Principles of Modern Communications Wireless Networking

based on 2011 lecture series by Dr. S. Waharte.
Department of Computer Science and Technology,
University of Bedfordshire.

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Outline

802.11 LAN MANAGEMENT

WLAN Management

- Access Points Placement in a Building
  - Must be done carefully for good coverage and to minimize interference between access points.
  - Lay out 30-meter to 50-meter radius circles on blueprints.
  - Adjust for obvious potential problems such as brick walls.
  - In multistory buildings, must consider interference in three dimensions.

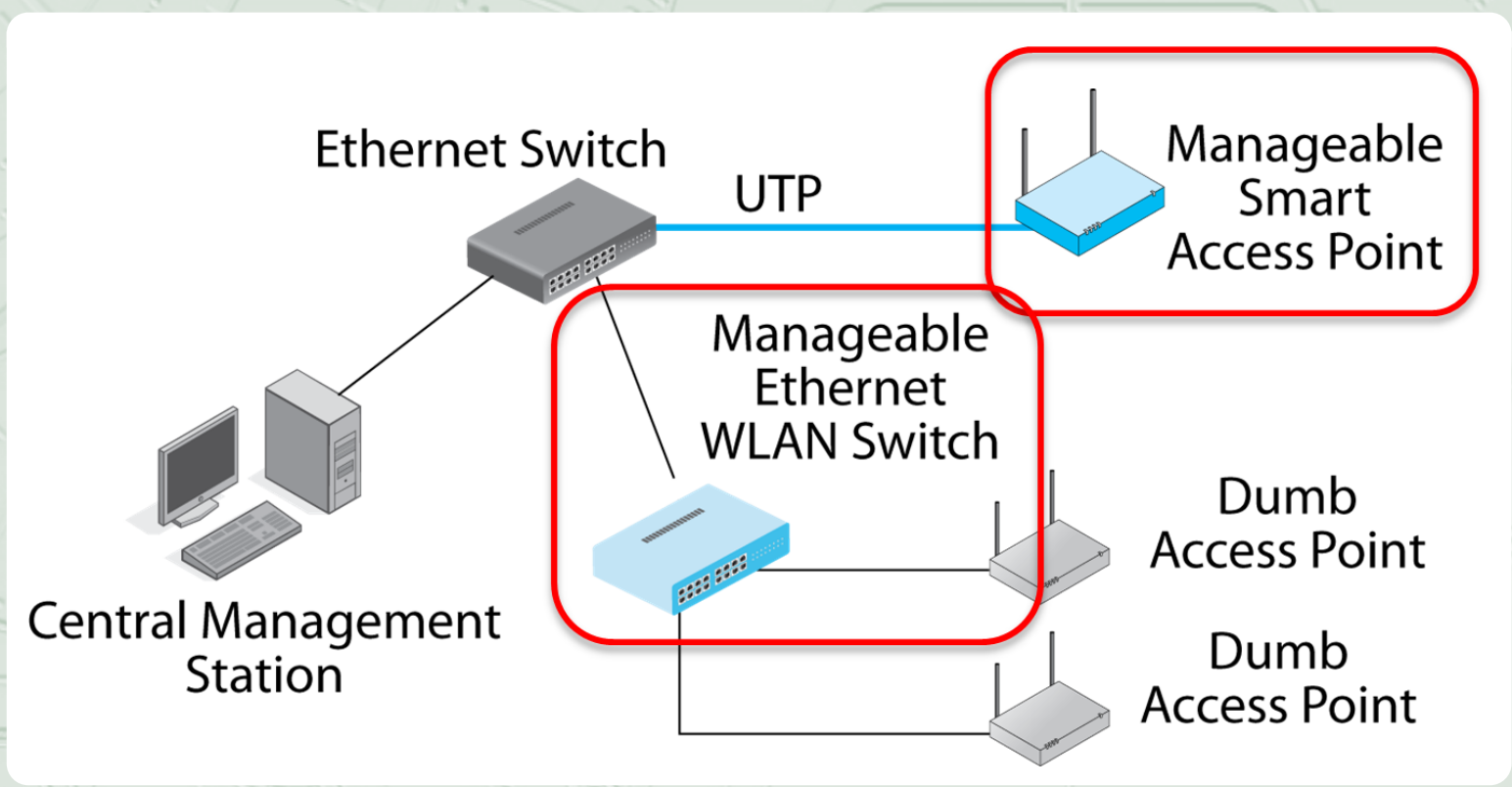
WLAN Management

- Access Points Placement in a Building
  - Install access points and do site surveys to determine signal quality.
  - Adjust placement and signal strength as needed.
  - In commercial access points, signal strength and other configuration information can be actively controlled.

WLAN Management

- Remote Access Point Management
  - The manual labour to manage many access points can be very high.
  - They must be managed.

Wireless Access Point Management Alternatives



WLAN Management

- Remote Access Point Management
  - Desired functionality:
    - Notify the WLAN administrators of failures immediately.
    - Support remote access point adjustment.
    - Should provide continuous transmission quality monitoring.
    - Allow software updates to be pushed out to all access points or WLAN switches.
    - Work automatically whenever possible.

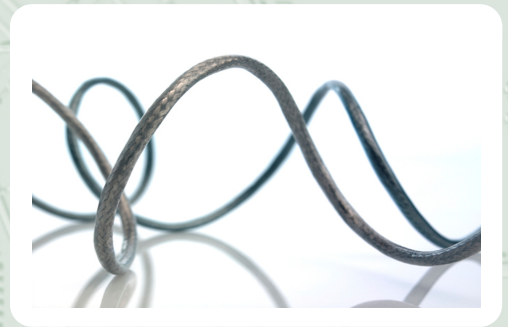
Other local wireless technologies

Bluetooth

- For Personal Area Networks (PANs)
  - Devices on a person's body and nearby (earphone, mobile phone, netbook computer, etc.)
  - Devices around a desk (computer, mouse, keyboard, printer)

Bluetooth

- Cable Replacement Technology
  - For example, with a Bluetooth phone, you can print wirelessly to a nearby Bluetooth-enabled printer
  - Does not use access points
  - Uses direct device-to-device communication



Bluetooth

- Advantages Compared with 802.11
  - Low battery power drain, so long battery life between recharges
  - Bluetooth profiles (printing, earphones, two-way headsets, wireless keyboards and mice, etc.)
    - No need to do device-specific configuration for each device pair
  - Somewhat rudimentary
  - Devices typically automate only a few Bluetooth profiles

Emerging Local Wireless Technologies

- Ultrawideband (UWB)
  - Uses channels several gigahertz wide (spans multiple frequency bands)
  - Low power per hertz to avoid interference still gives very high speeds
  - But limited to short distances
  - Wireless USB provides 480 Mbps up to 3 meters, 110 Mbps up to 10 meters

Bluetooth

- Disadvantages Compared with 802.11
  - Short distance (10 meters)
  - Low speed (3 Mbps today with a slower reverse channel)
- Bluetooth 3.0
  - Can switch to 802.11 radio transmission for higher speeds than traditional Bluetooth provided

802.11 Bluetooth

- Major Bluetooth Standards
- 2.0 and 2.1 + EDR
  - This is the currently dominant Bluetooth standard
  - EDR is Enhanced Data Rate
  - 3 Mbps with a slower back channel
  - 2.1 products became available in 2010

802.11 Bluetooth

- Major Bluetooth Standards
- 3.0 + HS
  - Adopted but not widely used
  - Can operate over 802.11 transmission processes
  - 802.11 speeds but no access points
  - Better security

802.11 Bluetooth

- Propagation Distances
  - Bluetooth Class 1
    - Higher-power devices that can reach 100 meters
    - Rare
  - Bluetooth Class 2
    - Lower-power radio
    - 10-meter propagation distance
    - The norm

802.11 Bluetooth

- Bluetooth Profiles for Phones
  - Headset Profile
    - Basic actions such as accepting incoming calls, ending calls, controlling volume
  - Hands-Free Profile
    - More capabilities
    - Redial last number called
    - Call waiting
    - Dial by speaking

802.11 Bluetooth

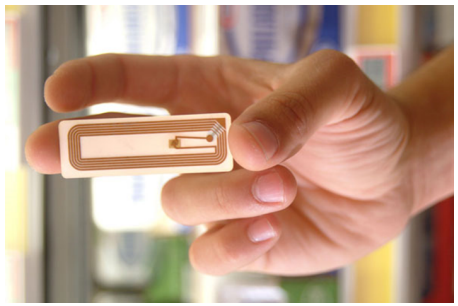
- Other Bluetooth Profiles
  - Remote Control Profile to control your music devices
  - Advanced Audio Distribution Profile for music streaming
  - Object Push Profile to send business cards and other information to another phone
  - More coming

Emerging Local Wireless Technologies

- 802.11 and Bluetooth are not the only local wireless technologies.
- ZigBee
  - For almost-always-off sensor networks at low speeds
  - Very long battery life
  - 250 kbps maximum

Emerging Local Wireless Technologies

- RFIDs
  - Like bar code tags but readable remotely
  - Some are powered by the scanner's energy

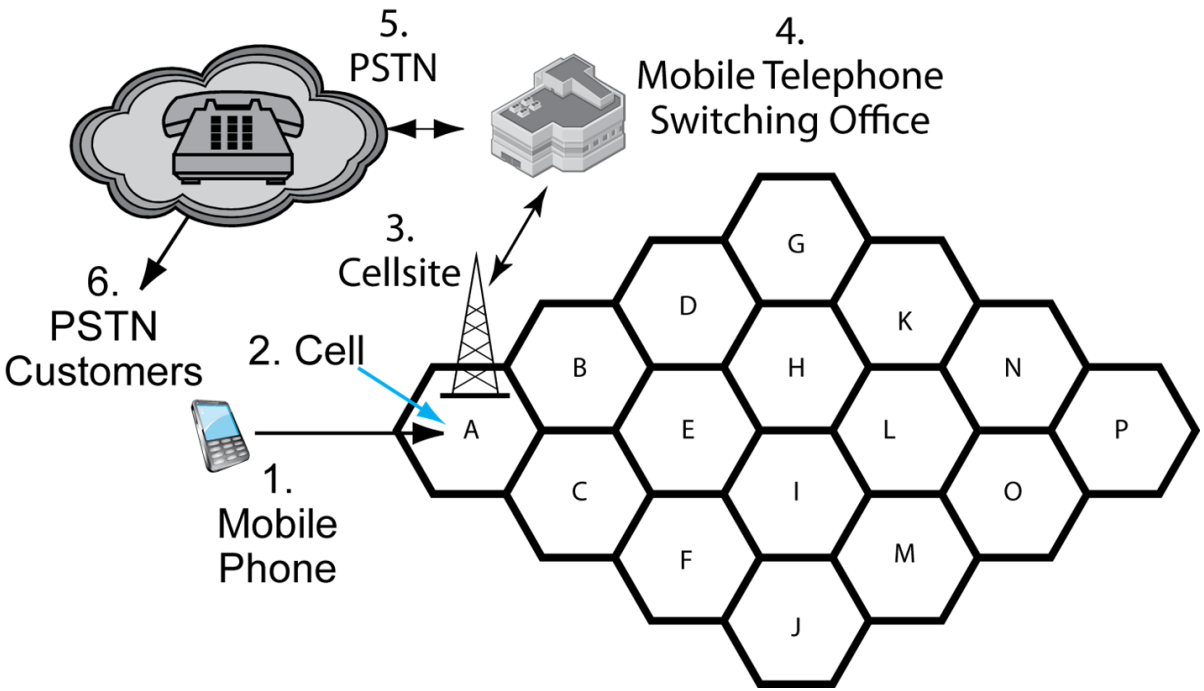


Emerging Local Wireless Technologies

- Software-Defined Radio
  - Can implement multiple wireless protocols
  - No need to have separate radio circuits for each protocol
  - Reduces the cost of multi-protocol devices

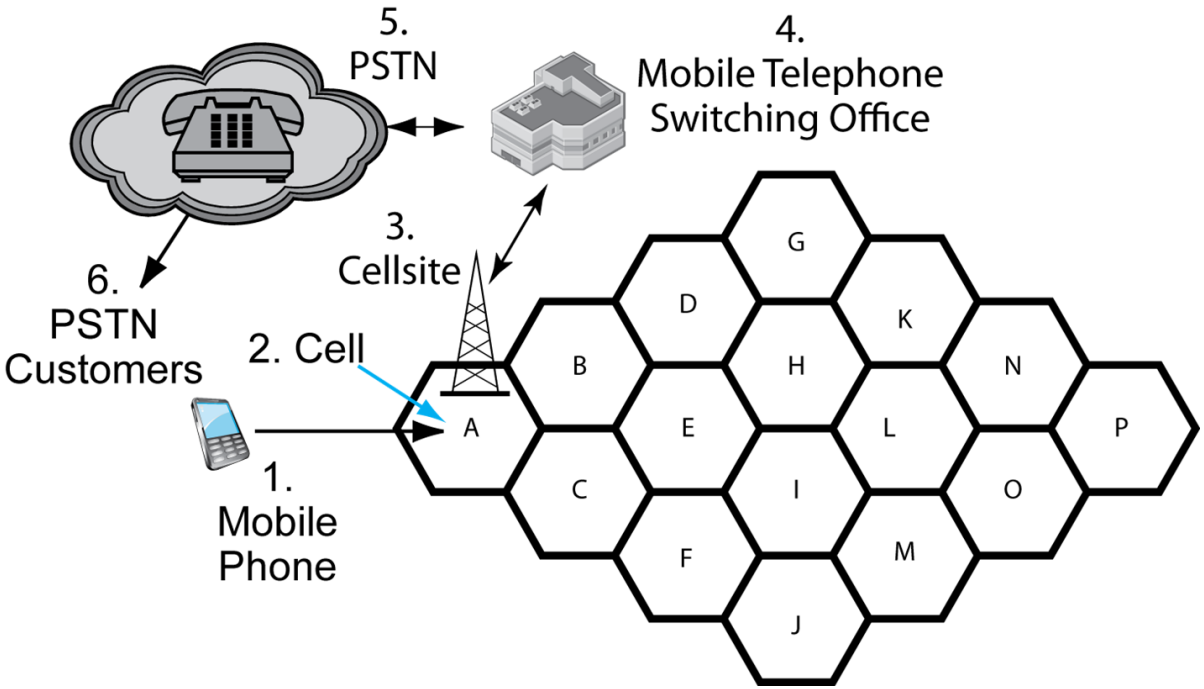
Cellular technology

Cellular Technology



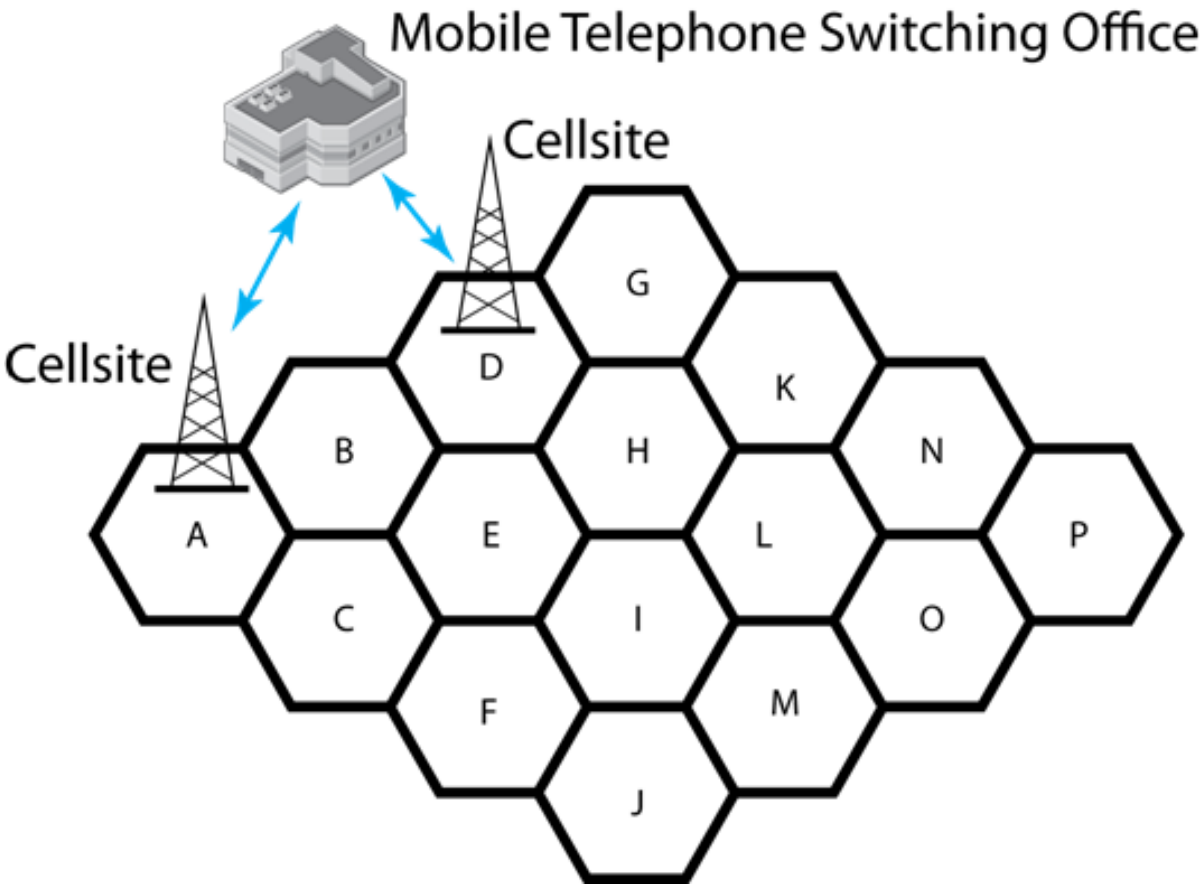
- A geographical area is divided into areas called cells.
- Each cell has a cellsite with a transmitter/receiver.

Cellular Technology



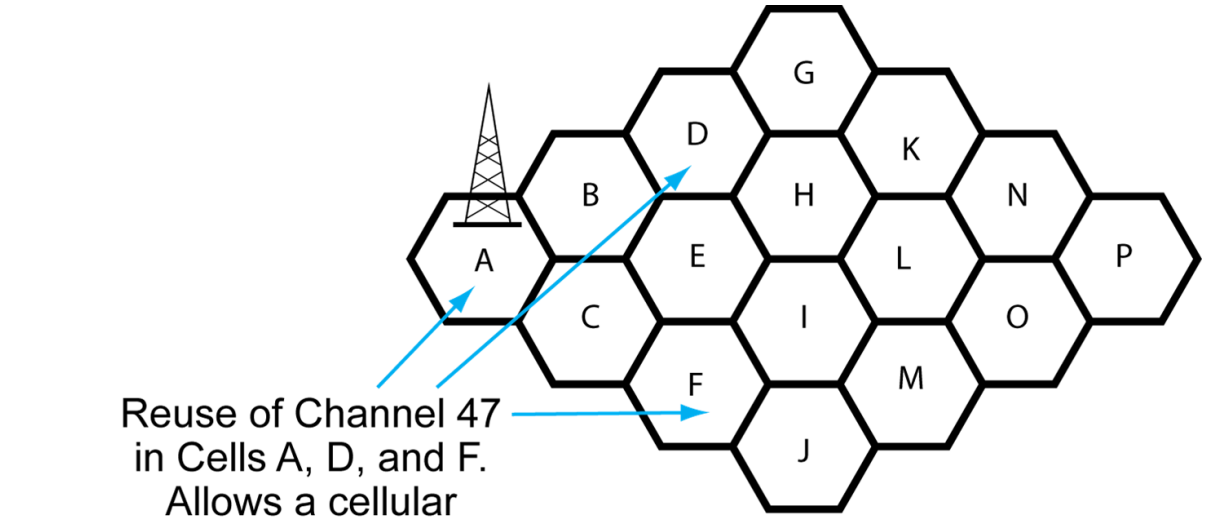
- The route of a cellular telephone call to a wireline customer.

Cellular Technology

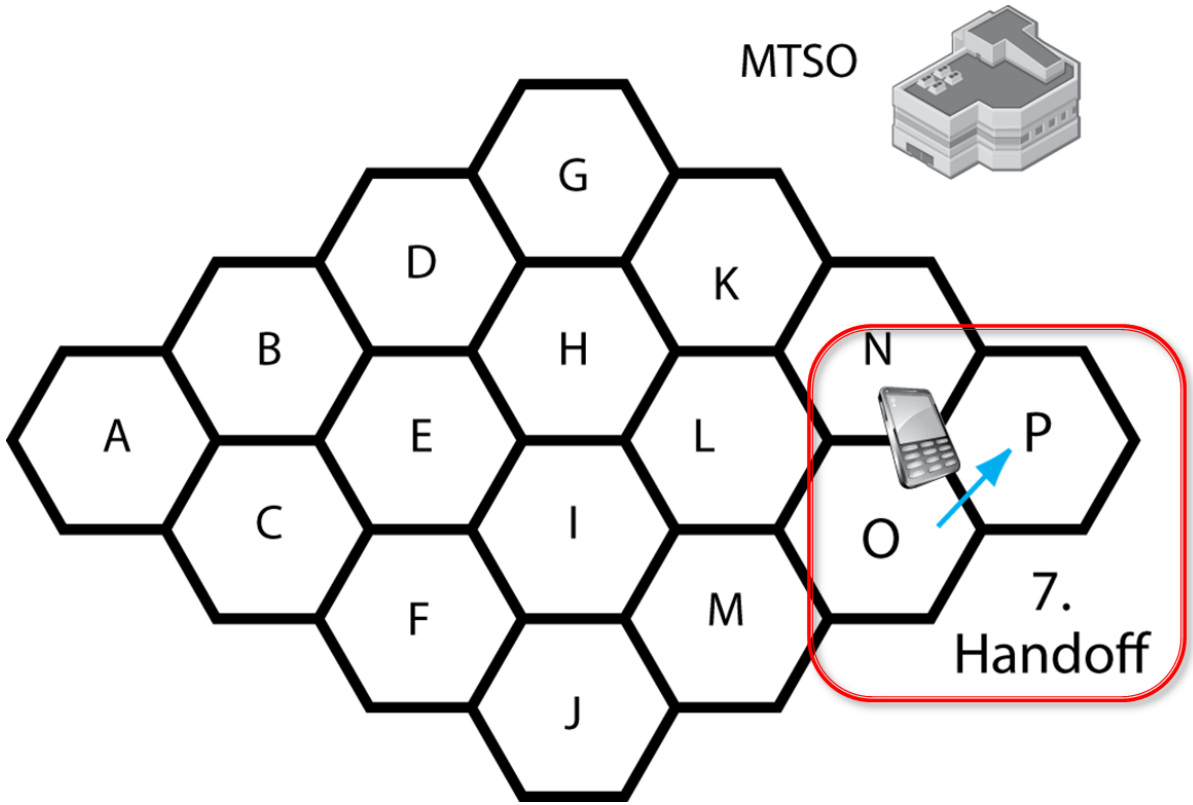


- The MTSO constantly monitors and controls all cellsites in a cellular system.

Cellular Technology



Cellular Technology



- In cellular telephony, a handoff takes place when you move between cells. A new cellsite serves you. The MTSO manages the handoff.

Handoffs and Roaming: 802.11 v Cellular

	802.11 WLANs	Cellular Telephony
Relationship	Handoff and roaming mean the *same thing.*	Handoff and roaming mean *different things.*
Handoffs (means the same in both)	Wireless host travels between access points in an organization.	Mobile phone travels between cellsites in the *same* cellular system.
Roaming (means different things)	Wireless host travels between access points in an organization.	Mobile phone travels to a *different* cellular system.

Generations of Cellular

- Generation 1 (1G)
  - Introduced around 1980
  - Analog signaling only
  - Data transmission difficult, limited to 10 kbps

Generations of Cellular

- Generation 2 (2G)
  - Introduced around 1990
  - All-digital, so clean signals
  - Still limited to 10 kbps
  - Sufficient for texting and the exchange of low-quality photos

Generations of Cellular

- Generation 3 (3G)
  - Introduced around 2000
  - Typical speed 300 kbps to 500 kbps
  - Sufficient for somewhat sluggish Web access
  - Sufficient for low-quality video
  - Sufficient for exchanging high-quality photographs

Generations of Cellular

- Generation 4 (4G)
  - Introduced around 2010
  - Typical speed 3 Mbps to 5 Mbps
    - X10 over 3G
  - Eventually, 100 Mbps to mobile users and 1 Gbps to stationary users
  - Sufficient for high-definition video
  - Runs over IP

Generations of Cellular

- Generation 4 (4G)
  - Designed to give at least 2 Mbps download speeds to fixed customers
  - Designed to give at least 100 Mbps download speeds to fixed customers
  - Throughput lower in practice
  - Will be needed for high-definition video

Generations of Cellular

- Generation 4 (4G)
  - There are two competing technologies.
  - WiMAX 4G technology.
    - Based on 802.16 standard.
    - WiMAX forum promotes WiMAX and does interoperability testing.
    - 802.16m will eventually provide 100 Mbps to mobile users and 1 Gbps to stationary users.

Generations of Cellular

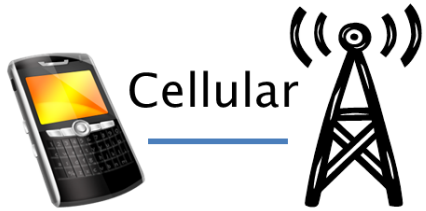
- Generation 4 (4G)
  - There are two competing 4G technologies.
  - Long-Term Evolution (LTE)
    - The 4G technology that most cellular carriers have adopted.
    - Not full 4G technology.
    - LTE Advanced will provide 100 Mbps to mobile users and 1 Gbps to stationary users.

Generations of Cellular

- Lies, Damned Lies, and Mobile Speeds
  - Mobile speeds vary widely.
  - All users share the capacity of a cellsite.
    - Usage will vary with the number of simultaneous users.
  - Distance from a transmitter means slower speeds.
  - Speeds are not equal in all parts of a city.
  - Buildings and other obstructions may create local areas of poor service.

Cellular-802.11 Convergence

- Traditional Roles
  - 802.11: networking within a firm
  - Cellular telephony: service outside the firm
  - Growing convergence



Cellular-802.11 Convergence

- 3G Mobile Smartphones
  - Often can connect directly to an 802.11 WLAN for service
  - Typically faster speeds than cellular for data
  - Cellular companies like offloading flat-fee subscribers to the WLAN

Cellular-802.11 Convergence

- Some Smart Phones Can Act as 802.11 Access Points
  - Several 802.11users can share its capacity.