7.1.3 Wireless Networking Facts

This lesson covers the following topics:

- Wireless networking architecture
- 802.11 standards
- 802.11n technologies
- 802.11ac technologies
- Additional speed facts
- Additional radio frequency facts
- Additional wireless standards facts

Wireless Networking Architecture

The following table describes details of a wireless networking architecture:

Characteristic	Description	
Devices	An STA (station) is any device that is able to use the 802.11 protocol to communicate on a wireless network. Devices on a wireless network include: ▪ A wireless NIC for sending and receiving signals. ▪ A wireless access point (AP) is a lot like a hub. It receives wireless signals from several nodes and retransmits them to the rest of the network. ▪ A wireless bridge connects two wireless APs into a single network or connects your wireless AP to a wired network. Most APs today include bridging features. Many wireless access points include ports (i.e., switches or routers) to connect the wireless network to the wired portion of the network.	
Connection Method	Ad hoc	An ad hoc network works in peer-to-peer mode. The wireless NICs in each host communicate directly with one another. An ad hoc network is difficult to maintain for a large number of hosts because connections must be created between a host and every other host, and special configurations are required to reach wired networks. You will typically use an ad hoc network only to create a direct, temporary connection between two hosts.
	Infrastructure	An infrastructure wireless network employs an access point that functions like a hub on an Ethernet network. With an infrastructure network, you can easily add hosts without increasing administrative efforts (scalable), and the access point can be easily connected to a wired network, allowing clients to access both wired and wireless hosts. You should implement an infrastructure network for all but the smallest of wireless networks.
Service Set Identifier (SSID)	The SSID, also called the network name, groups wireless devices together into the same logical network. All devices on the same network must use the same SSID.	

802.11 Standards

The original 802.11 specification operated in the 2.4 GHz range and provided up to 2 Mbps. Additional IEEE subcommittees have further refined wireless networking, resulting in the following standards:

Specification	Standard				
	802.11a	802.11b	802.11g	802.11n	802.11ac
Frequency	5 GHz (U-NII)	2.4 GHz (ISM)	2.4 GHz (ISM)	2.4 GHz (ISM) or 5 GHz (U-NII)	5 GHz (U-NII)
Maximum speed	54 Mbps	11 Mbps	54 Mbps	600 Mbps	1.3 Gbps
Maximum distance	100 ft.	150 ft.	150 ft.	300 ft.	150 ft.
Channels (non-overlapped)	23 (12)	11 (3)	11 (3)	2.4 GHz: 11 (3 or 1) 5 GHz: 23 (12 or 6)	Depends on configuration

Modulation technique	OFDM	DSSS, CCK, DQPSK, DBPSK	DSSS (and others) at lower data rates; OFDM, QPSK, BPSK at higher data rates	OFDM (and others, depending on implementation)	OFDM
Backwards compatibility	N/A	None	802.11b	802.11a/b/g, depending on implementation	802.11b/g/n

802.11n Technologies

802.11n modified the previous 802.11a (5 GHz) and 802.11g (2.4GHz) standards in order to increase its potential bandwidth and transmission distance. This was done by implementing the following technologies:

Technology	Details
Multiple-Input, Multiple-Output (MIMO)	MIMO increases bandwidth by using multiple antennas for both the transmitter and receiver. A system is described by the number of sending and receiving antennas. The 802.11n specifications allow up to four sending and four receiving antennas. The benefit of adding additional antennas declines as the number increases; going above 3x3 provides a negligible performance increase.
Channel Bonding	Channel bonding combines two, non-overlapping 20 MHz channels into a single 40 MHz channel, resulting in slightly more than double the bandwidth. ▪ The 5 GHz range has a total of 23 channels, with 12 non-overlapping. This allows for a maximum of 6 non-overlapping bonded (combined) channels. ▪ The 2.4 GHz range has a total of 11 channels, with 3 non-overlapping. This allows for a maximum of 1 non-overlapping bonded channel. For this reason, channel bonding is typically not practical for the 2.4 GHz range.

802.11ac Technologies

802.11ac increased bandwidth and communication speeds by using the following technologies:

Technology	Details
Multi-User MIMO (MU-MIMO)	*MU-MIMO* is an enhancement to MIMO that allows multiple users to use the same channel. In addition to adding MU-MIMO, 802.11ac doubled the number of MIMO radio streams from four to eight.
Channel Bonding	Channel bonding is used to combine even more channels in the 5 GHz band, allowing for up to 160 MHz wide channels. Even though 160 MHz wide channels are supported, most 802.11ac networks use 80 MHz wide channels.

Additional Speed Facts

- Transmission speeds are affected by distance, obstructions (such as walls), and interference.
- Maximum signal distance depends on several factors, including obstructions, antenna strength, and interference. For example, for communications in a typical environment (with one or two walls), the actual distance would be roughly half of the maximum.
- Because transmission speeds decrease with distance, you can either achieve the maximum distance or the maximum speed, but not both.

Additional Radio Frequency Facts

- The ability of newer devices to communicate with older devices depends on the capabilities of the transmit radios in the access point. Some 802.11n devices are capable of transmitting at either 2.4 GHz or 5 GHz. However, a single radio cannot transmit at both frequencies at the same time.

  When you connect a legacy device to the wireless network, all devices on the network operate at the legacy speed. For example, connecting an 802.11b device to an 802.11n or 802.11g access point slows down the network to 802.11b speeds.

- A dual band access point can use one radio to transmit at one frequency, and a different radio to transmit at a different frequency. For example, you can configure many 802.11n devices to use one radio to communicate at 5 GHz with 802.11a devices, and the remaining radios to use 2.4 GHz to communicate with 802.11n devices. Dual band 802.11a and 802.11g devices are also available.

Additional Wireless Standards Facts

- When you configure an access point, some configuration utilities use the term *mixed mode* to designate a network with both 802.11n and non-802.11n clients. In this configuration, one radio transmitter is used for legacy clients, and the remaining radio transmitters are used for 802.11n clients.

- Many 802.11n access points can support clients running other wireless standards (802.11a/b/g). When a mix of clients using different standards are connected, the access point must disable some 802.11n features to be compatible with non-802.11n devices, which decreases the effective speed.
- Some newer 802.11a and 802.11g devices provide up to 108 Mbps using 802.11n pre-draft technologies (MIMO and channel bonding).
