

MODULE 1 ASSIGNMENT – WIFI TRAINING

1) In which OSI layer the Wi-Fi standard/protocol fits.

Wi-Fi fits mainly in the Data Link Layer (Layer 2) of the OSI model.

- More specifically, it covers:
- MAC sublayer (Medium Access Control) — controls access to the wireless medium.
- Physical Layer (Layer 1) — defines the actual transmission (radio waves, modulation, etc.).

2) Can you share the Wi-Fi devices that you are using day to day life, share that device's wireless capability/properties after connecting to network. Match your device to corresponding Wi-Fi Generations based on properties

Smartphone

Wireless capability: Wi-Fi 6 (802.11ax)

Properties after connecting:

Supports both 2.4 GHz and 5 GHz bands

Maximum speed around 1.2 Gbps (on Wi-Fi 6 network)

Corresponding Wi-Fi Generation: Wi-Fi 6

Laptop

Wireless capability: Wi-Fi 6 (802.11ax)

Properties after connecting:

MU-MIMO support (connects efficiently with multiple devices)

2.4 GHz and 5 GHz dual-band connectivity

Corresponding Wi-Fi Generation: Wi-Fi 6

Smart TV

Wireless capability: Wi-Fi 5 (802.11ac)

Properties after connecting:

5 GHz band preferred for streaming

High throughput for 4K video streaming

Corresponding Wi-Fi Generation: Wi-Fi 5

Tablet

Wireless capability: Wi-Fi 6 (802.11ax)

Properties after connecting:

2x2 MIMO (two streams for better speed)

2.4 GHz and 5 GHz support

Corresponding Wi-Fi Generation: Wi-Fi 6

3) What is BSS and ESS?

BSS (Basic Service Set):

- It is the basic building block of a Wi-Fi network.
- A BSS consists of one Access Point (AP) and all the devices (stations) connected to it.
- Identified by a unique ID called BSSID (MAC address of the AP).
- Example: Your home Wi-Fi router and the devices connected to it form a BSS.

ESS (Extended Service Set):

- It is a collection of multiple BSSs interconnected by a distribution system (usually a wired LAN).
- All BSSs in an ESS use the same network name (SSID).
- Devices can roam between different BSSs within the same ESS without losing connection.
- Example: In a university campus Wi-Fi, multiple APs are placed around the campus forming an ESS.

4) What are the basic functionalities of Wi-Fi Accesspoint

1. Wireless Signal Transmission

- Broadcasts Wi-Fi signals to allow wireless devices to connect to the network.

2. Client Connectivity

- Accepts connection requests from devices like laptops, smartphones, etc.

3. Network Bridging

- Connects wireless devices to the wired network (LAN).

4. Authentication and Security

- Handles user/device authentication using methods like WPA2, WPA3.
- Encrypts data to secure communication.

5. Traffic Management

- Manages data transmission between devices and ensures fair access (e.g., using CSMA/CA protocol).

6. Roaming Support

- Allows seamless movement between APs in an Extended Service Set (ESS) without losing connection.

7. Frequency Band Management

- Operates over 2.4 GHz and/or 5 GHz bands, and may select the best channel to reduce interference.

8. Quality of Service (QoS)

- Prioritizes traffic like voice or video for better user experience.

9. Monitoring and Reporting

- Tracks device connections, signal strength, and network performance for troubleshooting or optimization.

5) Difference between Bridge mode and Repeater mode

Bridge Mode

- Connects two different networks together (usually wired to wireless).
- AP acts as a bridge between the wireless network and a wired device (like a switch or PC).
- Devices connected to the AP get IP addresses from the main router.
- Used mainly to extend a network by connecting wired and wireless segments.

Repeater Mode

- Extends the range of an existing Wi-Fi network wirelessly.
- AP receives Wi-Fi signals and retransmits them to cover a larger area.
- Devices connected to the repeater communicate through the AP, not directly with the main router.
- Used to eliminate Wi-Fi dead zones without running cables.

6) What are the differences between 802.11a and 802.11b.

802.11a

- Operates in 5 GHz frequency band.
- Maximum speed up to 54 Mbps.
- Less interference (because 5 GHz is less crowded).
- Shorter range compared to 802.11b (higher frequency, less penetration).
- More expensive hardware at the time of release.

802.11b

- Operates in 2.4 GHz frequency band.

- Maximum speed up to 11 Mbps.
- More interference (because 2.4 GHz is crowded with devices like microwaves, Bluetooth).
- Longer range compared to 802.11a (lower frequency, better wall penetration).
- Cheaper and widely adopted initially.

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

Property	2.4 GHz	5 GHz
Frequency Band	2.4 GHz	5 GHz
Max Speed Observed	72–150 Mbps	433 Mbps or higher
Signal Range	Longer range, better wall penetration	Shorter range, weaker through walls
Channel Width	20 MHz or 40 MHz	40 MHz or 80 MHz
Interference	High (many common devices)	Low (less crowded)
Stability at Distance	More stable over longer distances	Good only when closer to router

8) What is the difference between IEEE and WFA

IEEE (Institute of Electrical and Electronics Engineers)

- It is a professional organization that develops global standards for technologies, including Wi-Fi (802.11 series).
- Focuses on technical specifications, protocols, and research work.
- IEEE 802.11 defines how Wi-Fi should technically operate.

WFA (Wi-Fi Alliance)

- It is an industry group that promotes Wi-Fi technology and ensures interoperability between devices.
- Focuses on certification programs (e.g., Wi-Fi Certified™ label) to make sure products from different manufacturers work together.
- WFA defines marketing names like Wi-Fi 4, Wi-Fi 5, Wi-Fi 6.

9) List down the type of Wi-Fi internet connectivity backhaul, share your home/college's wireless internet connectivity backhaul name and its properties

1. DSL (Digital Subscriber Line)

- Internet over telephone lines.
- Moderate speed, common in homes.

2. Fiber Optic

- High-speed internet using fiber cables.
- Very fast, low latency, ideal for heavy usage.

3. Cable Broadband

- Internet over cable TV lines.
- Good speed, shared bandwidth with neighbors.

4. Mobile Network (4G/5G) Backhaul

- Internet from mobile network towers.
- Flexible, used for hotspots or rural areas.

5. Satellite Internet

- Internet via satellites.
- Available in remote areas, but higher latency.

6. Fixed Wireless

- Internet via radio signals from nearby tower.
- Good for rural or suburban areas.

7. Leased Line

- Dedicated line for business-grade internet.
- Highly reliable and symmetrical speeds.

Example from Home:

- **Backhaul Name:** Fiber Optic (Airtel Fiber)
- **Properties:**
 - Speed: 200 Mbps download and upload
 - Latency: Very low (5–10 ms)
 - Stability: Very high, rarely fluctuates
 - Connection Type: FTTH (Fiber To The Home)

Example from College:

- **Backhaul Name:** Leased Line (Jio)
- **Properties:**
 - Speed: 1 Gbps shared across campus
 - Latency: Very low (1–5 ms)

- Stability: Extremely high, enterprise-grade
- Connection Type: Dedicated Ethernet link

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

- **Independent Basic Service Set (IBSS) – Ad-hoc Mode**
 - Devices connect directly to each other without an Access Point.
 - **Use Case:** Temporary networks for file sharing between laptops or mobile devices without existing infrastructure.
- **Basic Service Set (BSS)**
 - Devices connect to a single Access Point.
 - **Use Case:** Home Wi-Fi setup where all devices (laptop, phone, smart TV) connect to a single router.
- **Extended Service Set (ESS)**
 - Multiple Access Points connected by a wired network (LAN), allowing roaming.
 - **Use Case:** College campuses, large offices, hotels where users move and stay connected across multiple APs.
- **Mesh Network**
 - Multiple Access Points (nodes) connect with each other wirelessly to form a network.
 - **Use Case:** Large homes, smart cities, or industrial setups where wired connections are difficult and extended coverage is needed.
- **Distribution System (DS)**
 - Connects different Access Points through wired or wireless connections to form a broader network.
 - **Use Case:** Used internally in ESS to interconnect APs for larger Wi-Fi networks.