1. **What are the different 802.11 PHY layer standards? Compare their characteristics.**

**802.11b**

* Works on the 2.4 GHz band.
* Uses DSSS for modulation.
* Offers a max speed of 11 Mbps.
* Known for decent range, but often affected by interference since the 2.4 GHz band is quite crowded.

**802.11a**

* Operates at 5 GHz.
* Uses OFDM modulation.
* Can reach up to 54 Mbps.
* Faster than 802.11b but doesn't cover as much range due to higher frequency.
* Better at avoiding interference.

**802.11g**

* Also uses the 2.4 GHz band.
* Uses OFDM like 802.11a but supports backward compatibility with 802.11b.
* Max speed is 54 Mbps.
* Basically combines 802.11a’s speed with 802.11b’s range.

**802.11n (Wi-Fi 4)**

* Works in both 2.4 GHz and 5 GHz bands.
* Uses OFDM and introduces MIMO (Multiple-Input Multiple-Output).
* Speeds can go up to 600 Mbps.
* MIMO helps boost both range and data rates using multiple antennas.

**802.11ac (Wi-Fi 5)**

* Operates only in the 5 GHz band.
* Uses OFDM and MU-MIMO (Multi-User MIMO).
* Designed for very high throughput—can achieve gigabit-level speeds.
* Supports wider channel widths for better performance.

**802.11ax (Wi-Fi 6 / 6E)**

* Works on 2.4 GHz, 5 GHz, and now also 6 GHz (for Wi-Fi 6E).
* Uses OFDMA and MU-MIMO.
* Focuses more on efficiency in crowded environments rather than just raw speed.
* Also, more power-efficient.

**802.11be (Wi-Fi 7)**

* The latest standard.
* Aims for ultra-high speed, low latency, and better reliability.
* Builds upon Wi-Fi 6 features.
* Introduces 320 MHz channel bandwidth, 4096-QAM, and Multi-Link Operation (MLO) for even faster, more stable connections.