Building Cisco Multilayer Switched Networks (BCMSN)

Wireless Client Access

http://www.INE.com

Types of Wireless Networks

- Personal Area Networks (PANs)
  - Short range for peripheral access
  - e.g. Bluetooth
- Wireless Local Area Networks (WLANs)
  - Medium range extension of normal Ethernet LAN
  - e.g. 802.11a/b/g/n (Wi-Fi)
    - Our focus for this class
- Metropolitan Area Networks (MANs)
  - Medium to long range replacement for last mile access
  - e.g. 802.16 (WiMAX)
- Wide Area Networks (WANs)
  - Long range
  - e.g. 3G cell phones, satellite

WLANs Overview

- WLANs replace Physical (layer 1) and Data Link (layer 2) transports with wireless
  - Upper layer protocols like IP/TCP/UDP/etc. are not affected
- Similar in many ways to legacy Ethernet
  - Uses MAC addresses for layer 2 addressing
  - WLAN is a shared media
    - Access Point (AP) acts like a hub/repeater
    - Uses same RF for transmit and receive
    - Implies communication is half-duplex
    - Collisions can occur

Collision Detection

- 802.3 (Ethernet) uses CSMA/CD
  - Listen on the wire for Contention Window duration
    - If, someone is transmitting, wait Backoff duration
    - Else, transmit
  - Listen for jam signal for Propagation Delay duration
    - If jam, collision occurred, wait Backoff duration
    - Else, transmission successful

Collision Avoidance

- In WLANs, collisions can't be detected…
  - Can't listen while sending
    - Implies we can't hear a jam signal
  - Possible "hidden terminal" problem
    - A is in range of B & C, but B & C are not in range of each other
- Instead, 802.11 (WLAN) uses CSMA/CA
  - Tries to avoid collisions before they happen
    - Uses Distributed Coordinated Function (DCF) with random Backoff timers to accomplish this
  - If ACK received, transmission assumed successful
    - AP is responsible for ACKing client data

Distributed Coordinated Function

- DCF is the implementation of collision avoidance
- Listen on RF channel
  - If free, transmit and advertise duration of frame
    - i.e. how many microseconds I need to transmit
  - Else
    - Wait for duration heard to expire plus DCF Inter Frame Spacing (DIFS)
    - Listen again for random Backoff duration
      - If free, transmit and advertise duration
      - Else, wait for duration to expire plus DIFS plus random Backoff…
- Since Backoff is random, unlikely that stations transmit at the same time

DCF Example

- HostA listens on RF and finds it free
  - Packet sent with Duration X and DIFS Y
- HostB listens and hears A sending
  - HostB must wait X + Y + random Backoff Z_B
- HostC listens and hears A sending
  - HostC must wait X + Y + random Backoff Z_C
- If $Z_B < Z_C$, HostB sends next
- If $Z_C < Z_B$, HostC sends next
- If $Z_B = Z_C$, collision will occur

WLAN SSIDs

- Ethernet LANs define who can talk to each other based on the broadcast domain (VLAN)
- With WLANs, everyone is in the same collision and broadcast domain
  - e.g. stations can receive everyone's traffic
- WLANs are logically separated based on Service Set Identifier (SSID) value
  - Devices with mismatched SSIDs (generally) ignore each others traffic
  - Does not affect collision domain

SSIDs and Modes

- SSIDs fall into three categories and two modes based on who participates in the WLAN
- Independent Basic Service Set (IBSS)
  - Ad hoc mode
  - Wireless clients without an Access Point
- Basic Service Set (BSS)
  - Infrastructure mode
  - Wireless clients associated with the same Access Point
- Extended Service Set (ESS)
  - Infrastructure mode
  - Wireless clients associated with multiple Access Points with the same SSID
  - Allows for advanced applications like transparent roaming

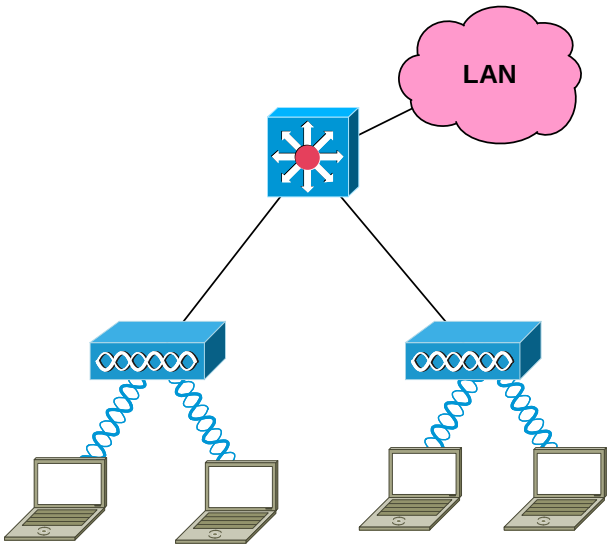
Wireless Association

- In order to communicate with an AP, clients perform a negotiation process called “association”
- Association steps are…
  - Client sends “probe request” to find AP
  - AP responds with “probe response”
    - AP can also send unsolicited “beacon”
  - Client starts association
  - AP accepts/rejects association
  - If successful, AP installs client’s MAC

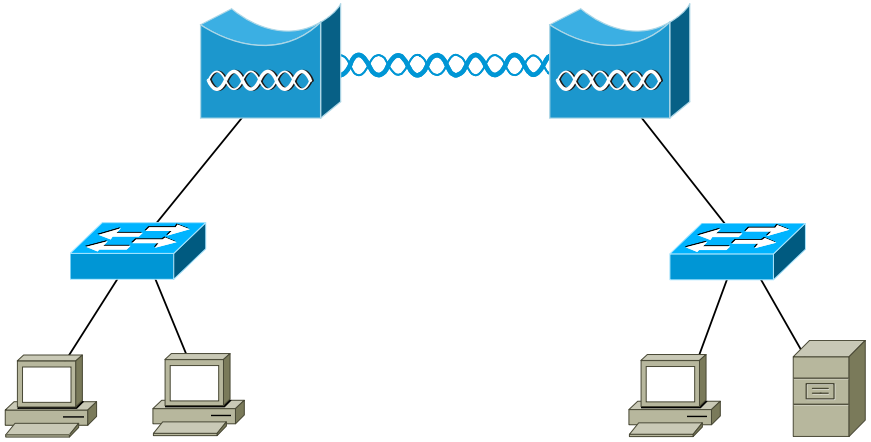
WLAN Topologies

- Once association is complete, APs main job is to bridge traffic either…
  - Wired to wireless
  - Wireless to wireless
- APs can performs different roles such as…
  - Bridges
    - Accept traffic in LAN and forward it to client
    - Used to translate between wired and wireless network
    - Can be point-to-point (Workgroup Bridge) or point-to-multipoint
  - Repeaters
    - Accept RF signal and resend it
    - Used to extend range of wireless network
  - Mesh topologies
    - Combination of both repeating and bridging
    - Used for fault tolerance, load distribution, transparent roaming, etc.

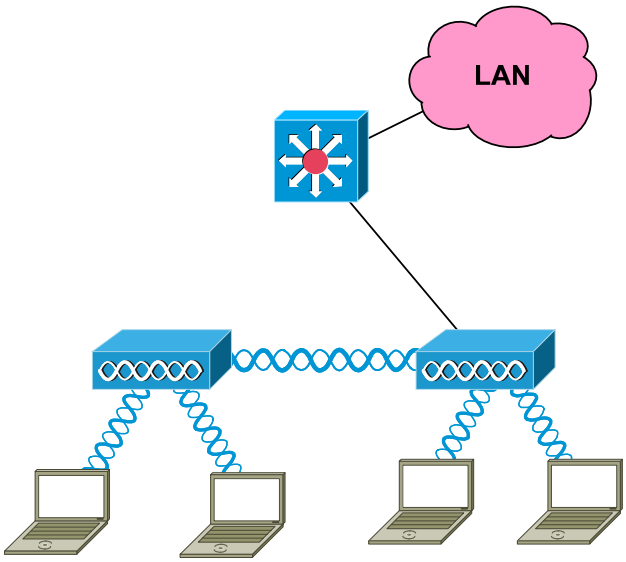
WLAN Multipoint Bridging Topology



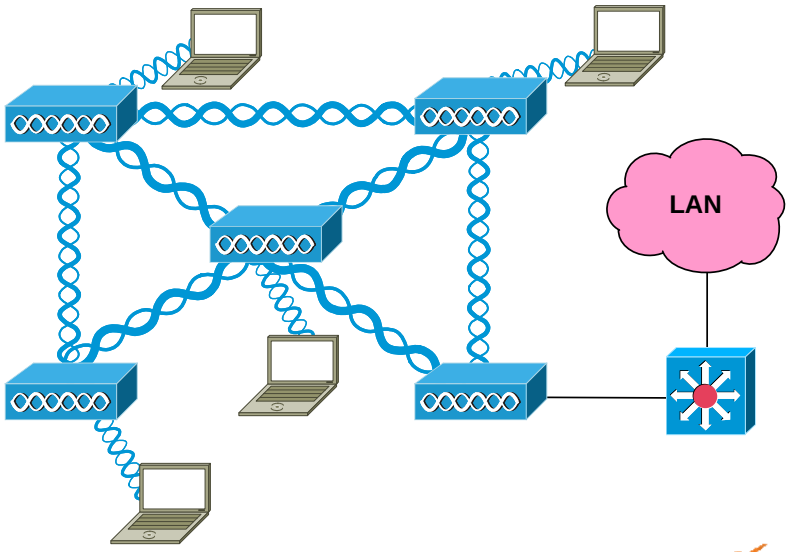
WLAN Point-to-Point Bridging Topology



WLAN Repeaters Topology



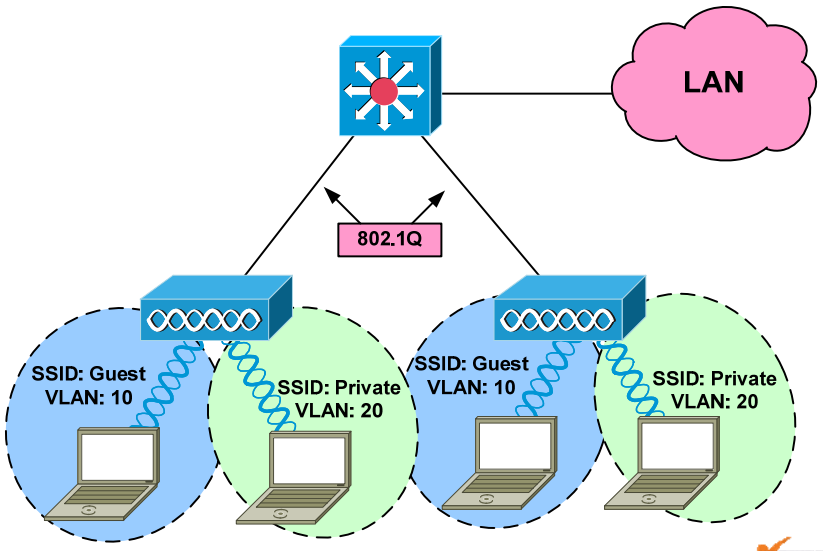
WLAN Mesh Topology



WLAN VLAN Support

- Enterprise APs (e.g. Aironet) can support multiple SSIDs per AP
- SSIDs can be mapped to VLANs, and then trunked back to the LAN via 802.1q
- Does not separate the broadcast or collision domain, but does create different logical segments
  - E.g. VLAN 10 SSID “guest” with open access
  - E.g. VLAN 20 SSID “private” with WPA2

WLAN VLAN Topology



Cisco Unified Wireless Solution

- Standalone or “autonomous” APs are easy to install, but in large deployment difficult to manage
  - Each AP requires manual config of parameters such as SSIDs, VLAN, Security, etc.
- CUWS adds scalability by separating the WLAN data plane and control plane into a “split MAC” design with two key components
  - Lightweight Access Points (LWAPs)
  - Wireless LAN Controllers (WLCs)

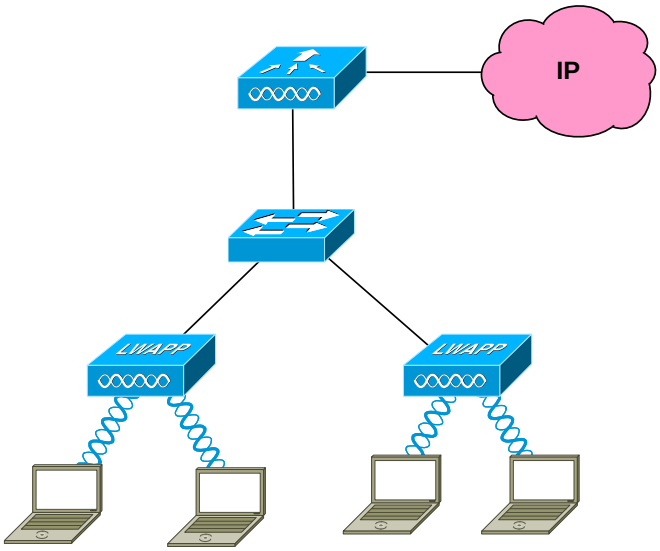
Lightweight WLANs

- Split MAC means that LWAP and WLC share functionality that an autonomous AP performs on its own
  - LWAP
    - Actual RF transmission
    - Controls real-time operations
      - Beacons, probes, buffering, etc.
  - WLC
    - Controls management and non real-time operations
      - SSIDs, VLANs, association, authentication, QoS, etc.
- LWAPs are now plug-and-play and require the WLC for operation

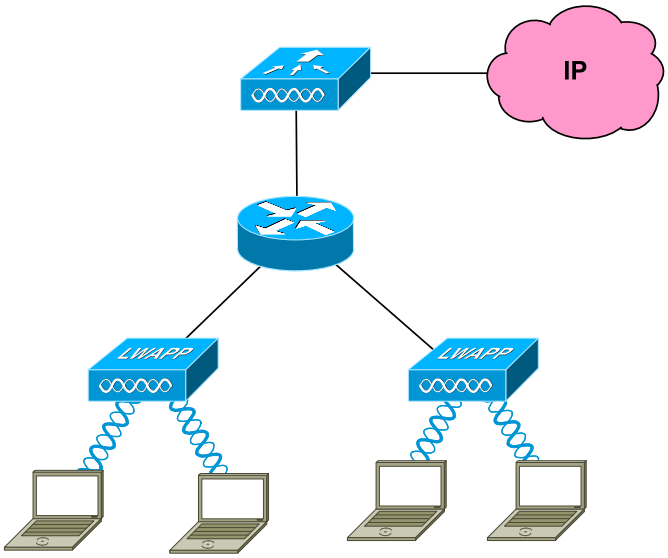
LWAP to WLC Communication

- All RF traffic an LWAP receives must first go to the WLC
  - Traffic forwarding paradigm now changes
    - Even for hosts associated to same AP
  - Tunneled with the Lightweight Access Point Protocol (LWAPP)
- LWAPP tunnel can run in two modes
  - Layer 2
    - LWAP receives 802.11 frame and encapsulates inside Ethernet towards WLC
    - Implies LWAP and WLC must be in same VLAN & subnet
  - Layer 3
    - LWAP receives 802.11 frame and encapsulates inside UDP towards WLC
    - Implies WLC can be anywhere as long as reachable

Layer 2 LWAPP Topology



Layer 3 LWAPP Topology



Wireless Client Configuration

- BCMSN blueprint also includes “Configure a wireless client (i.e. ADU)”
  - Refers to the Cisco Aironet Desktop Utility
- For more information visit ADU documentation at Cisco Aironet 802.11a/b/g Wireless LAN Client Adapters (CB21AG and PI21AG) Installation and Configuration Guide, Release 4.0

Wireless Q&A