

## Conducted and Wireless Media (Part II)

(October 5, 2016)

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### Learning Objectives

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- Outline characteristics of wireless media
- Understand Wireless LAN

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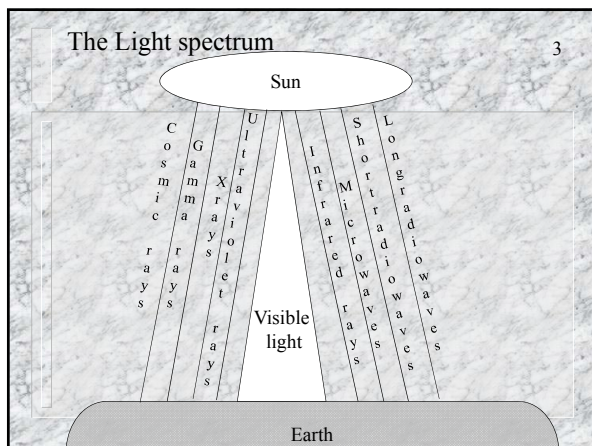
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### The Light spectrum

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### Wireless media used for data transmission 4

- Infrared light
  - Has many of the same characteristics as visible light
  - Travels in straight lines (but for short distances)
  - Cannot penetrate solid objects
- Radio waves
  - Travel in straight lines
  - Can penetrate through solid objects
  - Can travel long distances

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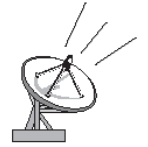
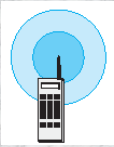
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### Omnidirectional and Dish Antennas 5

 <p><b>Dish Antenna</b></p> <p>Concentrates incoming and outgoing signals in a narrow range</p> <p>-----</p> <p>Must point at receiver Good for fixed subscribers</p>	 <p><b>Omnidirectional Antenna</b></p> <p>Signal spreads as a sphere Rapid signal attenuation</p> <p>-----</p> <p>No need to point at receiver Good for mobile subscribers</p>
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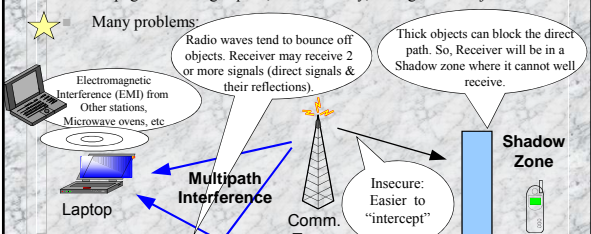
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### Wireless Media 6

- Use electromagnetic waves or electromagnetic radiation for data transmission
- Propagation through space, and indirectly, through solid objects
- Many problems:
  - ★ Electromagnetic Interference (EMI) from Other stations, Microwave ovens, etc
  - ★ Multipath Interference: Radio waves tend to bounce off objects. Receiver may receive 2 or more signals (direct signals & their reflections).
  - ★ Insecure: Easier to "intercept" messages
  - ★ Shadow Zone: Thick objects can block the direct path. So, Receiver will be in a Shadow zone where it cannot well receive.



+ Much more attenuation: **Inverse Square law**

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## Wireless Transmission

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Using multiple antennas or using square or fan-shaped antennas reduces Multipath Interference's effects

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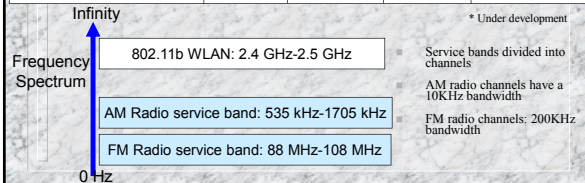
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## IEEE 802.11 WLAN standards

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originally licensed by the Wi-Fi Alliance

	802.11b	802.11a	802.11g	802.11n*
Unlicensed Band	2.4 GHz	5 GHz	2.4 GHz	2.4 GHz or 5 GHz
Rated Speed	≤11 Mbps	≤ 54 Mbps	≤ 54 Mbps	≤ 250 Mbps
Range (Indoor/Outdoor)	35m/100m	25m/75m	25m/75m	50m/125m
# of channels	3	12	12	14



802.11g uses Orthogonal Frequency Division Multiplexing (OFDM) modulation scheme to achieve higher speed than 802.11b

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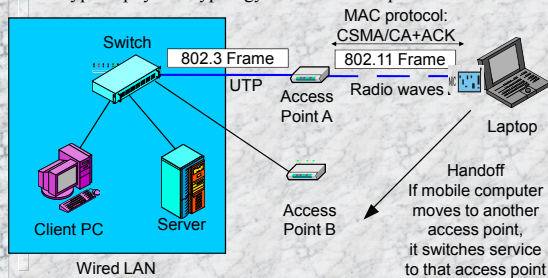
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## Wireless LAN (802.11 standard)

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Typical physical typology: Point-to-Multipoint




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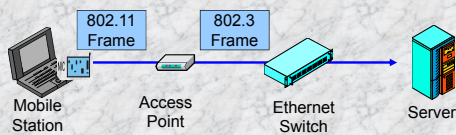
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## Wireless LAN (802.11 standard)

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- The Wireless Station sends a frame to a server via the access point
- The access point converts the 802.11 frame into an 802.3 Ethernet frame and sends the frame to the server



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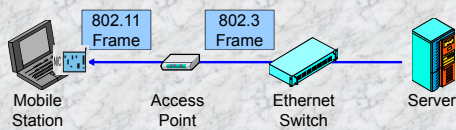
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## Wireless LAN (802.11 standard)

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- The server responds, sending a frame to the access point
- The access point converts the 802.3 frame into an 802.11 frame and sends the frame to the mobile station.



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## Wireless LAN (802.11 standard)

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- CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
  - Sending Station or Access point listens for traffic
    - If there is **no traffic**, can send if there has been no traffic for a specified amount of time
    - If the specified amount of time has not been met, must wait for the specified amount of time. Can send if the line is still clear

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## Wireless LAN (802.11 standard)

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- CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
  - Sending Station or Access point listens for traffic
    - If there is traffic, the sender must wait until traffic stops
    - The sender must then set a random timer and must wait while the timer is running
    - If there is no traffic when the station or access point finishes the wait, it may send

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## Wireless LAN (802.11 standard)

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- ACK (Acknowledgement)
  - Receiver immediately sends back an acknowledgement
  - If sender does not receive the acknowledgement, retransmits using CSMA/CA
  - Wireless NIC implements CSMA/CA+ACK when it sends
  - Access point implements CSMA/CA+ACK when it sends

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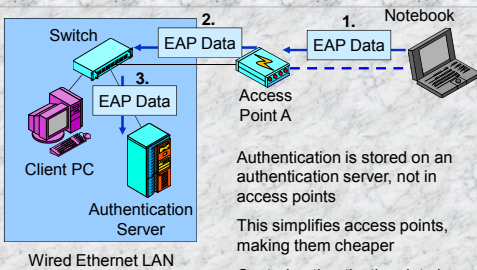
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## Using Extensible Authentication Protocol (EAP) for Security

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Authentication is stored on an authentication server, not in access points  
This simplifies access points, making them cheaper  
Central authentication data is easier to manage and change

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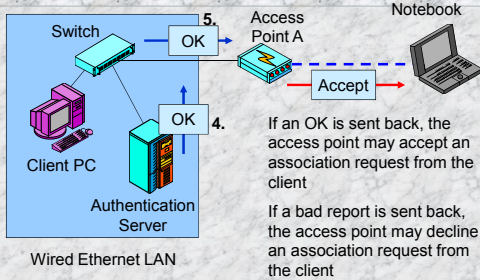
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## Using Extensible Authentication Protocol (EAP) for Security, Continued

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## Summary Questions

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- a) Wireless transmission can experience propagation problems due to shadow zones and multipath interference. Explain.
- b) Describe the elements in a typical 802.11 Wireless LAN.
- c) What does handoff refer to?
- d) Explain how attenuation occurs in wireless communications: Inverse square law.

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## Summary Questions

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- Can we implement a completely wireless LAN not connected to a Wired LAN? Explain.

Yes. Using a switch with built-in Access Point, we can implement a Wireless LAN not connected to a Wired LAN. We can even implement a small completely wireless LAN without Access Point or Switch. In this case, Wireless NICs operate automatically in ad hoc mode, in which they talk directly to other wireless stations. This only works for small LANs.

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