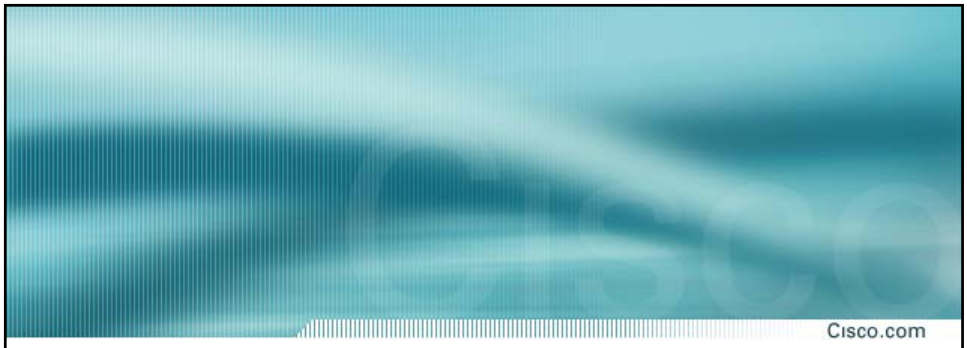

Wireless Radio Technology
WLAN topologies

Olga Torstensson
Halmstad University

Key terms

- Repeater
- VLAN
- Roaming
- Redundancy
- Load Balancing
- Hot Standby
- Scalability
- Multirate
- QoS

Wireless LAN Implementations

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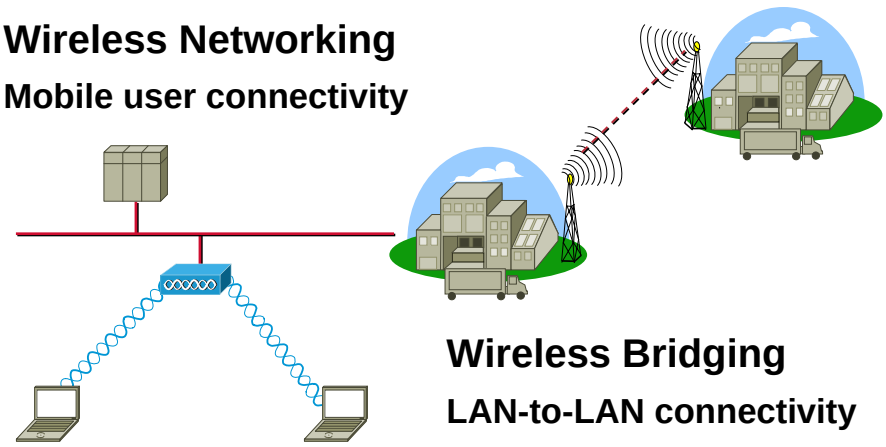
Wireless Networking

Mobile user connectivity



Wireless Bridging

LAN-to-LAN connectivity

Typical WLAN Topologies

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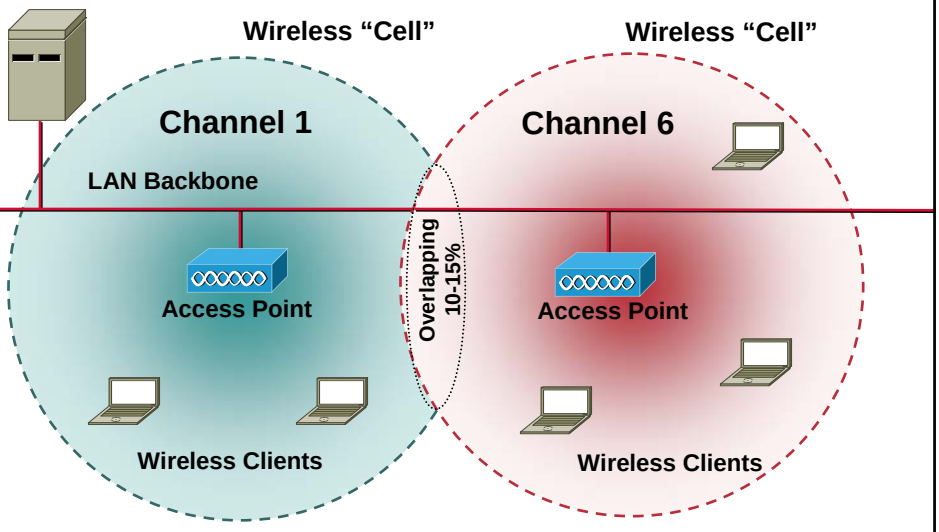

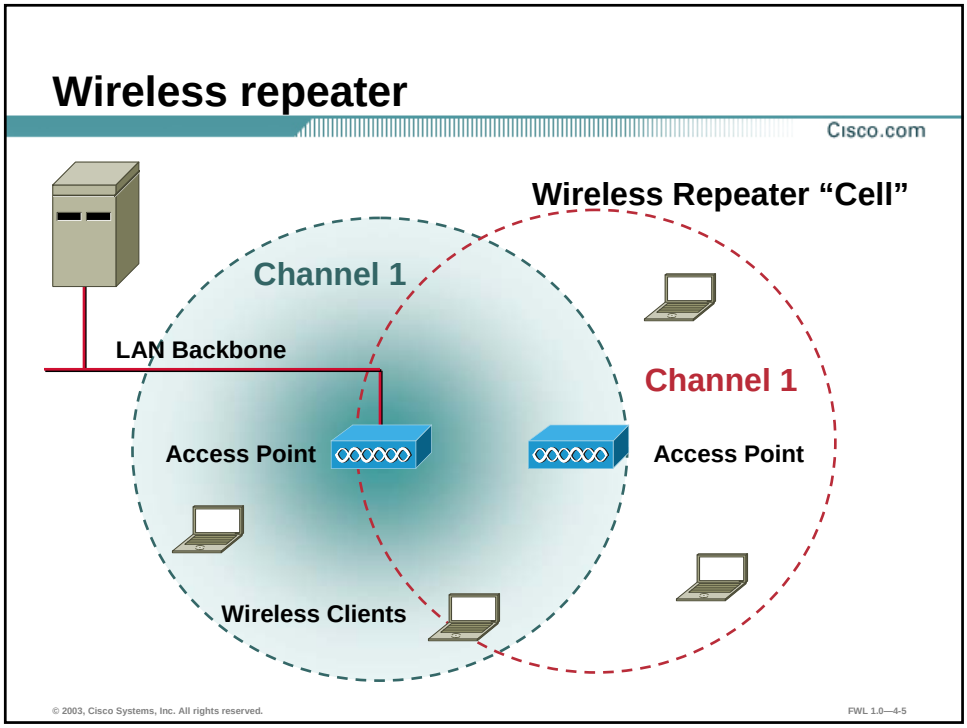

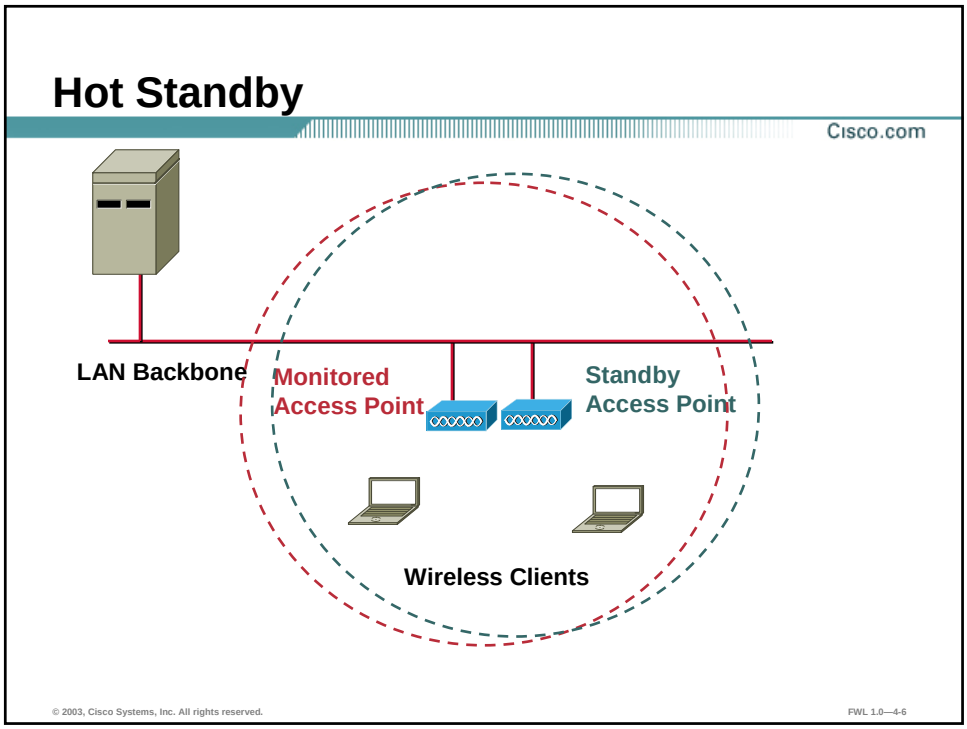

Alternative Peer-to-Peer Topology

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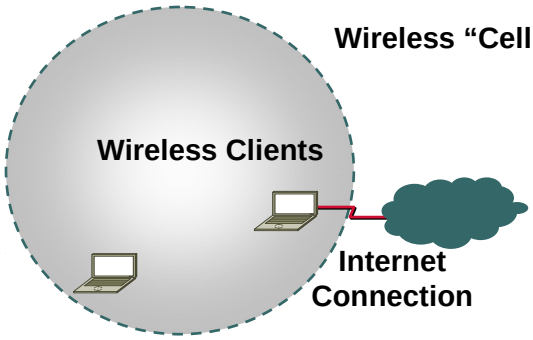
Peer-to-Peer Configuration (ad hoc mode)



Roaming

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- Factors need to be considered when designing a WLAN with seamless roaming capabilities for devices that are powered on while moving from one point to another:
  - Coverage must be sufficient for the entire path.
  - A consistent IP address should be available throughout the entire path.
- Clients will associate with initial AP. Re-association will occur as the AP strength weakens, and a new AP is found for association.

Association

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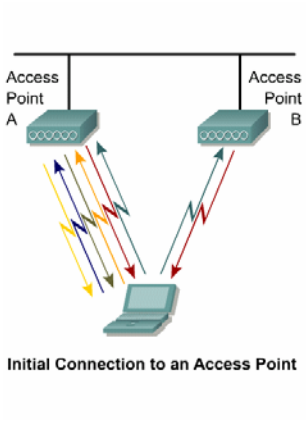

Initial Connection to an Access Point

Steps to Association:

- Client sends probe.
- AP sends Probe Response.
- Client evaluates AP response, selects best AP.
- Client sends authentication request to sselected AP (A).
- AP A confirms authentication and registers client.
- Client sends association request to selected AP (A).
- AP A confirms association and registers client.

If more than one AP replies, the client will associate based on the information returned.

Re-association

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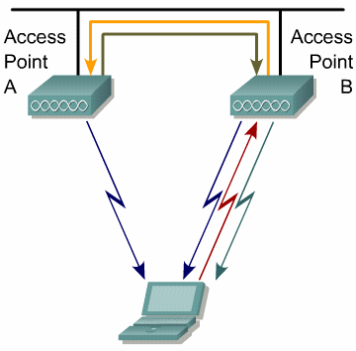

Roaming from Access Point A to Access Point B

Steps to Re-association:

- Adapter listens for beacons from APs.
- Adapter evaluates AP beacons, selects best AP.
- Adapter sends association request to selected AP (B).
- AP B confirms association and registers adapter.
- AP B informs AP A of re-association witth AP B.
- AP A forwards buffered packets to AP B and de-registers adapter.

Scalability

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- Scalability is the ability to locate more than one access point in the same area. This will increase the available bandwidth of that area for all users local to that access point.
- Depending on the number and speed of the available channels, cells can achieve higher data rates.
  - With 802.11b, there are 3 separate, 11-Mbps channels, yielding up to a theoretical 33 Mbps per cell. User devices operate at a maximum theoretical value of 11Mbps, since they can only connect to one AP at any given time.
  - 802.11a has 8 54 Mbps channels, yielding a theoretical 432 Mbps.

Channel Setup Overview

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- There are two critical steps for a good WLAN deployment:
  - Determine number and placement of access points or bridges. Very few gaps in the coverage should be left. These gaps are essentially dead air and the client will lack connectivity in these locations.
  - Map out the channel assignments: There should be as little overlap as possible between channels that use the same frequency.
- Remember: 802.11b has 3 channels, 802.11a has 8 channels.

Access point coverage & comparison

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- As a client moves away from the AP, the transmission signals between the client and AP weaken.
- Rather than decreasing reliability, the AP shifts to a slower data rate, which gives more accurate data transfer. This is called data rate or multi-rate shifting.
- This happens without losing the connection, and without any interaction from the user.

Rate Shifting

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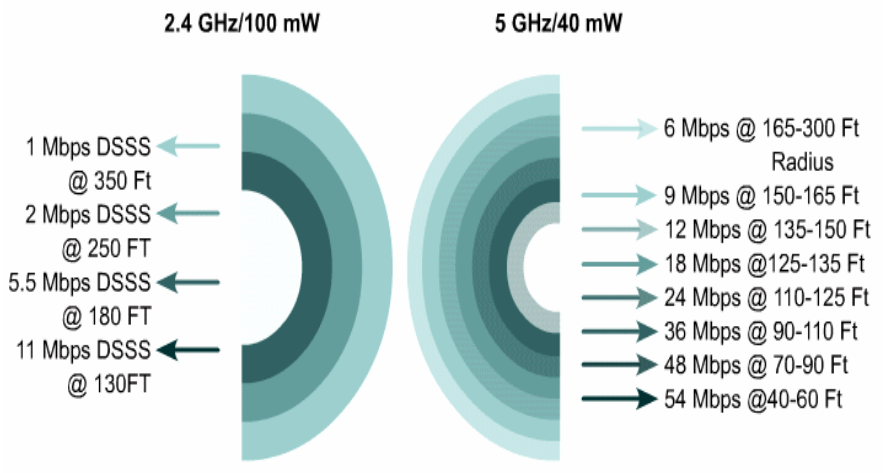

Multi-rate implementation

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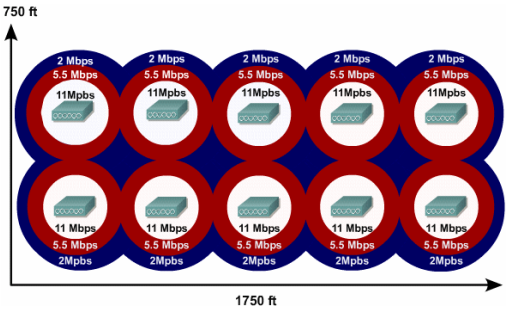

- The distance from an access point effects the available bandwidth. Multi-rate technology allows a step down in bandwidth to gain greater coverage distances.
- If 11Mbps is required everywhere, the access points would need to be relocated, so that only the 11-Mbps circles are touching each other, with some overlap.

Bridge Topologies Root modes

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- Access points and bridges have two different root modes, in which to operate the following:
  - Root = ON: The bridge or AP is a root. If it is a bridge, then it is called the master bridge.
  - Root = OFF: The bridge or AP is not a root.
- This setting controls when associations and communication between different infrastructure devices will be allowed.

Bridge Root Modes

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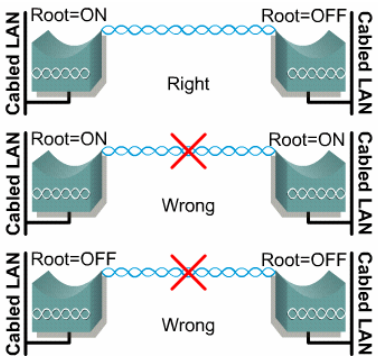

Root=ON

- Accepts association and communication with clients and repeaters
- Will not communicate with other Root=On devices.

Root=OFF

- Associates and communicates with Root=ON master bridge only.

Access Point Root Modes

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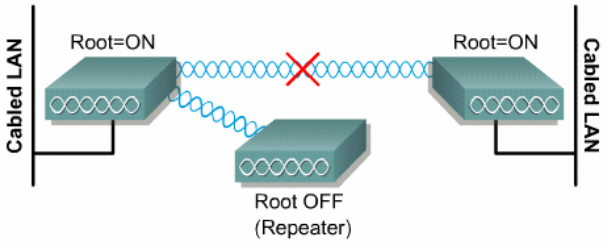

Access Point - Root Mode

Root=ON (Root)
- Accepts association and communicates with ONLY clients and repeaters.
- Will NOT communicate with other Root=ON devices
- There can be any number of Root=ON per RF system

Root=OFF (Repeater)
- Associates and communicates to a Root=ON or another Root=OFF that is associated to a Root=ON
- Accepts association and communicates with ONLY clients and repeaters, as long as it is registered to a Root=ON
- The Ethernet interface is disabled

Point-To-Point Wireless Bridging

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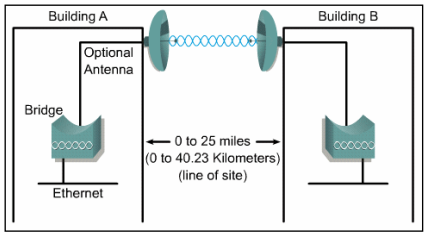
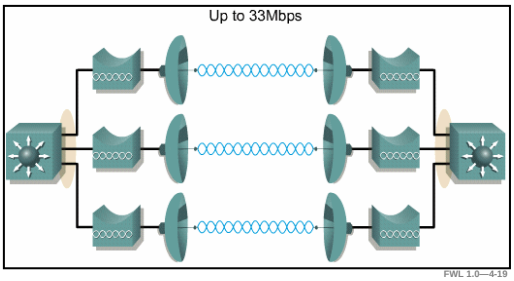


Point-to-point wireless bridges, two LANs can be located up to 25 miles apart.

Antennas must have line-of-site. Obstacles cause communication problems.

One bridge to Root = ON and the other Root = OFF.

With Cisco IOS, it is possible to use Fast Etherchannel or multi-link trunking, to aggregate up to three bridges together, yielding 33 Mbps.



Point-to-multipoint configuration

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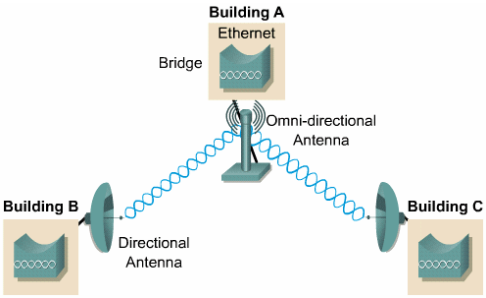

All the LANs appear as a single segment. Traffic from one remote site to another will be sent to the main site and then forwarded to the other remote site. Remote sites cannot communicate directly with one another.

- **Omni directional antenna used at the main site. Directional antennas at the remote sites.**
- **Line of sight must be maintained between remote and main sites.**
- **Main bridge** Root = ON **and all other bridges** Root = OFF**/**

Distance limitations

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- For distances ≤ 1 mile, the workgroup bridge and AP can be used.
- For > 1 mile, bridges should be used.
- Using an AP or WGB for greater distances is unreliable due to timing constraints.
- Cisco bridge products have a timing parameter that can be adjusted (violating 802.11 standards), to support distances over 1 mile.

Bandwidth

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- The maximum aggregate date rate can only be achieved in a cell, if all remote units are operating at the highest rate. The number of users that can be supported by a single AP is dependent upon the bandwidth and the application needs.
- Typical throughput will be lower than maximum data rate for all devices.

Ad Hoc Topology

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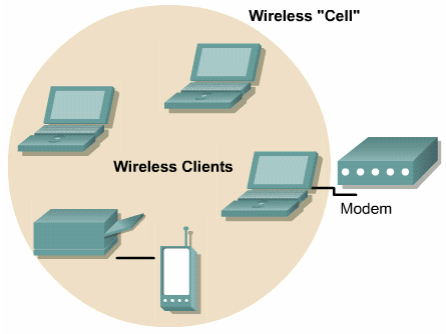

- Peer-to-Peer (Ad Hoc) Topology (IBSS)
  - Can consist of 2 or more PCs with wireless network adapters.
  - Sometimes called an Independent BSS.
  - Limited range.

Basic Infrastructure Topology (BSS)

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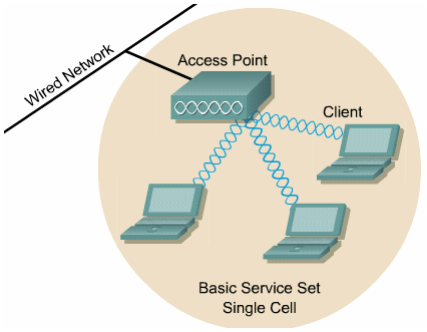

- Building block of an 802.11 LAN that covers a single cell
- When a device moves out of its BSS, it can no longer communicate with other members of the BSS.
- Uses infrastructure mode, requires an access point (AP).
  - All stations communicate through the AP, not directly with peers.
  - A BSS has one service set ID (SSID).

Extended Infrastructure Topology (ESS)

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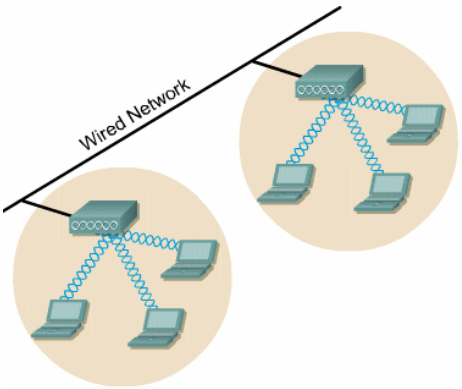

- 2 or more BSSs that are connected by a common distribution system
- Allows the creation of a wireless network of arbitrary size and complexity.
- All packets in an ESS must go through one of the APs.

Base Station-Dial-up

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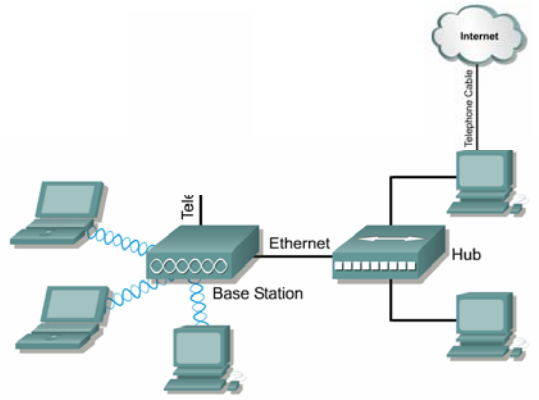

Designed for the small office/home office (SOHO). Gives telecommuters, SOHOs, and home users the convenience of wireless connectivity.

Base Station—DSL

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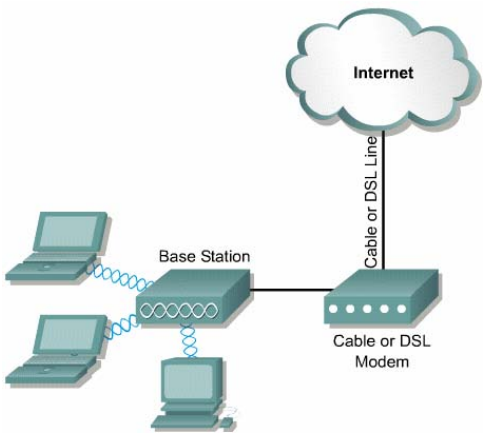

- Offers support for a Cable or DSL modem
- Will only support wireless clients.
- DHCP functionality is supported, but access to the wired network is not provided, as the Ethernet port must be used to connect to the Cable/DSL modem.
- Support for PPP over Ethernet.

Campus Topologies

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- Serves as an access system that incorporates complete mobility.
- Allows users to access information from unwired places outdoors, in dining halls or informal study spaces, from classroom seats and, even, the athletic fields
- Not a replacement for the wired LAN.
- Provides networking in hard-to-reach and/or temporary locations.
- Allows users to work together in common areas will maintaining network access.

Campus topologies

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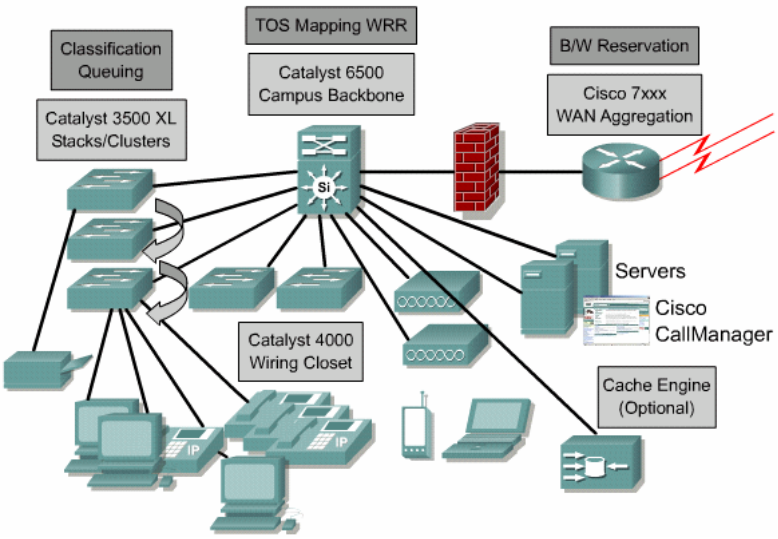

WLAN addition to AVVID

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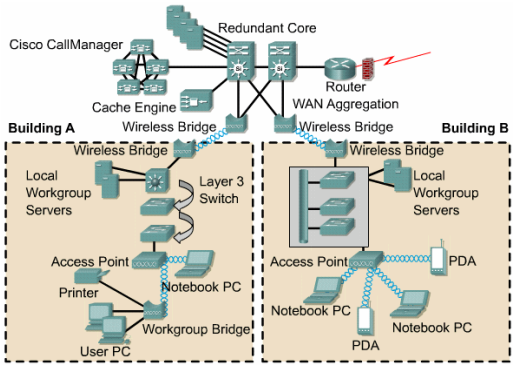
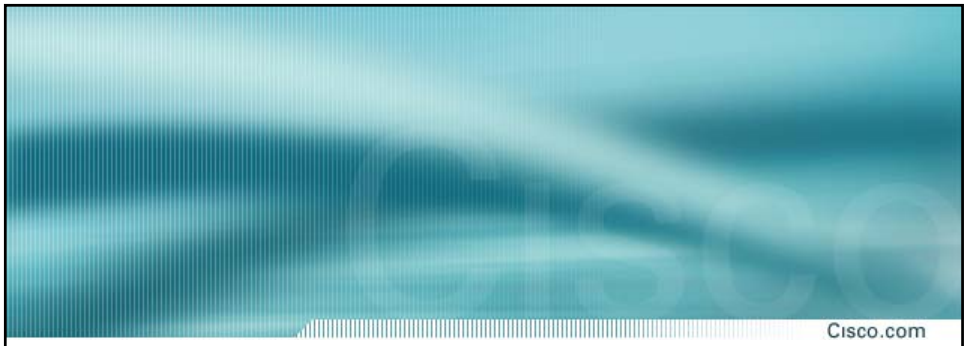


- **WLANs are part of Cisco's Architecture for Voice, Video, and Integrated Data (AVVID). AVVID provides the roadmap for combining business and technology strategies into one cohesive model.**



VLAN, QoS and Proxy Mobile IP

VLAN features

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- Security—separating systems that have sensitive data from the rest of the network.
- Departments/job types—VLANs set up for departments that are heavy network users or a VLAN that is dedicated to specific types of employees.
- Broadcasts/Traffic flow—Since a principle element of a VLAN is the fact that it does not pass broadcast traffic to nodes that are not part of the VLAN, it automatically reduces broadcasts.
- WLANs can now fit nicely into the larger network because VLANs have been enabled on the Access Points. This allows WLAN users to roam from access point to access point maintaining connectivity to the proper VLAN.

VLANs in the Wireless network

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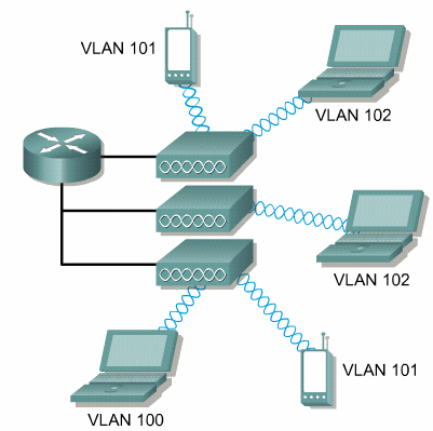

- VLAN 100 allows guest access.
- VLAN 101 supports barcode scanners with WEP security.
- VLAN 102 supports 802.1x EAP security.

Quality of Service (QoS) feature

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- Used for time critical traffic (voice, video)
- Current support for downstream QoS only: AP to client. (802.11q)
- Upstream will be supported with firmware upgrade. (802.11e QoS)
- 802.11e includes:
  - Enhanced Distributed Coordination Function (eDCF), which is responsible for prioritization.
  - Transmission Opportunity (TXOP), which is responsible for transmission control.

Enhanced Distributed Coordination Function

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- eDCF allows higher priority traffic first access to the WLAN media.
- With QoS, instead of backing off for a random period of time, high priority packets will back off for reduced amount of time.
- The higher priority traffic passes through the AP faster than packets with lower priority.

Transmission Opportunity

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- Transmission Opportunity (TXOP) is for environments that have a large amount of WLAN traffic.
- High priority packets will only wait a few seconds to retransmit.
- If the traffic volume is still high, the high priority packet will continue to resend again and again.
- TXOP will always reserve a place in line for the high priority packets by reserving the first few seconds for high priority packets, guaranteeing priority packet handling.
- If there is not a high priority packet in the queue, the AP processes the next packet in line.

Proxy mobile IP: Layer 2 Roaming/IAPP

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- 802.11 does not define how APs track mobile users or how APs negotiate a handoff from one AP to the next (roaming).
- Several companies have introduced proprietary Inter-Access Point Protocols (IAPP) to support roaming.
- IAPP accomplishes roaming within a subnet. However, it does not address how the wireless system tracks users moving from one subnet to another when the same session must be maintained, as in the case of voice calls.

Layer 3 Roaming / Mobile IP

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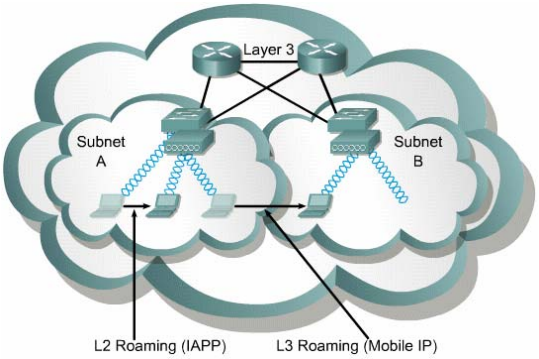

Where wireless is being deployed across multiple subnets, there are options to achieve seamless roaming.

Wireless client adapters can contain proprietary client IP stacks that understand mobility and allow roaming between subnets. All mobile users on the network must have special software installed.

Layer 3 Roaming / Proxy Mobile IP

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- The wireless infrastructure contains the intelligence to allow user roaming.
- Cisco's Proxy Mobile IP is designed for use in complex network environments. As the wireless device leaves an area and enters the next, the new AP queries the device for its home agent.
- After the home agent has been located, packet forwarding is established automatically between the new and old APs to ensure the device can transparently exchange data.
- Does not require installation of client-side software; however both the router and the APs must be configured to support Proxy IP.

Proxy Mobile IP

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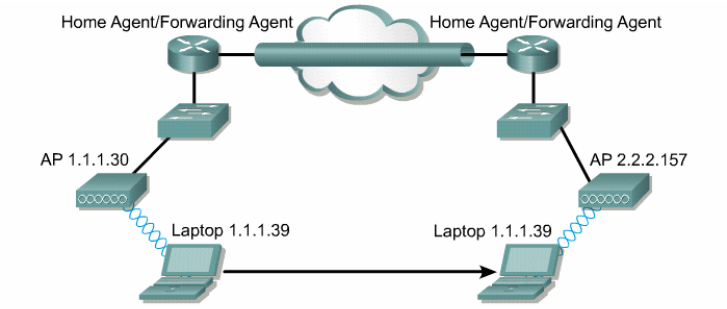

Before Roam
- Client is in the subnet of AP
- All traffic directly connecting to client

After Roam
- Client IP address does not change
- Since AP is in a different subnet all traffic must go through router for directions