



## Lecture (05)

CS  
IT

# WLAN Technologies and Topologies

By:

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## Agenda

- General Wireless Topologies
- Original 802.11 Topologies

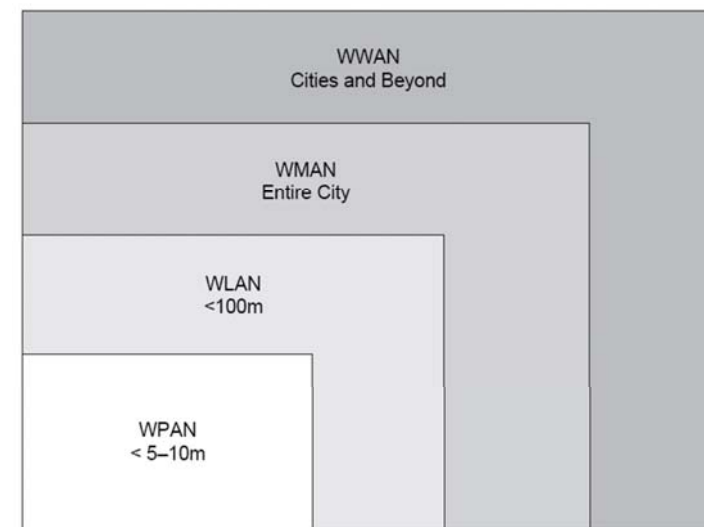
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## General Wireless Topologies

- If you are talking about how your wireless network looks next to your wired network, you are most likely talking about a wireless local-area network (WLAN).
- The goal of a WLAN versus a wireless personal-area network (WPAN) is quite different.

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## General Wireless Topologies (2)



Wireless Topology Overview

## General Wireless Topologies (3)

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### WPAN

- A WPAN has the following characteristics:
- The range is short—about 5-10m.
- Eight active devices
- Unlicensed 2.4-GHz spectrum
- Called a piconet

## General Wireless Topologies (4)

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- many people have Bluetooth headsets and mice and such, expect a lot of interference, but that's not the case.
- As Bluetooth uses Frequency Hopping Spread Spectrum (FHSS).
- Although Bluetooth operates on the same frequency as 802.11b and 802.11g, they don't interfere
- *as Bluetooth communicates with a shared hopping sequence (FHSS) in a small local area is what makes it a piconet while WLAN uses DSSS, or OFDM technologies.*

## General Wireless Topologies (5)

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- WPANs are standardized by the 802.15 IEEE workgroup.
- A WPAN study group was formed in 1998, and two months later a Bluetooth Special Interest Group (SIG) was formed.
- Shortly thereafter the study group became the IEEE 802.15 group.
- The Bluetooth SIG has more than 9000 members and continues to further the technology.

## General Wireless Topologies (6)

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### WLAN

- WLANs are designed for a larger area than that of a WPAN.
- These can scale from very small home offices to large enterprise networks.
- The fact that they are local-area means that the organization where the WLAN exists also manages and probably owns the equipment.

## General Wireless Topologies (7)

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WLANs have the following characteristics:

- 2.4-GHz or 5-GHz spectrum.
- A larger range than a WPAN—close to 100 meters from AP to client.
- It's not personal; rather, more clients are expected.
- WLANs are very flexible, so more than eight active devices/clients are expected, unlike a WPAN.

## General Wireless Topologies (8)

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- WLAN is a mix of dual-band wireless access points, laptops, and desktops
- Operates in either the 2.4-GHz spectrum for 802.11b/g or the 5-GHz spectrum for 802.11a.
- The 802.11a, b, g, and n WLAN standards are commonly found in networks around the world.
- The frequency spectrums used by 802.11a/b, g, and n are all unlicensed.
- Because WLANs cover larger areas, they require more power output than a WPAN.
- Governing bodies (FCC, ETSI, IEEE) mandates power levels, and frequency bands.

## General Wireless Topologies (9)

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- WLANs are designed to give mobile clients access to network resources, wireless print servers, presentation servers, and storage devices.
- So a WLAN expects to see multiple users, and clients, which ends up with many devices connecting to each other or sharing information with each other, usually over a common distribution system such as the local-area network.
- This makes WLANs much more complex than WPANs.

## General Wireless Topologies (10)

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WMAN

- A wireless metropolitan-area network (WMAN) covers a large geographic area and has the
  - following characteristics:
    - Speeds decrease as the distance increases.
    - Close to broadband speeds versus Ethernet speeds.
    - Used as a backbone, point-to-point, or point-to-multipoint.
    - Most well-known is WiMax.
- WMANs are used as backbone services, point-to-point, or even point-to-multipoint links that can be a replacement for technologies such as T1 and T3.

## General Wireless Topologies (11)

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- WMAN uses licensed frequencies, this requires payment for exclusive rights.
- Why? because others could use the same frequency,
- This places them in a closer category to broadband than to Ethernet using interference.
- The most widely known WMAN is WiMax (802.16b).
- WiMax can be used to offer last-mile access as an alternative to broadband services such as DSL or cable connections.
- WiMax is an excellent solution where facilities (fixed lines for DSL links) or distance (no exchanges in urban areas) are a limitation.

## General Wireless Topologies (12)

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- With WiMax, you pay a service provider for access, because the cost of deployment is normally very high.

## General Wireless Topologies (13)

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### WWAN

- A wireless wide-area network (WWAN) covers a large geographic area.
- WWANs have the following characteristics:
  - Low data rates
  - Pay-for-use
  - High cost of deployment
- Because they cover a large geographic area, WWANs usually are very expensive to deploy.
- An example of WWAN is, is cellular service.
- cell service is a WWAN and probably offers data access as well as voice access.

## General Wireless Topologies (14)

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- Data rate varies with the offered technology,
  - GSM data
  - GPRS
  - EDGE
  - 3G
  - 4G
- Payment for data access or even voice access is typically based on usage.

## Original 802.11 Topologies

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the original topologies, defined by the 802.11 committees, including the following:

- Ad hoc mode
- Infrastructure mode

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## Original 802.11 Topologies (2)

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### 1. Ad Hoc Networks

- When two computers want to communicate directly with one another, they do so in the form of an *ad hoc network*.
- don't require a central device to allow them to communicate.
- One device sets a group name and radio parameters, and the other uses it to connect.

#### **Basic Service Set (BSS),**

- *which defines the area in which a device is reachable.*
- Because the two machines don't need a central device to speak to each other, it is called an *Independent Basic Service Set (IBSS)*.

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## Original 802.11 Topologies (3)

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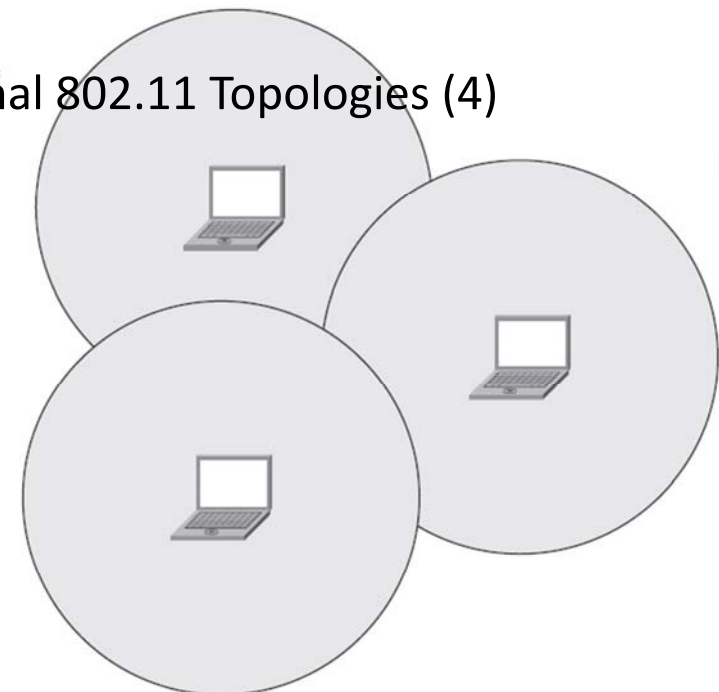
- Each computer has only one radio.
- Because there is only one radio, the throughput is lower and acts as a half-duplex device, because you can't send and receive at the same time.
- You don't have much control in these networks, so you're stuck when it comes to methods such as authentication.
- In addition, you need to address who starts the conversation and who decides on the order of communication, to name just a couple issues.

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## Original 802.11 Topologies (4)

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*Ad Hoc Network*

## Original 802.11 Topologies (5)

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### 2. Network Infrastructure Mode

- access point acts as a connection point for clients.
- An AP is actually a cross between a hub and a switch.
- There is one radio, which cannot send and receive at the same time. This is where the AP is likened to a hub. It's a half-duplex operation.
- APs have some intelligence that is similar to that of a switch. That is how an AP can see a frame and decide to forward it based on MAC addresses.

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## Original 802.11 Topologies (6)

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- What is different on an AP versus a switch is that wireless frames are more complex.
- Standard Ethernet frames have a source MAC address and a destination MAC address.
- Wireless frames can have three or four MAC addresses.
  - Two of them are the source and destination MAC addresses,
  - and one is the AP's MAC address that is tied to a workgroup.
- Note: client is called a *station (STA)*, and an AP is called an *infrastructure device*.

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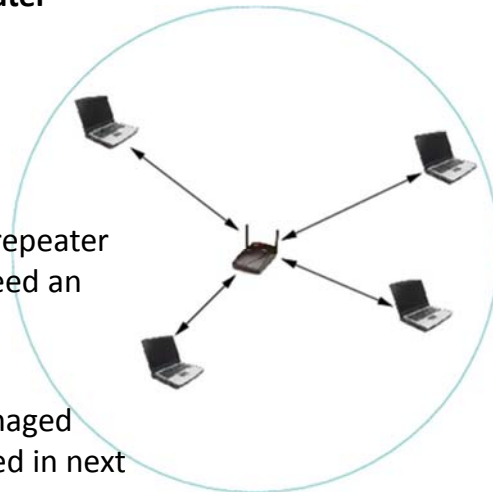
## Original 802.11 Topologies (7)

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### 2.1 AP acts as standalone repeater

Basic Service Area (BSA):

- the coverage area of the AP.
- known as a wireless cell.
- (Some APs can function in a repeater mode, in which they don't need an Ethernet connection.)
- This can be formed as unmanaged wireless LAN (will be discussed in next slide)



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## Original 802.11 Topologies (8)

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### 2.2 AP act as bridge to wired LAN

- Assuming that the AP has an Ethernet connection, it bridges the 802.11 wireless traffic from the wireless clients to the 802.3 wired network on the Ethernet side.
- In that case, wireless LAN can be formed in two different kinds:
  - Unmanaged wireless LAN, where wireless controller is integrated to AP.In that case AP can act as standalone repeater (previous case) or bridge to wired LAN (current case)

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## Original 802.11 Topologies (9)

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- Managed AP, (may called wireless terminal),
  - The wired network attached to the AP's Ethernet port is a path to a wireless LAN controller (or controller for short).
  - The client traffic is passed through the controller and then is forwarded to the wired network, called the *distribution system*.

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## Original 802.11 Topologies (10)

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### ***The distribution system set***

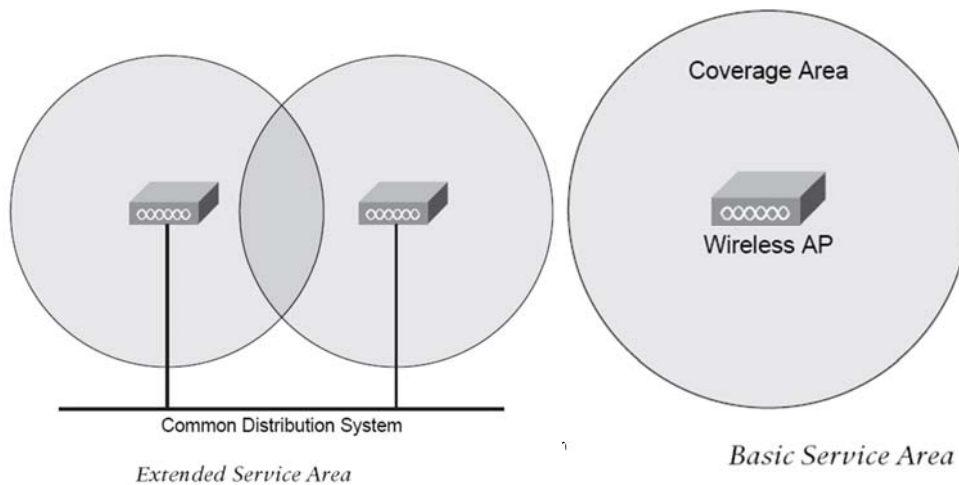
- APs are connected to wired LAN, defining is how a client accesses the Internet, file servers, printers, and anything else available on the wired network.
- When more than one AP is connected to a common distribution system, the coverage area is called an *Extended Service Area (ESA)*.

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## Original 802.11 Topologies (11)

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## Original 802.11 Topologies (12)

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- Why would you want more than one AP connected to the same LAN? There are a few reasons:
  - To provide adequate coverage in a larger area. (**coverage**)
  - To allow clients to move from one AP to the other and still be on the same LAN. (**Roaming**)
  - To provide more saturation of APs, resulting in more bandwidth per user. (**Capacity**)

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## Original 802.11 Topologies (13)

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### Roaming

- This process of a client moving from one AP to another is called *roaming*.
- For roaming to work, the APs must overlap., notice that because interference in a wireless network is a common issue.
- The reason for the overlap is so that a client can see both APs and associate to the one with the stronger signal.
- As soon as the signal from the associated AP hits the threshold built into the client, the client looks for another AP with a better signal.

## Original 802.11 Topologies (14)

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### Service Set Identifiers

- On your laptop, you might see a popup that says “Wireless networks are available” or something to that effect.
- When you look at the available networks, you see names.
- On the AP, the network is associated with a MAC address.
- This network or workgroup that your clients connect to is called a *Service Set Identifier (SSID)*.
- So on an AP, the SSID is a combination of MAC address and network name.
- This MAC address can be that of the wireless radio or another MAC address generated on the AP.

## Original 802.11 Topologies (15)

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- When an AP offers service for only one network, it is called a *Basic Service Set Identifier (BSSID)*.
- *APs offer* the ability to use more than one SSID.
- This would let you offer a Guest Network and a Corporate Network and still use the same AP.
- When the AP has more than one network, it is called a *Multiple Basic Service Set Identifier (MBSSID)*.
- *You can think of it as a virtual AP.*
- It offers service for multiple networks, but it's the same hardware.

## Original 802.11 Topologies (16)

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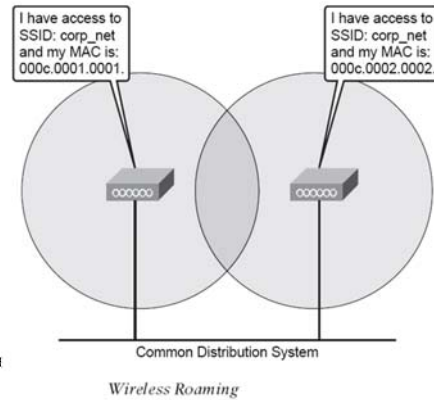
- Because it's the same hardware and the same frequency range, users on one network share with users on another and can collide if they send at the same time.



## Original 802.11 Topologies (17)

### Back to roaming again

- To get roaming to work, the BSA of each AP must overlap.
- The APs also need to be configured for the same SSID.
- This enables the client to see that the same network is offered by different MAC addresses,



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## Original 802.11 Topologies (18)

- When a client roams and moves from one AP to the other, the SSID remains the same, but the MAC address changes to the new AP with a better signal.
- Another issue to consider when roaming is the possibility of interference between the two overlapping APs.
- Even though they offer the same SSID, they need to be on different *channels, or frequency ranges, that do not overlap.*
- *This prevents co-channel interference, which should be avoided.*
- The 2.4 spectrum allows only three non overlapping channels.
- You must consider this fact when placing APs.

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Thanks,..  
See you next week (ISA),...

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