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Certified Wireless Network Administrator (CWNA) PW0-106

Chapter 7
Wireless LAN Topologies

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Chapter 7 Overview

- Wireless Networking Topologies
  - Wireless Wide Area Network (WWAN)
  - Wireless Metropolitan Area Network (WMAN)
  - Wireless Personal Area Network (WPAN)
  - Wireless Local Area Network (WLAN)
- 802.11 Configuration Modes
  - Access Point Modes
  - Client Station Modes

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Chapter 7 Overview (continued)

- 802.11 Topologies
  - Access Point
  - Client Station
  - Integration Service (IS)
  - Distribution System (DS)
  - Wireless Distribution System (WDS)
  - Service Set Identifier (SSID)
  - Basic Service Set (BSS)
  - Basic Service Set Identifier (BSSID)
  - Basic Service Area (BSA)
  - Extended Service Set (ESS)
  - Independent Basic Service Set (IBSS)
  - Mesh Basic Service Set (MBSS)

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Wireless Networking Topologies

- Wireless technologies are arranged into four major wireless topologies:
  - Wireless Wide Area Network (WWAN)
  - Wireless Metropolitan Area Network (WMAN)
  - Wireless Personal Area Network (WPAN)
  - Wireless Local Area Network (WLAN)

Wireless Wide Area Network (WWAN)

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- Provides RF coverage over a vast geographical area
- May traverse an entire state, region, or country, or even span worldwide
- Typically use cellular telephone technologies or proprietary licensed wireless bridging technologies
- Examples include GPRS, CDMA, TDMA, LTE, GSM
- Data rates and bandwidth are relatively slow when compared to 802.11
- The convergence of Wi-Fi technology and cellular technologies is a fast-growing vertical market

Wireless Metropolitan Area Network (WMAN)

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- Provides RF coverage to a metropolitan area such as a city and the surrounding suburbs
- One wireless technology associated with a WMAN is the 802.16 standard
- Direct competitor to broadband services such as DSL and cable
- Thought of as a last-mile data-delivery solution
- Some 802.11 vendors have partnered with 4G/LTE companies to create metro WMANs

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Wireless Personal Area Network (WPAN)

- Wireless computer network used for communication between computer devices with close proximity of a user
- Devices such as laptops, gaming devices, tablet PCs, and smartphones can communicate with each other
- Examples: Bluetooth and infrared
- 802.11 WPAN example would be an ad-hoc connection between 2 or more computers

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Wireless Local Area Network (WLAN)

- 802.11-2007 standard is a WLAN
- Provides networking for building or campus
- 802.11 is perfect fit for WLAN due to range and speed
- Multiple access points connected by a wired network backbone
- Provides end users with access network resources and services

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802.11 Topologies

- Main component is the radio card, referred to as a *station (STA)*
- STA can reside in an access point or client
- 802.11-2007 standard defines three *service sets*
  - Basic Service Set (BSS)
  - Extended Service Set (ESS)
  - Independent Basic Service Set (IBSS)
- Mesh Basic Service Set (MBSS) – defined by the 802.11s-2011 amendment

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Review of Basic Networking Terms

- Simplex
  - One device can transmit only
  - Other device(s) can receive only
- Half-Duplex
  - Both devices can transmit and receive
  - Only one device can transmit at a time
  - Used by 802.11
- Full-Duplex
  - Both devices can transmit and receive at the same time

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Access Point (AP)

- Essentially wireless equivalent of a wired hub (although actually operates at layer 1 and 2)
- Half-duplex device
- Autonomous Access Point – Standalone device
- Cooperative Access Point – APs with switchlike intelligence that work together
- Controller-Based Access Point – "Thin" or lightweight AP that communicates with central controller, where the network intelligence resides

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Access Point (AP)

- MAC Service Data Unit (MSDU) – Upper-layer information contained in the 802.11 wireless data frame
- Distribution System Services (DSS) – Switchlike intelligence in AP or WLAN controller that forwards the MSDU
- Many APs also support the use of *virtual local area networks* (VLANs)

Client Station

- Radio card that is not part of an access point
- Built into many user devices; laptops, tablets, scanners, phones, and other mobile devices
- All stations (AP or client) contend for the half-duplex medium in the same manner
- Associated – When a client station has a layer 2 connection with an access point

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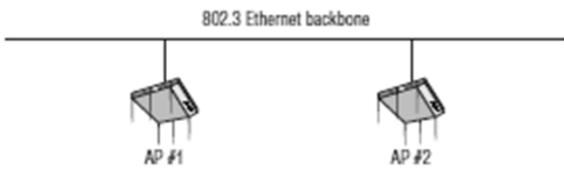
Integration Service (IS)

- Enables delivery of MSDUs between the distribution system (DS) and a non-802.11 LAN, via a portal
- Portal is usually either an AP or WLAN controller
- Eventual destination of the MSDU payload is usually a wired network
- Removes the 802.11 header and trailer, then bridges the frame to the other network, such as an 802.3 network

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Distribution System (DS)

- Used to interconnect a set of basic service sets (BSSs) to create an extended service set (ESS)
- Consists of two main components
- Distribution System Medium (DSM) – medium used for communications between APs
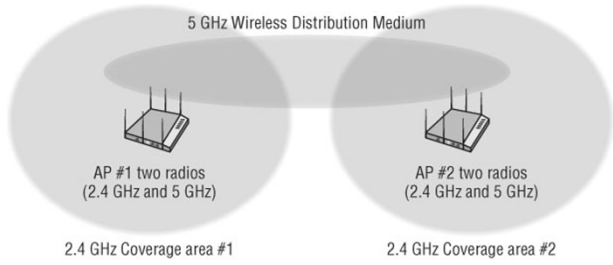- Distribution System Service (DSS) – Services provided to transport STA MSDUs between APs within an ESS

802.3 Ethernet backbone

AP #1   AP #2

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Wireless Distribution System (WDS)

- Distribution system services using a four-MAC-address wireless frame format
- Wireless backhaul
- Wireless bridge, repeater, or mesh network

5 GHz Wireless Distribution Medium

AP #1 two radios   AP #2 two radios
(2.4 GHz and 5 GHz)   (2.4 GHz and 5 GHz)

2.4 GHz Coverage area #1   2.4 GHz Coverage area #2

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Wireless repeater

- Client station sends a frame to the repeater and it is forwarded to an AP connected to the wired backbone. The frame payload is converted into an 802.3 Ethernet frame and sent to a server on the backbone.
- The 802.11 communications between the repeater and the access point is a WDS.
- A frame sent within any type of WDS requires four MAC addresses, a source address, a destination address, a transmitter address, and a receiver address.

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Wireless repeater

18
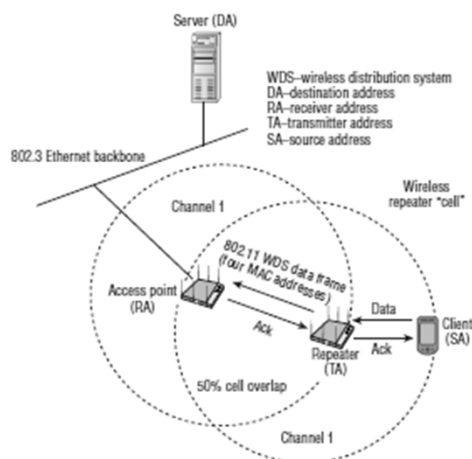
WDS frame header with 4 MAC addresses

Service Set Identifier (SSID)

- Logical name used to identify an 802.11 wireless network
- Logically comparable to a Windows workgroup name
- Identified using active or passive scanning
- Configurable on all radio cards
- Up to 32 characters long and case sensitive
- Hiding the SSID is not defined in the 802.11 standard

| SSID* | Sybex Wi-Fi | (1-32 characters) |
| SSID Broadcast Band | 2.4 GHz & 5 GHz (11n/a + 11n/b/g) | |

Basic Service Set (BSS)

- Cornerstone topology of an 802.11 network
- An AP with one or more client stations
- Client stations communicate through the AP
- Stations connected to a BSS are called associated

Basic Service Set Identifier (BSSID)

- 48-bit (6-octet) MAC address of an access point's radio
- Layer 2 identified of each individual BSS
- Provides differentiation between two APs configured identically in an ESS (configured to provide the same ESSID and security)

```
802.11 MAC Header
    Version:                0
    Type:                   $10   Data
    Subtype:                $0000  Data Only
    Frame Control Flags=$00000010
    Duration:               213   Microseconds
    Destination:            00:02:2D:74:67:2A
    BSSID:                  00:0C:85:62:D2:1D
    Source:                 00:0C:85:62:D2:1D
```
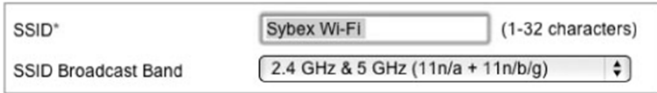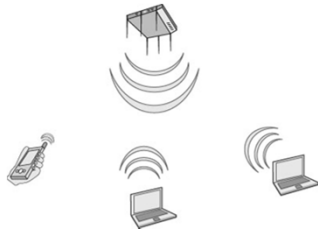
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Basic Service Area (BSA)

- Physical area of coverage provided by an access point in a BSS
- Roaming area of the BSS
- Size and shape of BSA varies due to environmental and physical surroundings
- Client stations will change data rate based upon received signal strength indicator (RSSI) thresholds
- Dynamic Rate Switching – Process of moving between data rates
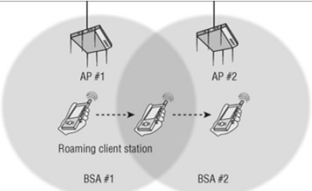
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Extended Service Set (ESS)

- One or more basic service sets connected by a distribution system medium
- BSSs typically are deployed with partial overlap to provide seamless roaming
- Most vendors recommend 15-25% overlap
- Overlap and seamless roaming is not required

AP #1   AP #2

Roaming client station

BSA #1   BSA #2

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Extended Service Set (ESS) (continued)

- Overlap and seamless roaming is not required
- Mobility between disjointed cells is referred to as nomadic roaming

Extended Service Set (ESS) (continued)

- Seamless Roaming

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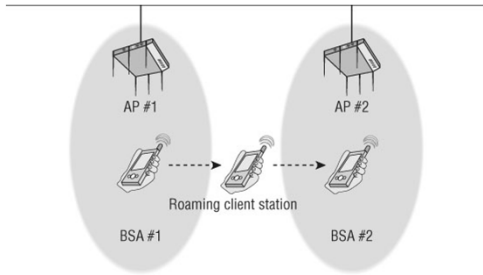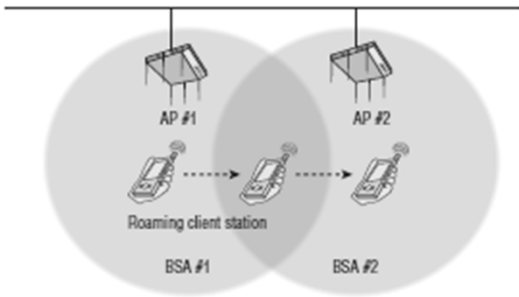## Extended Service Set (ESS) (continued)

- Nomadic Roaming

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Extended Service Set (ESS) (continued)

- Colocation – Deploying an ESS with multiple access point with total or almost total overlap of coverage
- Intended to increase client capacity

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Extended Service Set (ESS) (continued)

- The APs are connected by an 802.3 distribution system
- The APs share the same SSID name
- Each AP has its own unique BSSID

802.3 Ethernet backbone

SSID = Sybex
BSSID = 00:19:77:AA:3D:21
Channel 1

SSID = Sybex
BSSID = 00:19:77:AA:24:AE
Channel 6

AP #1   AP #2

Roaming client station

BSA #1   BSA #2

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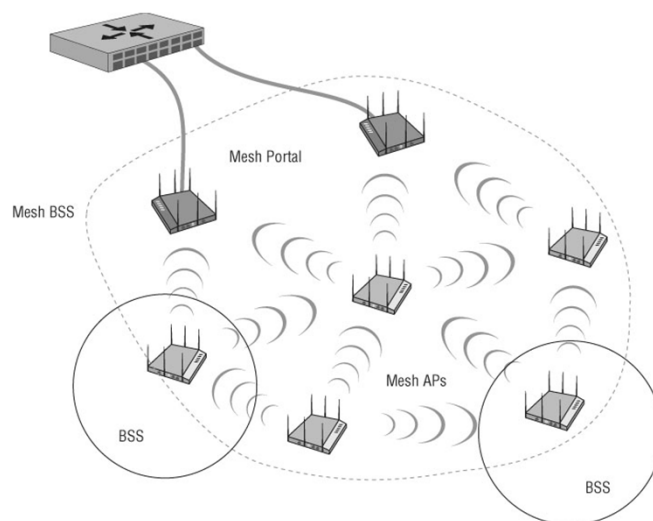**SYBEX** **WILEY**

Independent Basic Service Set (IBSS)

- Two or more client stations communicating without the use of an AP
- Also known as ad hoc or peer-to-peer network
- Clients are configured with the same SSID
- Clients communicate using the same channel

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Mesh Basic Service Set (MBSS)

- Ratified in 802.11s-2011 amendment
- New service set for 802.11 mesh topology
- Uses wireless distribution of network traffic
- Mesh Points (MP) use Hybrid Wireless Mesh Protocol (HWMP) to select mesh path
- A Mesh Point can also act as an AP in a BSS
- One or more Mesh Point Portals (MPP) act as gateways to an external network, such as an 802.3 wired backbone

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Mesh Basic Service Set (MBSS) (continued)

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Access Point Modes

- Not defined by the 802.11 standard, therefore each vendor will have different capabilities
- Bridge Mode – AP acts as a wireless bridge
- Workgroup Bridge Mode – AP acts as a wireless client for multiple wired devices
- Repeater Mode – AP acts as a wireless repeater
- Mesh Mode – AP acts as a wireless backhaul radio for a mesh environment. AP may also act as an AP in a BSS
- Scanner Mode – AP acts as a sensor radio, integrating it into a wireless intrusion detection system (WIDS) architecture

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Access Point Modes

- Mesh Mode – AP acts as a wireless backhaul radio for a mesh environment. AP may also act as an AP in a BSS
- Scanner Mode – AP acts as a sensor radio, integrating it into a wireless intrusion detection system (WIDS) architecture

Network Interfaces: Radio0-802.11G Settings

Enable Radio:	⊙ Enable	○ Disable
Current Status (Software/Hardware):	Enabled ⇑	Up ⇑
Role in Radio Network:	⊙ Access Point	
	○ Workgroup Bridge	
	○ Bridge	
	○ Scanner	
	○ Repeater	

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Client Station Modes

- Two modes
- Infrastructure Mode
  - Client will allow communications via an AP
  - Client can participate in a BSS or an ESS
- Ad Hoc Mode
  - Client will communicate directly with other clients, without an AP
  - Client can participate in an IBSS
  - All transmissions and frame exchanges are peer-to-peer

Client Name:	David Coleman
SSID1:	Sybex Wireless Network
SSID2:	
SSID3:	

Network Type:
○ Ad Hoc
● Infrastructure

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