### Q1)Key Features of Wi-Fi 6 (802.11ax), Wi-Fi 6E, and Wi-Fi 7 (802.11be) vs. Wi-Fi 5 (802.11ac)

Wi-Fi standards have evolved significantly, offering faster speeds, lower latency, and better efficiency.

**1. Wi-Fi 6 (802.11ax) – The Efficiency Revolution**

**Introduced:** 2019  
**Bands:** 2.4 GHz + 5 GHz

**Key Improvements Over Wi-Fi 5 (802.11ac)**

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| Feature | Wi-Fi 5 (802.11ac) | Wi-Fi 6 (802.11ax) |
| Max Speed | 3.5 Gbps | 9.6 Gbps |
| Modulation | 256-QAM | 1024-QAM (25% more data per signal) |
| MU-MIMO | Downlink-only (4x4) | Uplink + Downlink (8x8) |
| OFDMA | ❌ No | ✅ Yes (splits channels for multiple devices) |
| Target Wake Time (TWT) | ❌ No | ✅ Yes (better battery life for IoT) |
| BSS Coloring | ❌ No | ✅ Yes (reduces interference in dense networks) |

**Best For:** Homes/offices with many devices (smartphones, IoT, 4K streaming).

**2. Wi-Fi 6E – The 6 GHz Game-Changer**

**Introduced:** 2021  
**Bands:** 2.4 GHz + 5 GHz **+ 6 GHz**

**Key Advantages Over Wi-Fi 6**

* **6 GHz Band:**
* **1200 MHz of new spectrum** (no overlap with older Wi-Fi).
* **7 additional 160 MHz channels** (vs. only 2 in 5 GHz).
* **Lower Latency:**
* Less congestion (fewer legacy devices).
* **No DFS Restrictions:**
* Unlike 5 GHz, no radar interference issues.

**Best For:** VR/AR, 8K streaming, gaming, and high-density environments.

**3. Wi-Fi 7 (802.11be) – The Next Leap**

**Expected Release:** 2024 (devices already emerging)  
**Bands:** 2.4 GHz + 5 GHz + 6 GHz

**Key Upgrades Over Wi-Fi 6/6E**

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| --- | --- | --- |
| Feature | Wi-Fi 6/6E | Wi-Fi 7 |
| Max Speed | 9.6 Gbps | **46 Gbps** |
| Modulation | 1024-QAM | **4096-QAM (20% boost)** |
| Channel Width | 160 MHz | **320 MHz (double bandwidth)** |
| Multi-Link Operation (MLO) | ❌ No | ✅ Yes (combines bands for stability) |
| Preamble Puncturing | ❌ No | ✅ Yes (uses fragmented channels) |
| 4K QAM | ❌ No | ✅ Yes (higher efficiency) |

**Best For:**

* **8K video, metaverse, real-time cloud gaming.**
* **Stadiums, smart cities, and industrial IoT.**

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| **Standard** | **Max Speed** | **Bands** | **Key Feature** | **Best Use Case** |
| **Wi-Fi 5 (802.11ac)** | 3.5 Gbps | 5 GHz | MU-MIMO (Downlink) | HD streaming, basic home networks |
| **Wi-Fi 6 (802.11ax)** | 9.6 Gbps | 2.4/5 GHz | OFDMA, 1024-QAM | Smart homes, offices, 4K/8K streaming |
| **Wi-Fi 6E** | 9.6 Gbps | 2.4/5/6 GHz | 6 GHz band | VR/AR, gaming, low-latency apps |
| **Wi-Fi 7 (802.11be)** | 46 Gbps | 2.4/5/6 GHz | 320 MHz, MLO | Future-proofing, industrial IoT, metaverse |