**QUESTION : UNDERSTANDING WIFI GENERATIONS AND ITS PROPERTIES**

IEEE STANDARDS FOR WIFI :

1. IEEE – 802.11 (Wifi - 1) – First Wifi Standard : it was designed with 2.4 GHz frequency with maximum data rate of 2 Mbps and uses FHSS (Frequency Hopping Spread Spectrum – a modulation technique where both transmitter and receiver are expected to be synchronized and change the center frequency during transmission) without any reliability.
2. IEEE – 802.11a : it was designed with 5 GHz with OFDM modulation thereby proposed in achieving maximum data rate of 54 Mbps. Since 5 GHz was used, interference levels were reduced since Bluetooth, oven devices are using 2.4 GHz. Moreover, there will be many non-overlapping wider channels available in 5 GHz frequency and the usage of OFDM boosting the maximum data rate. However, range coverage is limited due to the usage of 5 GHz frequency
3. IEEE – 802.11b (Wifi - 2): it was designed with 2.4 GHz with DSSS modulation scheme that helps in boosting data rate rather than using FHSS since there can be continuous data transmission in DSSS at the cost of larger bandwidth with maximum data rate of 11 Mbps. It is the first mass adopted Wifi Standard.
4. IEEE – 802.11g (Wifi - 3): it was designed with 2.4 GHz frequency as like 802.11b and used OFDM as like 802.11a with OFDM modulation thereby achieved maximum data rate of 54 Mbps.
5. IEEE – 802.11n (Wifi - 4): it was significant breakthrough in wifi standards which introduced the usage of Dual band frequency (2.4 GHz and 5 GHz frequency bands) and channel bandwidth got widened from 20 MHz to 40 MHz. It used MIMO technology with OFDM thereby achieving maximum theoretical data rate of 600 Mbps.
6. IEEE – 802.11ac (Wifi - 5) : It was termed as Gigabit Wifi standard. it was designed with 5 GHz frequency but used OFDM with 256 QAM therefore achieving maximum data rate of 6.9 Gbps. It used MU-MIMO with still widened channel of around 80 to 160 MHz
7. IEEE – 802.11ax (Wifi - 6): it was designed with triple frequencies 2.4 , 5 , 6 GHz with OFDMA with 1024 QAM with BSS Coloring therefore achieving maximum data rate of 9.6 Gbps (Wifi – 6E is the extension of Wifi – 6 with 160 MHz)
8. IEEE – 802.11be (Wifi - 7): it is the upcoming wifi standard using OFDMA with 4096 QAM using 2.4 , 5 , 6 GHz frequencies and with many improvements in MIMO and could achieve the data rate of 40 Gbps with wider channel width of 320 MHz with MLO (Multi Link Operations) – where AP uses more than one channel simultaneously.

SOME OF THE WIFI DEVICES IN DAY TO DAY LIFE :

1. Smart phone :

Used for internet browsing, video streaming, VoIP calls, and Wi-Fi calling. It often support both 2.4 GHz & 5 GHz bands. Wi-Fi standards: 802.11n, 802.11ac, 802.11ax

1. Laptops & Computers :

for work, gaming, video conferencing, and cloud access. Typically support 2.4 GHz & 5 GHz bands (some support 6 GHz in Wi-Fi 6E/7). Wi-Fi Standards: 802.11ac (Wi-Fi 5), 802.11ax (Wi-Fi 6/6E), 802.11be (Wi-Fi 7).

1. Smart TVs :

Used for Netflix , youtube, screen mirroring. It supports Dual Band wifi frequencies

With 802.11ac or newer standards for smooth 4K streaming.

1. Smart Home Devices:

Used for safety and convenience in indoor usage. It mainly uses 2.4 GHz wifi with 802.11n / ac.

1. Wireless Security Cameras:

Used for surveillance applications with larger bandwidth for efficient transmission. It mainly work in 2.4 GHz for long range. It uses 802.11ac for smooth streaming.

PROPERTIES OF WIRELESS DEVICES :

1. Service Set Identifier , BSSID
2. Protocol (Wifi generation)
3. Frequency band of wifi operation
4. Channel number and channel width
5. Modulation
6. PHY Rate (Data Rate)
7. RSSI (Received Signal Strength Indicator)
8. Encryption scheme
9. Authentication protocols
10. Roaming standards
11. Wifi Driver version

Laptop is connected to mobile Hotspot and Wifi properties are observed as follows:

