**1. In which OSI layer does the Wi-Fi standard/protocol fit?**

Wi-Fi operates at two layers in the OSI model:

* Physical Layer (Layer 1): Handles the transmission medium, radio frequencies, and modulation techniques.
* Data Link Layer (Layer 2): Manages MAC (Media Access Control) addressing, framing, and error detection for data transmission.

**2. Can you share the Wi-Fi devices that you use in day-to-day life, along with their wireless capability/properties? Match them to corresponding Wi-Fi Generations based on properties.**

**A screenshot of a computer

AI-generated content may be incorrect.**

Several devices use Wi-Fi for connectivity, each supporting different generations based on their capabilities:

* **Laptops:** Most modern laptops support Wi-Fi 5 (802.11ac) or Wi-Fi 6 (802.11ax), operate on both 2.4GHz and 5GHz bands, and offer higher speeds with better efficiency. They are used for work, video conferencing, and streaming.
* **Smartphones:** These support Wi-Fi 5 or Wi-Fi 6, providing fast internet access, video calls, and streaming capabilities. Some high-end models also support Wi-Fi 6E, which uses the 6GHz band for even better performance.
* **Smart TVs:** Typically support Wi-Fi 5 (802.11ac) for seamless video streaming over 5GHz, reducing interference from other devices.
* **Tablets:** Like smartphones, tablets support Wi-Fi 5 or Wi-Fi 6, allowing smooth browsing, multimedia consumption, and video conferencing.
* **Smart Home Devices (Smart Speakers, Smart Bulbs, Security Cameras):** These mostly use Wi-Fi 4 (802.11n) on the 2.4GHz band to ensure a wider range and stable connectivity. Security cameras may support dual-band Wi-Fi for better performance.

**3. What is BSS and ESS?**

* **BSS (Basic Service Set):** A single Wi-Fi access point (AP) connecting multiple devices within a limited range. Used in small networks like home Wi-Fi setups.
* **ESS (Extended Service Set):** Multiple APs working together under the same network name (SSID) to provide seamless connectivity over a larger area, commonly used in office buildings and campuses.

**4. What are the basic functionalities of a Wi-Fi Access Point?**

A Wi-Fi Access Point (AP) provides wireless connectivity to devices and connects them to a wired network. Its main functionalities include:

* Broadcasting an SSID to allow devices to discover the network.
* Managing traffic to ensure stable connections.
* Enforcing security through WPA2/WPA3 encryption.
* Handling multiple devices in larger networks, allowing seamless roaming between APs.

**5. What is the difference between Bridge Mode and Repeater Mode?**

* **Bridge Mode:** Connects two separate networks, allowing devices from different networks to communicate. Used to extend a wired network wirelessly.
* **Repeater Mode**: Amplifies an existing Wi-Fi signal to extend coverage without creating a new network, though it may reduce speed due to signal rebroadcasting.

**6. What are the differences between 802.11a and 802.11b?**

* 802.11a operates on the 5GHz band, provides speeds up to 54 Mbps, and is less prone to interference but has a shorter range.
* 802.11b operates on the 2.4GHz band, offers speeds up to 11 Mbps, has a longer range but is more susceptible to interference from other household devices.

**7. Configure your modem/hotspot to operate only in 2.4GHz and connect your laptop/Wi-Fi** **device. Capture the capability/properties in your Wi-Fi device. Repeat the same in 5GHz and tabulate all the differences you observed during this.**

Steps to configure and test:

1. Log into your router settings via 192.168.1.1.
2. Disable 5GHz and enable only 2.4GHz. Connect a laptop/smartphone and observe the network properties.
3. Disable 2.4GHz and enable only 5GHz. Repeat the connection process.
4. Differences observed:

2.4GHz: Provides a longer range but lower speed. Suitable for IoT devices and basic browsing.

5GHz: Offers higher speed and lower interference but has a shorter range. Ideal for gaming, streaming, and video calls.

**8. What is the difference between IEEE and WFA?**

**IEEE (Institute of Electrical and Electronics Engineers):** Defines the technical standards for Wi-Fi, such as 802.11a/b/g/n/ac/ax.

**WFA (Wi-Fi Alliance):** Ensures compliance with Wi-Fi standards, certifies devices for interoperability, and enforces security protocols like WPA2 and WPA3.

**9. List the types of Wi-Fi internet connectivity backhaul, share your home/college's wireless internet connectivity backhaul name and its properties.**

Wi-Fi backhaul refers to the infrastructure connecting access points to the core network. Common types include:

* **Fiber Optic:** High-speed, low-latency backhaul commonly used in modern networks.
* **DSL (Digital Subscriber Line):** Uses telephone lines, slower than fiber but widely available.
* **Cable:** Uses coaxial cables, offering decent speed but shared bandwidth in neighborhoods.
* **Satellite:** Provides connectivity in remote areas but suffers from high latency.
* **Cellular (4G/5G):** Wireless backhaul for temporary setups or areas lacking wired infrastructure.

**Example from home/college:**

A home may use fiber-based broadband for high-speed internet.

Colleges often have enterprise-grade fiber connectivity for better performance and reliability.

**10. List the Wi-Fi topologies and use cases of each one.**

* **Infrastructure Mode:** The most common Wi-Fi setup, where devices connect to an access point, used in homes, offices, and public spaces.
* **Ad-hoc Mode:** Direct device-to-device communication without an access point, useful for small peer-to-peer networks.
* **Mesh Network:** Multiple interconnected APs providing seamless coverage over a large area, used in offices, campuses, and smart homes.
* **Star Topology:** Devices connect to a central AP, common in small home and office setups.
* **Hybrid Topology:** A mix of multiple topologies, often used in enterprise environments for scalability and reliability.