speed
RFID	1 inch (2.5 centimeters) to 300 feet (100 meters) depending on frequency and tag	Usually a few thousand bits-per-second (Kbps)
Bluetooth	33 feet (10 meters)	1 Mbps
UWB	150 feet (50 meters)	100 Mbps
WLAN 802.11b	375 feet (112 meters)	11 Mbps
WLAN 802.11g	300 feet (90 meters)	54 Mbps
WMAN 802.16 WiMax	35 miles (56 kilometers)	75 Mbps
2.5G digital cellular	Nationwide	384 Kbps
3G digital cellular	Nationwide	2 Mbps
Satellite	Worldwide	250 millisecond delay

## Wireless Local Area Networks (continued)

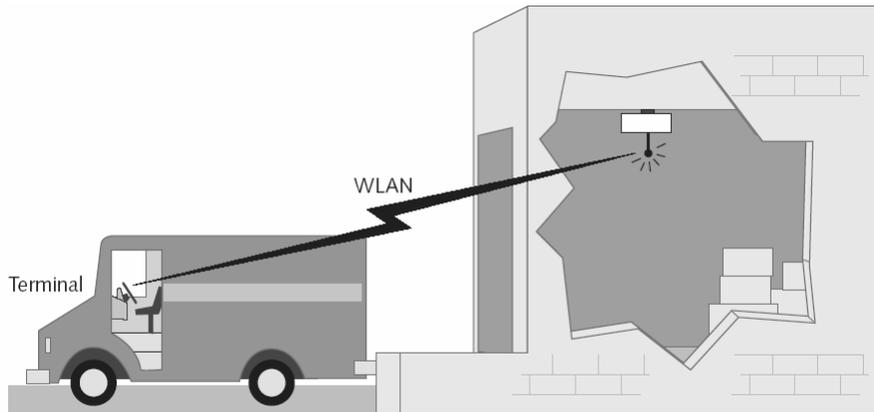


Figure 1-9 Warehouse WLAN

## Wireless Local Area Networks (continued)

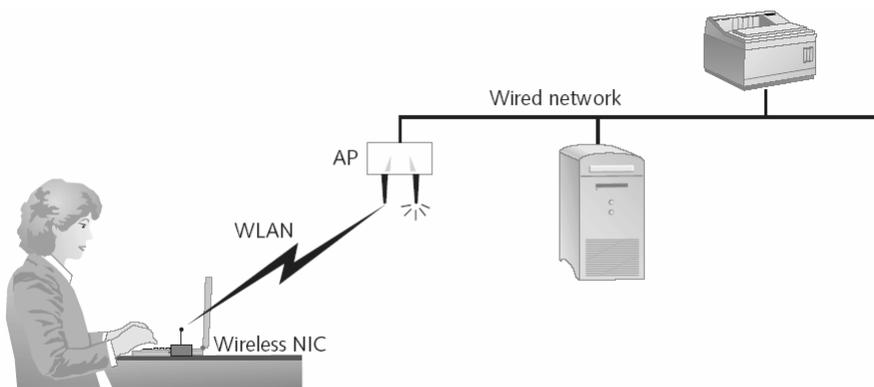


Figure 1-10 Office WLAN

## Fixed Broadband Wireless (continued)

- Wireless metropolitan area network (WMAN)
  - Covers a distance of up to 35 miles
  - Based on the IEEE 802.16 Fixed Broadband Wireless standard
  - Uses small custom antennas on the roof of each building
  - Transmission speeds
    - 75 Mbps at distances of up to 4 miles (6.4 km)
    - 17 to 50 Mbps at distances over 6 miles (10 km)

## Fixed Broadband Wireless (continued)

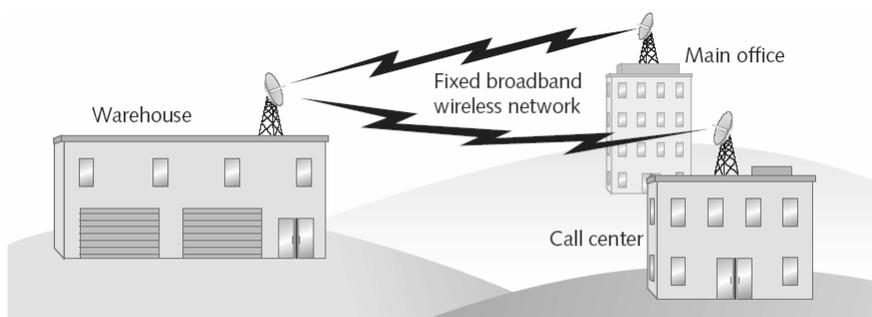


Figure 1-11 IEEE 802.16 Wireless metropolitan area network (WMAN)

## Wireless Wide Area Network

- Hypertext Markup Language (HTML)
  - Standard language for displaying content from the Internet
- Microbrowser
  - Miniaturized version of a Web browser
- Wireless Application Protocol version 2.0 (WAP2)
  - Provides a standard way to transmit, format, and display Internet data
    - For small wireless devices such as cell phones

## Wireless Wide Area Network (continued)

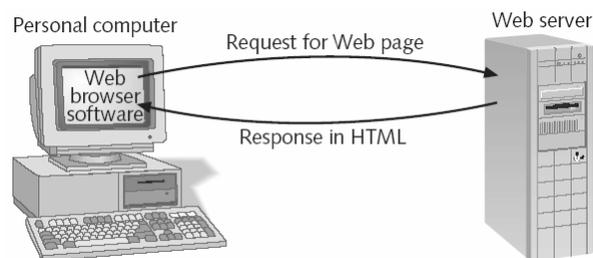


Figure 1-12 Browsing the World Wide Web on a PC

## Wireless Wide Area Network (continued)

- Programming languages
  - BREW (Binary Run-Time Environment for Wireless)
  - J2ME (Java 2 Micro Edition)
- Wireless Wide Area Network (WWAN)
  - Enables employees to access corporate data and applications from virtually anywhere

## Wireless Wide Area Network (continued)

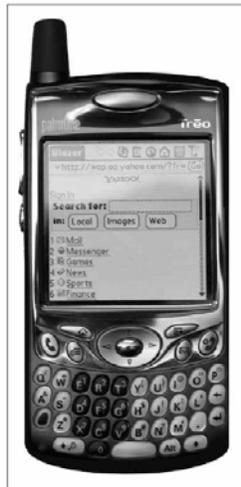


Figure 1-13 Displaying Web content on a Smartphone or cell phone

## Older Wireless Technologies

- Shared Wireless Access Protocol (SWAP)
  - Set of specifications for wireless data and voice communications around the home
  - Distance: 150 feet (45 meters)
  - Transmission speed: up to 10 Mbps
  - Includes not only computer equipment but also cordless telephones and home entertainment equipment
  - Established by the HomeRF Working Group

## The Wireless Landscape

- Wireless communications
  - Has become a standard means of communication for people in many occupations and circumstances

# The Wireless Landscape (continued)

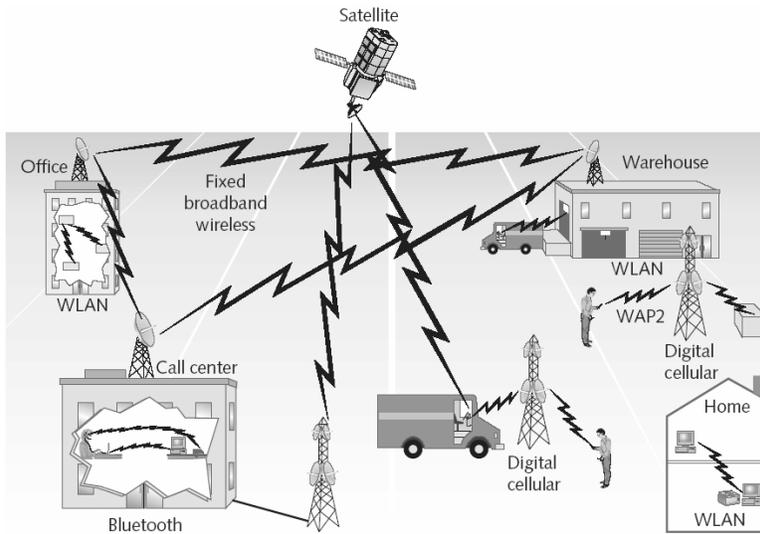


Figure 1-14 Wireless communications

# The Wireless Landscape (continued)

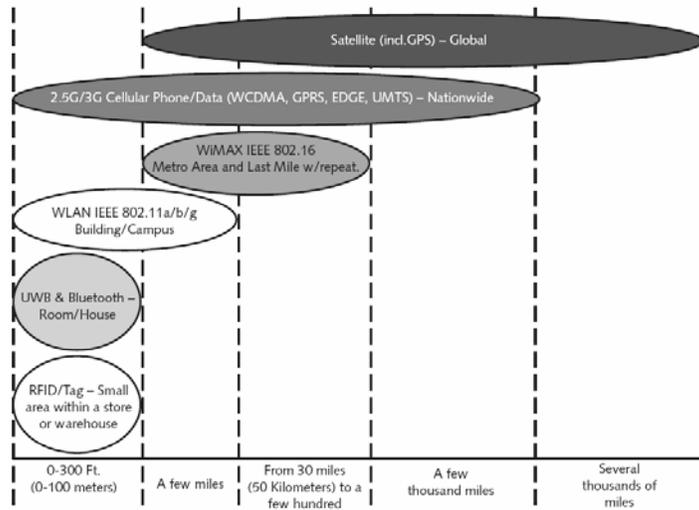


Figure 1-15 The wireless landscape

## Digital Convergence

- Digital convergence
  - Refers to the power of digital devices to combine voice, video, and text processing capabilities
    - As well as to be connected to business and home networks and to the Internet

## Wireless Applications

- Main areas
  - Education
  - Home entertainment
  - Health Care
  - Government and Military
  - Office environments
  - Event management
  - Travel
  - Construction and warehouse management
  - Environmental research
  - Industrial control

## Education

- Ideal application for colleges and schools
- It frees students from having to go to a specific computer lab or the library
  - To get on the school's computer network
- Wireless technology translates into a cost savings for colleges as well

## Home Entertainment

- Wireless communication
  - Enables movie and audio enthusiasts to download, distribute, and control all forms of digital entertainment from anywhere in the house

## Health Care

- Administering medication in a hospital setting
  - A major problem area for the health care industry
- Wireless point-of-care computer systems
  - Allow medical staff to access and update patient records immediately
- Even telephones are now being connected to hospital IEEE 802.11 WLANs
  - Employing VoIP technology

## Government

- Wireless communication
  - Lets city employees and contractors at remote sites access data stored in a central database
  - Delivers broadband connectivity to schools, libraries, and government buildings
  - Provides free Internet access to residents and attracts visitors and businesspeople

## Military

- Universal Handset
  - A 1.5-pound device
  - Allows military personnel in the field to communicate through a variety of methods
    - Using wireless technologies
  - Military is currently working on preventing enemies from eavesdropping on or jamming the signal

## Office Environments

- Employees in all lines of work no longer have to be away from the data they need
  - To help them make decisions
- Wireless technologies allow businesses to create an office
  - Where the traditional infrastructure doesn't already exist

## Event Management

- Wireless networks
  - Help identify a stolen or counterfeit ticket
  - Can also give a real-time look at traffic flow
  - In-progress game statistics are available to any fan in the stadium with a wireless device

## Travel

- Wireless global positioning systems (GPS)
  - Tie into emergency roadside assistance services
- Satellite radio
  - Transmits over 150 music and talk stations
- Airport terminals are likewise turning to wireless technologies
- Airplanes themselves are being equipped with wireless data access

## Construction

- Wireless communications
  - Send information from the job site to the main office
  - Alert when maintenance operations need to be performed on equipment

## Warehouse Management

- Implementing wireless technology is key for many warehouse operations
- Warehouse management system (WMS) software
  - Used to manage all of the activities from receiving through shipping
- In the near future
  - Most of the bar code functions, including inventory counting, will be replaced by RFID tags

## Environmental Research

- Scientists are now using small, battery- or solar-cell-powered WLAN sensors
  - In places that were previously difficult to access and monitor

## Industrial Control

- Motes
  - Remote sensors
  - Can connect to a WLAN
    - Then collect data and transmit it to a central location

## Wireless Advantages and Disadvantages

- As with any new technology, wireless communications offers both advantages and disadvantages

## Advantages of Wireless Networking

- Mobility
  - Freedom to move about without being tethered by wires
  - Permits many industries to shift toward an increasingly mobile workforce
  - Gives team-based workers the ability to access the network resources
- Easier and less expensive installation
  - Installing network cabling in older buildings can be a difficult, slow, and costly task
  - Makes it easier for any office to be modified with new cubicles or furniture

## Advantages of Wireless Networking (continued)

- Increased reliability
  - Network cable failures may be the most common source of network problems
- Disaster recovery
  - In the event of a disaster, managers can quickly relocate the office

## Disadvantages of Wireless Networking

- Radio signal interference
  - The potential for two types of signal interference exists
- Security
  - It is possible for an intruder to be lurking outdoors with a notebook computer and wireless NIC
    - With the intent of intercepting the signals from a nearby wireless network
  - Some wireless technologies can provide added levels of security

## Disadvantages of Wireless Networking (continued)

- Health risks
  - High levels of RF can produce biological damage through heating effects
    - Wireless devices emit low levels of RF while being used

## Summary

- Wireless communications have become commonplace
- Wireless networks and devices are found in all circles of life today
- Wireless wide area networks will enable companies of all sizes to interconnect their offices
  - Without the high cost charged by telephone carriers for their landline connections
- WLAN applications are found in a wide variety of industries and organizations

## Summary (continued)

- Remote sensors
  - Capable of communicating using wireless technologies
  - Used in large manufacturing facilities
    - To monitor equipment and for scientific research
- Wireless communication advantages
  - Mobility
  - Easier and less expensive installation
  - Increased network reliability
  - Support for disaster recovery

## Summary (continued)

- Wireless communication disadvantages
  - Radio signal interference
  - Security issues
  - Health risks