





**Certified Wireless Network Administrator (CWNA)
PW0-105**



Chapter 7
Wireless LAN Topologies



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)



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Wireless Wide Area Network (WWAN)

- 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



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Wireless Metropolitan Area Network (WMAN)

- 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
- Standard defines four *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)



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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

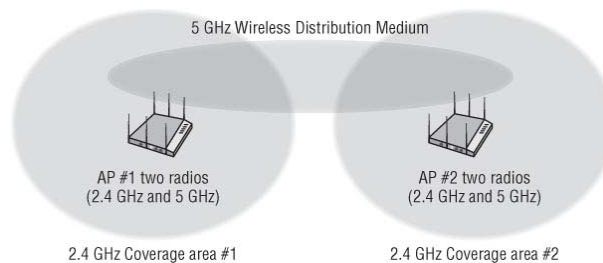
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Distribution System (DS)

- 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

Wireless Distribution System (WDS)

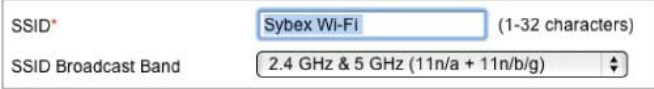
- Distribution system services using a four-MAC-address wireless frame format
- Wireless backhaul
- Wireless bridge, repeater, or mesh network



SYBEX **WILEY**

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




The screenshot shows a configuration window with two fields. The first field is labeled 'SSID*' and contains the text 'Sybex Wi-Fi' with '(1-32 characters)' to its right. The second field is labeled 'SSID Broadcast Band' and contains the text '2.4 GHz & 5 GHz (11n/a + 11n/b/g)' with a dropdown arrow to its right.

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SYBEX **WILEY**



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



The diagram illustrates a Basic Service Set (BSS) topology. At the top center is an icon of an Access Point (AP) with three curved lines representing radio waves emanating from it. Below the AP are three icons representing client stations: a mobile phone on the left, a laptop in the center, and another laptop on the right. Each client station has its own set of curved lines representing radio waves, indicating they are all communicating with the central AP.

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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: 410 Data
├─ Subtype: 40000 Data Only
├─ Frame Control Flags=400000010
├─ 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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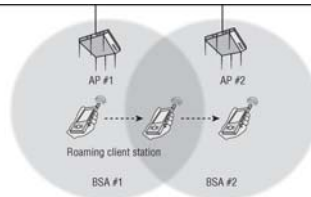
Basic Service Area (BSA)

- 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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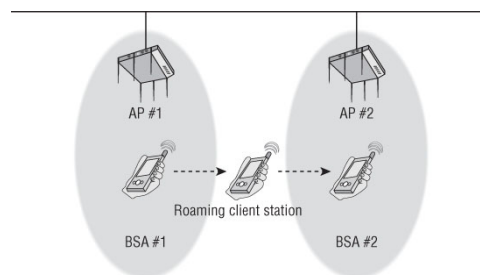
Extended Service Set (ESS)

- 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



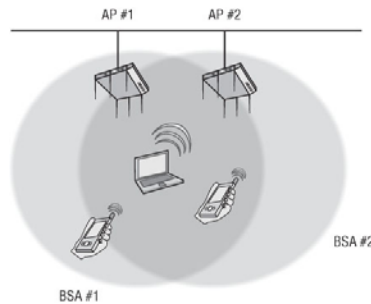
Extended Service Set (ESS) (continued)

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



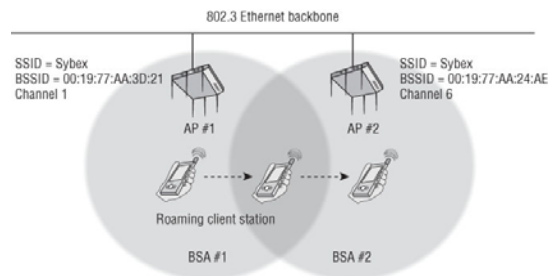
Extended Service Set (ESS) (continued)

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



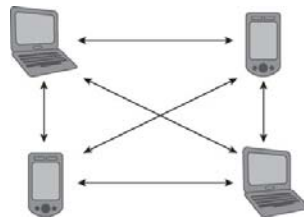
Extended Service Set (ESS) (continued)

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



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



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

SYBEX **WILEY**

Mesh Basic Service Set (MBSS) (continued)

The diagram illustrates a Mesh Basic Service Set (MBSS) network. A central Mesh Portal is connected to a Mesh BSS. The Mesh BSS is connected to several Mesh APs. The Mesh APs are connected to several BSSs. The diagram shows a central Mesh Portal connected to a Mesh BSS. The Mesh BSS is connected to several Mesh APs. The Mesh APs are connected to several BSSs.



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SYBEX **WILEY**

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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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

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