Wireless Design Models, Topologies and Infrastructure

Chapter 5

COMP3049 – CWNA

Objectives

- Define and describe the concepts of STAs, BSSID, IBSS, ESS
- Define and describe wireless distribution systems (DS) and media
- Outline different WLAN design models
- List and explain the different WLAN power management models and how they work

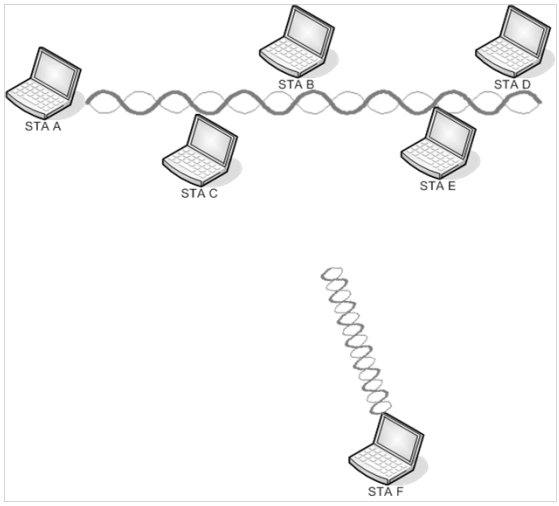
WLAN Service Sets

- Stations (STAs)
  - Any device that has 802.11 MAC and PHY compliant interface to WM
    - APs, PCs, Servers, PDAs, Residential Gateways (Wireless Routers), Print Servers, Presentation Gateways, Wireless Bridges, Wireless Gaming Adapters, Wireless VoIP devices
  - All 802.11 capable devices have STA services
- BSS – Basic Service Set
  - Basic Service Set: a set of STAs that have successfully synchronized
  - All STAs using DCF in the same channel and area, form a BSS

WLAN Service Sets

- BSA – Basic Service Area
  - A conceptual area within which members of a BSS may communicate
  - STAs may communicate directly (IBSS) or via an AP (BSS)
- IBSS
  - Also known as Ad Hoc mode
  - STAs communicate with directly with each other
  - No AP is present or no STAs associated with an AP

IBSS or Ad Hoc BSA



WLAN Service Sets

- Infrastructure Mode (Extended Service Set)
  - ESS is made possible when one or more BSSs share the same Service Set Identifier
  - *A set of one or more BSSs that appear as a single BSS to LLC at any STA associated with one of those BSSs*
  - No real *central controller*
  - Requires participating APs to be connected via a DS

WLAN Service Sets

- Don’t confuse SSID, BSSID, ESSID
- BSSID is the MAC address of a station participating in a BSS or ESS
  - Used by APs to track associations
- SSID is the name of the network
- ESSID is not part of 802.11
  - It is simply a shared SSID

WLAN Service Sets

- DS – Distribution System
  - What is used to connect multiple BSSs together
  - 802.11 standard allows Ethernet and others, such as Token Ring or even another form of wireless (WiMAX, cellular, etc.)
- DSM – Distribution System Medium
  - The medium used to interconnect APs in an ESS (Ethernet, Token Ring, etc.)

WLAN Service Sets

- DSS – Distribution System Services
  - Services that provide delivery of frame payloads between STAs in a BSS
  - 802.11 does not specify any
  - AP *drops* frames into a DSS and hopes that the infrastructure (routers, switches) will take care of delivering them

WLAN Service Sets

- Starting and joining an IBSS
  - First STA coming on defines the SSID
  - STAs can start an IBSS without scanning WM
- Starting and joining an ESS
  - Started when an AP is turned on and configured
  - AP sets SSID, PHY parameters, beacon period, data rates available

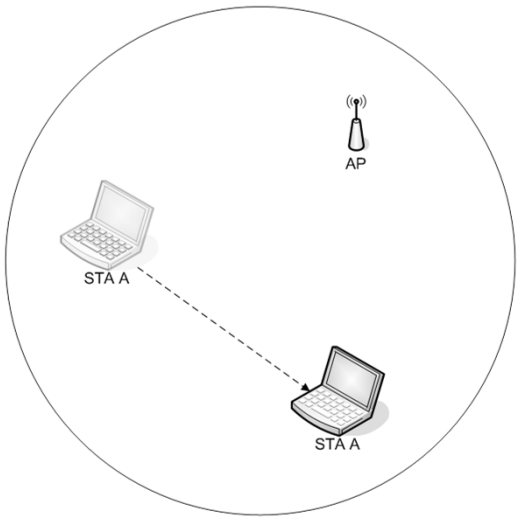
Layer 2 and Layer 3 Roaming

- STAs in a BSS are potentially associated with an ESS
- A STA may move out of range of an AP, disassociate and associate with another in the same ESS
- This is known as *roaming*

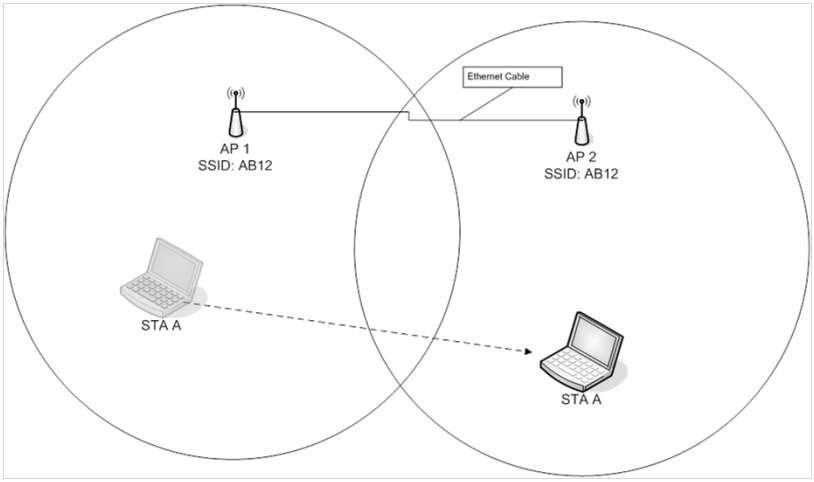
Layer 2 and Layer 3 Roaming

- Different types or roaming:
  - No-Transition – static or local movement
  - BSS-Transition – moving to different BSS in the same ESS. Connection is not lost
  - ESS-Transition – moving from a BSS in one ESS to a BSS in another ESS
    - Upper layer connections are not guaranteed and likely to be lost

No Transition



BSS Transition



Layer 2 and Layer 3 Roaming

- Seamless roaming involves not losing upper layer connections
- Reconnecting roaming involves reconnecting to the network
  - Requesting a new IP address, etc.
- Partially covered in IEEE 802.11F
- However, 802.11r (Fast Roaming) may provide a solution when ratified

Layer 2 and Layer 3 Roaming

- IEEE 802.11F
  - When a STA associates, AP will send an IAPP-ADD notify packet
  - IAPP-ADD uses multicast; informs other APs of the MAC address of an associated STA
  - IAPP-ADD is only processed by other nodes using IAPP
  - All APs should update their association tables
  - Capital “F” means it’s a stand-alone standard, not an amendment

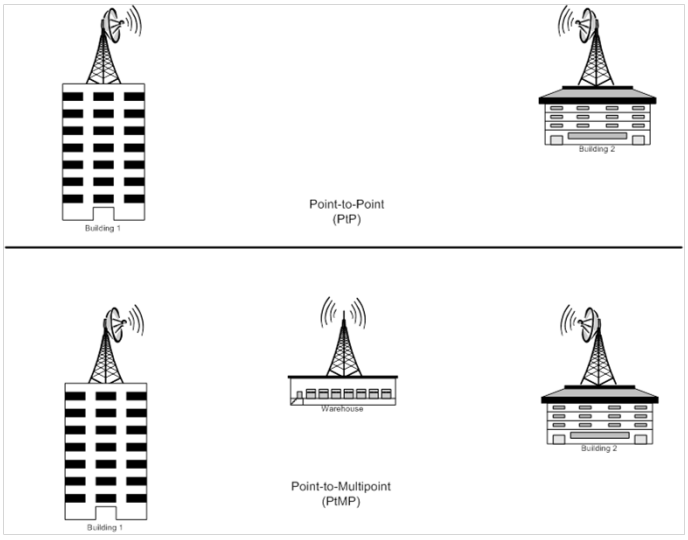
Layer 2 and Layer 3 Roaming

- IEEE 802.11F (cont'd.)
  - STAs send IAPP-MOVE request to reassociate with another AP in the same ESS (same SSID)
  - New AP will send IAPP-MOVE-notify to old AP
  - Old AP should send an IAPP-MOVE-response to new AP
  - 802.11F is no longer used; vendors have implemented proprietary mechanisms

WLAN Design Models

- Site-to-Site Connections
  - Point-to-Point (PtP or P2P)
    - Dedicated connection between two wireless devices
    - Usually wireless bridges connecting two wired LANs (building to building, outdoor applications)
    - Use semi-directional or highly directional antennas
  - Point-to-Multipoint (PtMP or P2MP)
    - Involves more than one link into a central link
    - Indoor or outdoor
    - Used when repeaters required or from WISP to customers

WLAN Design Models



WLAN Models

- Single MAC model
  - Edge, autonomous, or stand-alone
  - Fat APs; all 802.11 services reside on AP
  - Requires more ongoing support; decentralized administration
  - APs may be more expensive and be able to handle fewer STAs
  - No single point of failure; more features in ea. AP; less wired net traffic

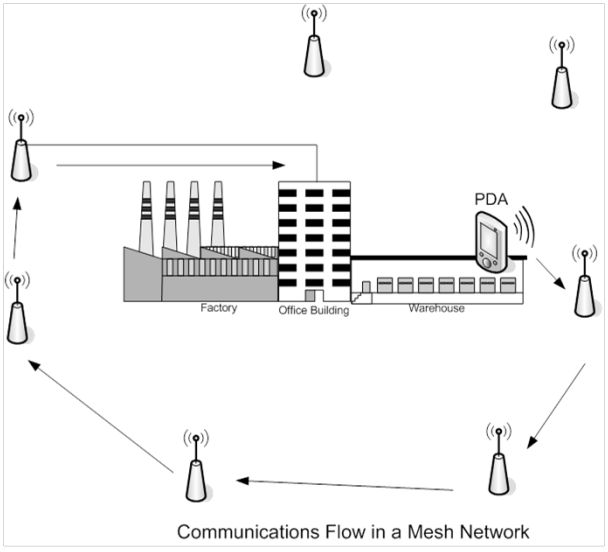
WLAN Models

- Split MAC Model (Centralized)
  - Portions of MAC layer handled by AP
  - Other portions handled by controller
    - Multiple radios (slim or dumb APs)
  - Possible single point of failure (controller)
  - Increased wired traffic to manage wireless STAs
  - APs usually less expensive; able to handle more STAs

WLAN Models

- Wireless Mesh Networks
  - Multipoint-to-Multipoint network
  - Today, the more wireless we implement, the more wires we install
  - APs can connect to each other over WM
  - Commonly known as a WDS – Wireless Distribution System
  - Covered in 802.11s

WLAN Models



Communications Flow in a Mesh Network

Evolution of WLAN Models

- Intelligent Edge (Distributed)
  - Fat (smart) or autonomous APs
  - Good for small LANs; WLANs with many APs are difficult to manage
- WNMS – WLAN Network Management System
  - Centralized management; distributed processing
  - Faster implementation than fat APs
  - Still uses autonomous APs

Evolution of WLAN Models

- Centralized WLAN Architecture (split MAC)
  - Lightweight or thin APs
  - APs depend on network connection to central controller or wireless switch
  - APs called *dumb* radios or Access Port
  - Much easier to manage; can perform many automated adjustments

Evolution of WLAN Models

- Distributed Data Forwarding (DDF)
  - APs can perform more functions than thin APs
  - Can still be managed by central controller
- Unified WLAN Architecture
  - Wireless control functions integrated on all standard wired switches
  - Specialized controllers no longer required

WLAN Power Management

- Active Mode
  - No power management used
  - Normally used in desktop computers
- Power Save Mode (TIM/DTIM/ATIM)
  - STAs can be awake or sleep (doze) for short periods of time
  - 802.11 radios consume too much power for battery devices
  - STAs awake periodically to check if there are frames cached at the AP, waiting to be xmitted

WLAN Power Management

- WMM Power Save
  - Adds power management function called *unscheduled automatic power-save delivery (U-APSD)*
  - Must use QoS capable APs
  - Provides longer battery life for VoIP phones, etc.
  - Also supports TIM/DTIM/ATIM

WLAN Power Management

- TIM – Traffic Indication Map
  - Every STA associated with an AP has an AID (association identifier)
  - TIM is xmitted in the beacons
  - Tells STA if traffic is waiting at the AP
  - STAs can *sleep* between beacon frames to save power

WLAN Power Management

- DTIM – Delivery Traffic Indication Map
  - Some frames are multicast
  - APs specify when next DTIM will occur
  - STAs must be awake for every DTIM
  - Every beacon contains a TIM
  - Only every n^{th} beacon contains a DTIM

WLAN Power Management

- ATIM – Ad Hoc Traffic Indication Map
  - Period of time when all STAs in an ad hoc WLAN must be awake
  - Sent as unicast frames by STA having frames destined for one other
- Administrators must strike a balance between power management and WLAN performance