Lecture (04)
WLAN Technologies and Topologies

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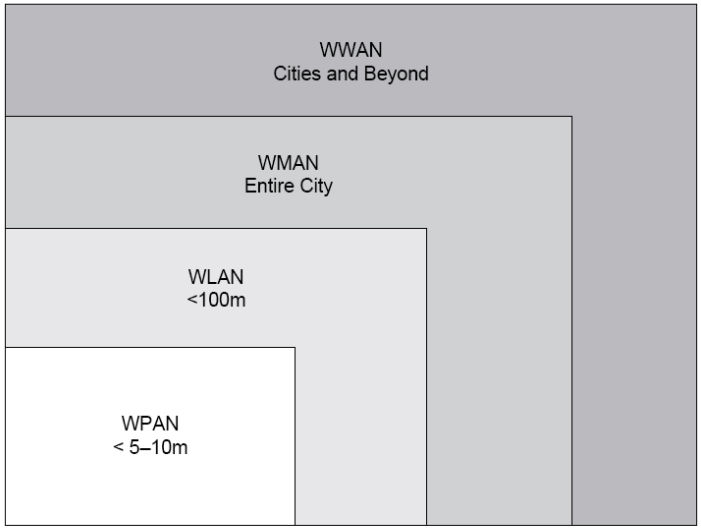
Agenda

- General Wireless Topologies
- Original 802.11 Topologies
- Vendor-Specific Topology Extensions

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.

General Wireless Topologies (2)



Wireless Topology Overview

General Wireless Topologies (3)

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)

- 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)

- 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)

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)

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)

- 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)

- 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)

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)

- 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)

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

General Wireless Topologies (13)

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)

- Data dare 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

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

- Ad hoc mode
- Infrastructure mode

Original 802.11 Topologies (2)

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.

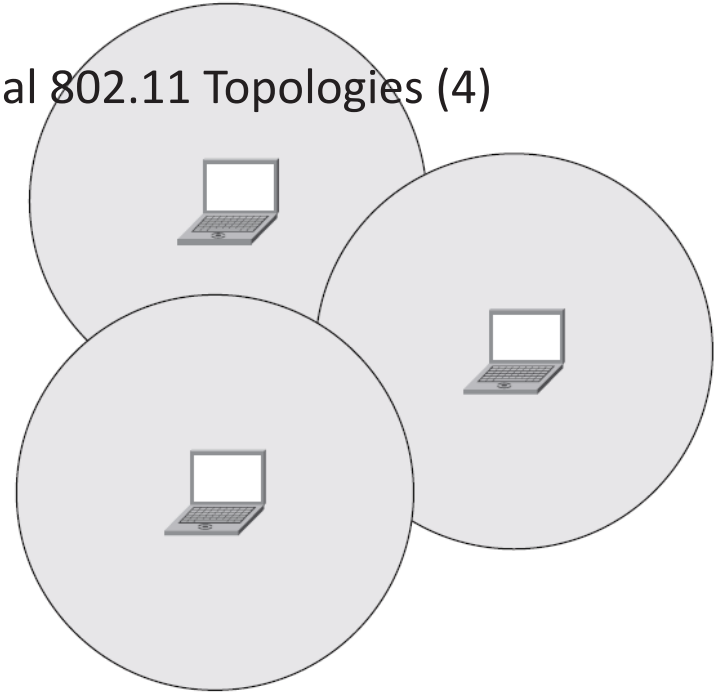
Basic Service Set (BSS),

- *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).*

Original 802.11 Topologies (3)

- 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.

Original 802.11 Topologies (4)



Ad Hoc Network

Original 802.11 Topologies (5)

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.

Original 802.11 Topologies (6)

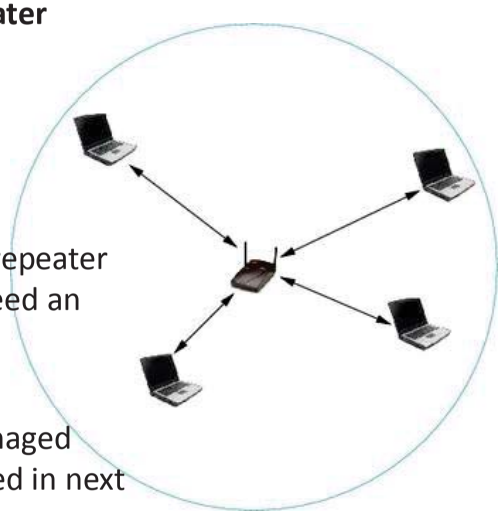
- What is different on an AP versus a switch is that wireless frames are more complex.
- Standard Ethernet frames have a source MAC address and a destination MAC address.
- Wireless frames can have three or four MAC addresses.
  - Two of them are the source and destination MAC addresses,
  - and one 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.*

Original 802.11 Topologies (7)

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)

Original 802.11 Topologies (8)

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)

Original 802.11 Topologies (9)

- 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.*

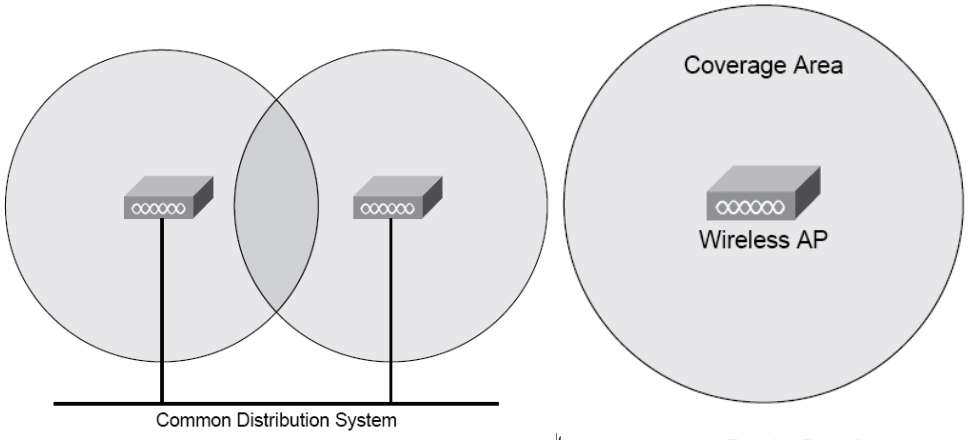
Original 802.11 Topologies (10)

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).*

Original 802.11 Topologies (11)



Original 802.11 Topologies (12)

- 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**)

Original 802.11 Topologies (13)

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)

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)

- 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.

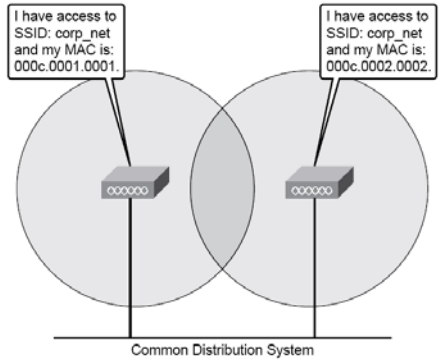
Original 802.11 Topologies (16)

- 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,



Wireless Roaming

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.

Vendor-Specific Topology Extensions

- The vendor-specific topology extensions are an enablement of additional network functionality by way of vendor-defined protocols, devices, and topologies.

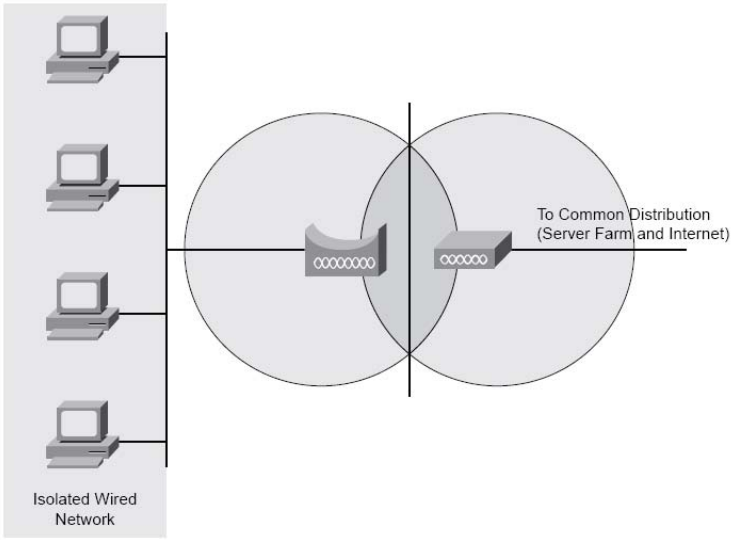
1. workgroup bridges,
2. wireless repeaters,
3. outdoor wireless bridges, and
4. Wireless mesh networks

Vendor-Specific Topology Extensions (2)

Workgroup Bridges

- You will most likely have times when you have an isolated network that needs access to the rest of the network for access to the server farm and the Internet.
- You might not be able to run an Ethernet cable to the isolated network, or you might not own the property so you can’t drill holes in the walls, and so on.
- In this scenario, you would use a WGB topology

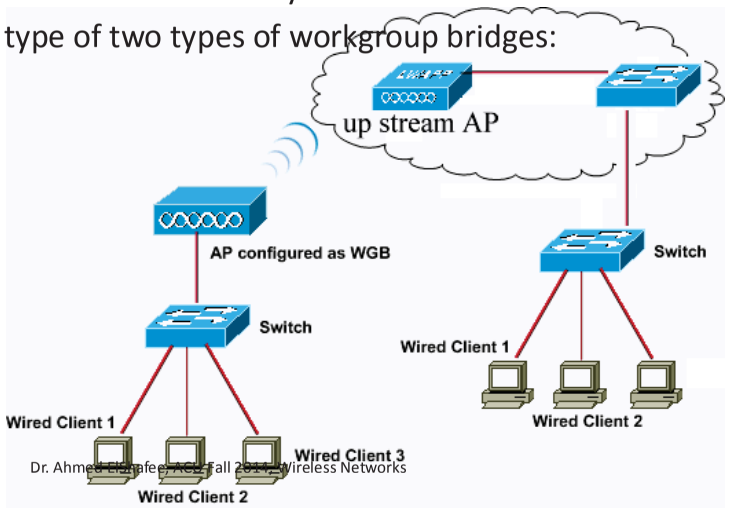
Vendor-Specific Topology Extensions (3)



Workgroup Bridge Topology

Vendor-Specific Topology Extensions (4)

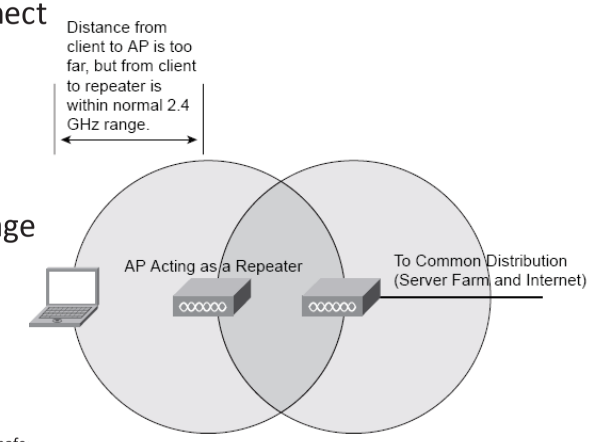
- Notice that the WGB is used to bridge a wired network to an AP that connects to a distribution system.
- There are two type of two types of workgroup bridges:



Vendor-Specific Topology Extensions (6)

Wireless Repeaters

- in an Extended Service Set (ESS), multiple APs connect clients.
- This is all well and good until you have clients roaming about who get into areas where coverage is necessary but not possible.



Wireless Repeater Topology

Vendor-Specific Topology Extensions (7)

- An example is a worker at a warehouse who carries a barcode scanner or even a wireless IP Phone.
- The solution of a WGB doesn't work, because a WGB connects users who are wired.
- There are scenarios where you can't run a cable into a location to install an AP.
- This is where you want to use a *wireless repeater.*
- *A wireless* repeater is simply an AP that doesn't connect to a wired network for its connectivity to the distribution network.
- Instead, it overlaps with an AP that does physically connect to the distribution network.
- The overlap needs to be 50 percent for optimal performance.

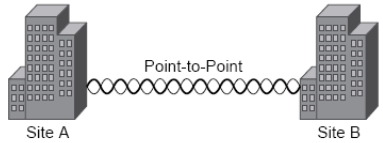
Vendor-Specific Topology Extensions (8)

- The catch is that you need a AP as the upstream "root" device, and only one SSID is supported in repeater mode.
- Additionally, the overall throughput is cut in half for each repeater hop.
- *Acts as repeater and AP*

Vendor-Specific Topology Extensions (9)

Outdoor Wireless Bridges

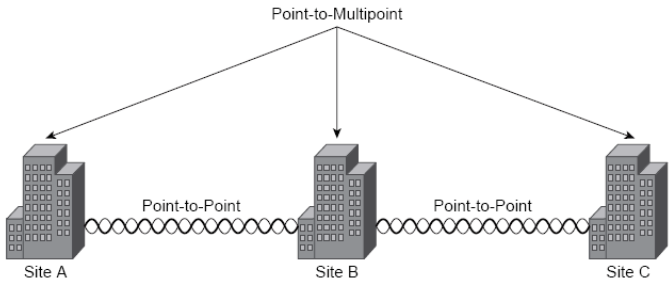
- When you have two or more LANs within a few miles of each other and you want to link them, you can use a wireless bridge.
- Because you are "bridging," the technology works at Layer 2.
- This means that the LANs do not route traffic and do not have a routing table.
- You can connect one LAN directly to another in a point-to-point configuration



Point-to-Point Wireless Bridge Topology

Vendor-Specific Topology Extensions (10)

- Each end of a point-to-multipoint topology would have to communicate through the hub if it wanted to communicate with the others.



Point-to-Multipoint Wireless Bridge Topology

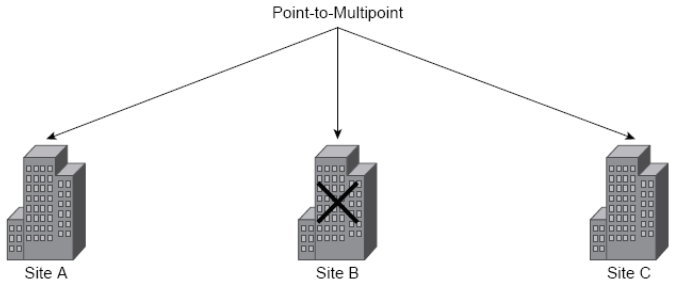
Vendor-Specific Topology Extensions (11)

Outdoor Mesh Networks

- As you can see, bridges are a good way to connect remote sites.
- However, suppose that you are operating in a point-to-multipoint topology, and the central site experiences congestion.
- Who suffers? Just the central site? Just the remote site? No; the answer is everyone.
- When two remote sites communicate through a central site, the central site makes all the difference

Vendor-Specific Topology Extensions (12)

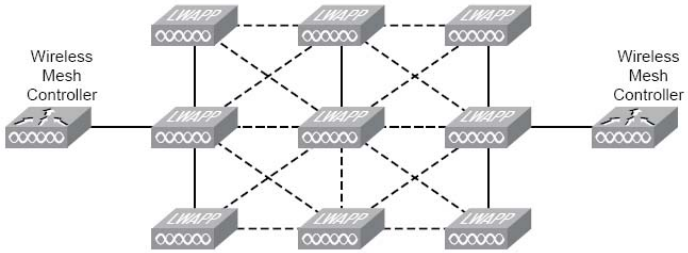
- Now the remote sites can't communicate with each other or the central site.
- This can be a major issue to contend with.
- The solution is to deploy a mesh network such as the one illustrated in Figure



Wireless Bridge Issues

Vendor-Specific Topology Extensions (13)

- The mesh solution is appropriate when connectivity is important, because multiple paths can be used.
- The IEEE is currently working on a mesh standard (802.11s).



Wireless Mesh Solution

Vendor-Specific Topology Extensions (14)

- When you have a mesh network, some *nodes (another term for APs in a mesh network)* are connected to a wired network. Some nodes simply act as repeaters.
- A mesh node repeats data to nearby nodes.
- More than one path is available, so a special algorithm is used to determine the best path.
- The alternative paths can be used when there is congestion or when a wireless mesh node goes down.

Thanks,

See you next Week, isA