

Wi-Fi 6 (802.11ax)

- **Frequency Bands:** 2.4 GHz and 5 GHz.
- **Channel Width:** Up to 160 MHz.
- **Modulation:** 1024-QAM (higher data encoding efficiency).
- **Max Theoretical Speed:** ~9.6 Gbps.
- **MIMO:** 8x8 MU-MIMO (uplink and downlink).
- **Key Features:**
 - **OFDMA (Orthogonal Frequency Division Multiple Access):** Divides channels into smaller sub-channels for efficient data transmission to multiple devices, reducing latency in crowded networks.
 - **TWT (Target Wake Time):** Improves battery life for IoT and mobile devices by scheduling wake times.
 - **BSS Coloring:** Reduces interference in dense environments by marking network traffic.
 - Enhanced MU-MIMO and beamforming for better performance in high-device scenarios.
 - Higher efficiency and capacity for crowded areas (e.g., stadiums, offices).
- **Differences from Wi-Fi 5:**
 - Supports 2.4 GHz for better range and compatibility with older devices.
 - Higher throughput and efficiency due to 1024-QAM and OFDMA.
 - Better suited for dense environments with many connected devices.
 - Lower latency and improved power efficiency.

Wi-Fi 6E (802.11ax extension)

- **Frequency Bands:** 2.4 GHz, 5 GHz, and **6 GHz** (new band).
- **Channel Width:** Up to 160 MHz (wider channels in 6 GHz).
- **Modulation:** 1024-QAM.
- **Max Theoretical Speed:** ~9.6 Gbps (same as Wi-Fi 6 but with less congestion).
- **MIMO:** 8x8 MU-MIMO (uplink and downlink).
- **Key Features:**
 - Introduces the **6 GHz band**, offering more spectrum (up to 1200 MHz in some regions) and less interference from legacy devices.
 - Wider channels (up to 160 MHz) in the 6 GHz band for faster speeds and lower latency.
 - Inherits all Wi-Fi 6 features (OFDMA, TWT, BSS Coloring, etc.).
 - Ideal for high-bandwidth, low-latency applications like VR/AR and 8K streaming.
- **Differences from Wi-Fi 5:**
 - Adds 6 GHz and 2.4 GHz support, significantly increasing available spectrum.
 - Lower latency and higher capacity for modern applications.

Wi-Fi 7 (802.11be)

- **Frequency Bands:** 2.4 GHz, 5 GHz, and 6 GHz.
- **Channel Width:** Up to **320 MHz** (double Wi-Fi 6/6E).
- **Modulation:** 4096-QAM (even higher data encoding efficiency).
- **Max Theoretical Speed:** ~46 Gbps.
- **MIMO:** 16x16 MU-MIMO (uplink and downlink).
- **Key Features:**
 - **Multi-Link Operation (MLO):** Allows devices to use multiple bands (2.4, 5, 6 GHz) simultaneously for higher throughput and reliability.
 - **Enhanced OFDMA:** Further improves efficiency in dense environments.
 - **Deterministic Latency:** Supports ultra-low latency for real-time applications (e.g., gaming, industrial IoT).
 - Wider 320 MHz channels in the 6 GHz band for massive throughput.
 - Improved power efficiency and backward compatibility with older standards.
- **Differences from Wi-Fi 5:**
 - Far greater speeds, capacity, and efficiency.
 - Supports all three bands (2.4, 5, 6 GHz) with advanced features like MLO and 4096-QAM.
 - Optimized for ultra-high-bandwidth, low-latency use cases.

Feature	Wi-Fi 5 (802.11ac)	Wi-Fi 6 (802.11ax)	Wi-Fi 6E (802.11ax)	Wi-Fi 7 (802.11be)
Frequency Bands	5 GHz	2.4, 5 GHz	2.4, 5, 6 GHz	2.4, 5, 6 GHz
Max Channel Width	160 MHz	160 MHz	160 MHz	320 MHz
Modulation	256-QAM	1024-QAM	1024-QAM	4096-QAM
Max Speed	~3.5 Gbps	~9.6 Gbps	~9.6 Gbps	~46 Gbps
MIMO	4x4 MU-MIMO	8x8 MU-MIMO	8x8 MU-MIMO	16x16 MU-MIMO
Key Technologies	Beamforming, MU-MIMO	OFDMA, TWT, BSS Coloring	OFDMA, TWT, 6 GHz	MLO, Enhanced OFDMA
Best Use Case	Basic HD streaming	Dense environments	High-bandwidth apps	Ultra-low latency, VR/AR

Key Differences from Wi-Fi 5

- **Wi-Fi 6** improves efficiency, supports more devices, and adds 2.4 GHz for better range.
- **Wi-Fi 6E** introduces the 6 GHz band for less congestion and faster speeds.
- **Wi-Fi 7** pushes the limits with wider channels, MLO, and 4096-QAM for extreme throughput and low latency.

Each standard is backward compatible, but new features (e.g., 6 GHz, MLO) require compatible hardware. Wi-Fi 7 is the most future-proof, but Wi-Fi 6/6E are still excellent for most current applications.