Wifi Training Assignment 1

- Yuvan Shankar G

Problem1:

Operates in both Physical Layer and Data Link Layer.

Physical Layer handles transmission over the air, frequency bands, and modulation.

Data Link Layer's MAC sublayer manages framing, addressing, and access control and uses CSMA/CA to prevent collisions.

Problem2:

```
C:\Users\Lenovo>netsh wlan show interfaces

There is 1 interface on the system:

    Name                   : Wi-Fi
    Description            : Realtek 8821CE Wireless LAN 802.11ac PCI-E NIC
    GUID                   : a493f3a0-54c1-4ffe-9e23-3c60acabf4d7
    Physical address       : 28:39:26:d6:5f:a5
    State                  : connected
    SSID                   : Laxmi Narasima pg S2
    BSSID                  : aa:74:84:ed:ba:fa
    Network type           : Infrastructure
    Radio type             : 802.11n
    Authentication         : WPA2-Personal
    Cipher                 : CCMP
    Connection mode        : Auto Connect
    Channel                : 6
    Receive rate (Mbps)    : 120
    Transmit rate (Mbps)   : 120
    Signal                 : 81%
    Profile                : Laxmi Narasima pg S2

    Hosted network status  : Not available
```

This belongs to Wi-Fi 4 (802.11n) – 2.4/5 GHz, max 600 Mbps, MIMO

Problem3:

BSS (Basic Service Set)

        - A single Wi-Fi network with one access point (AP) and connected devices.

        - Identified by a BSSID (Basic Service Set Identifier), which is usually the MAC address of the AP.

ESS (Extended Service Set)

   - A group of multiple BSSs (multiple APs) connected to the same network.

   - Identified by an SSID (Service Set Identifier), which remains the same across all APs.

   - Used in large areas like offices, malls, and campuses.

Problem4:

Wireless Connectivity – Provides wireless access to devices using Wi-Fi standards (802.11).

Bridging Wired and Wireless Networks – Connects wireless devices to a wired network via Ethernet.

SSID Broadcasting – Advertises the network name (SSID) for device discovery.

Authentication and Security – Implements encryption (WPA2, WPA3) to protect data.

Channel Selection – Uses the best frequency/channel to minimize interference.

Traffic Management – Handles multiple device connections efficiently using MU-MIMO and OFDMA.

DHCP Relay (if enabled) – Helps assign IP addresses to connected devices.

Roaming Support – Works with other APs in an ESS for seamless device movement.

Power Management – Adjusts signal strength to optimize coverage and reduce power usage.

QoS (Quality of Service) – Prioritizes traffic (e.g., VoIP, gaming) for better performance.

Problem5:

Bridge Mode:

Connects two separate networks (wired or wireless) to function as a single network.

Uses Ethernet or Wi-Fi to link networks while keeping separate IP subnets.

Example: Connecting a corporate LAN to a guest network without merging them.

Repeater Mode:

Extends the coverage of an existing Wi-Fi network by amplifying the signal.

Uses the same SSID and IP subnet as the main network.

Example: Extending Wi-Fi signal to weak areas without adding new cables.

Problem6:

802.11a operates in the 5 GHz frequency band, while 802.11b operates in the 2.4 GHz band.

802.11a has a maximum data rate of 54 Mbps, whereas 802.11b has a maximum of 11 Mbps.

802.11a has a shorter range due to higher frequency, while 802.11b has a longer range with better wall penetration.
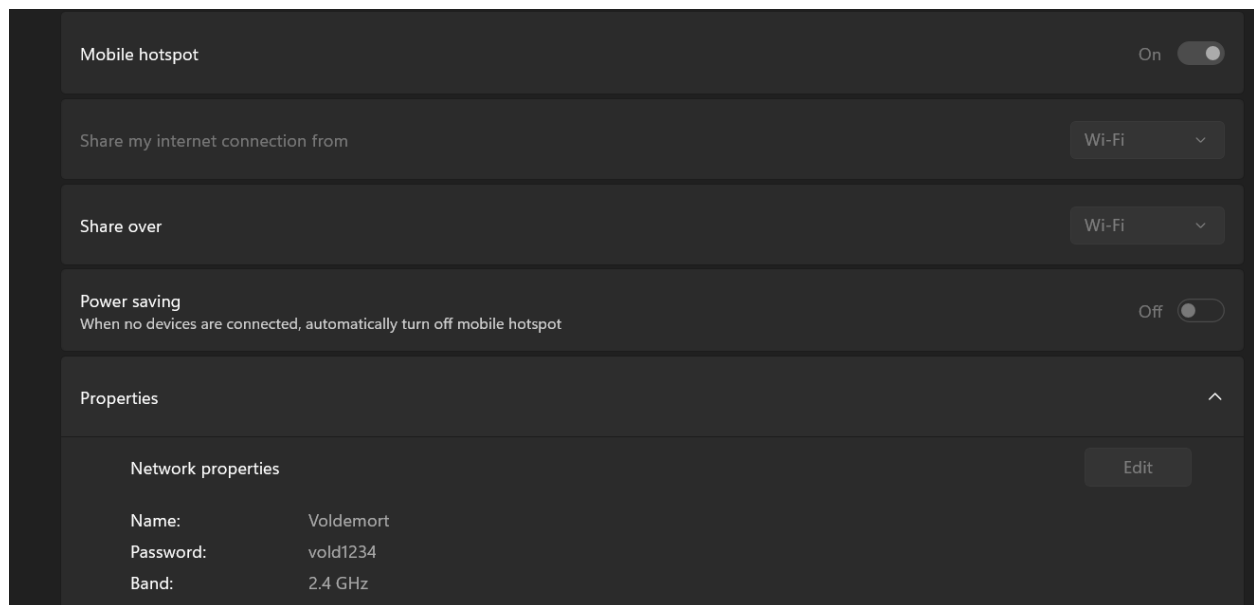
802.11a experiences less interference since 5 GHz is less crowded, whereas 802.11b is more prone to interference from other 2.4 GHz devices.

802.11a uses 20 MHz wide channels, while 802.11b uses 22 MHz wide channels.

802.11a and 802.11b are not compatible with each other due to different frequency bands.

802.11a was initially less widely adopted due to higher costs, while 802.11b gained more popularity due to affordability and better range.

Problem7:

Network & internet › **Mobile hotspot**

2.4 GHz band.

| Mobile hotspot | On 🟣 |

| Share my internet connection from | Wi-Fi ⌄ |

| Share over | Wi-Fi ⌄ |

Power saving
When no devices are connected, automatically turn off mobile hotspot — Off ⚪

Properties ⌃

Network properties — Edit

Name: Voldemort
Password: vold1234
Band: 5 GHz
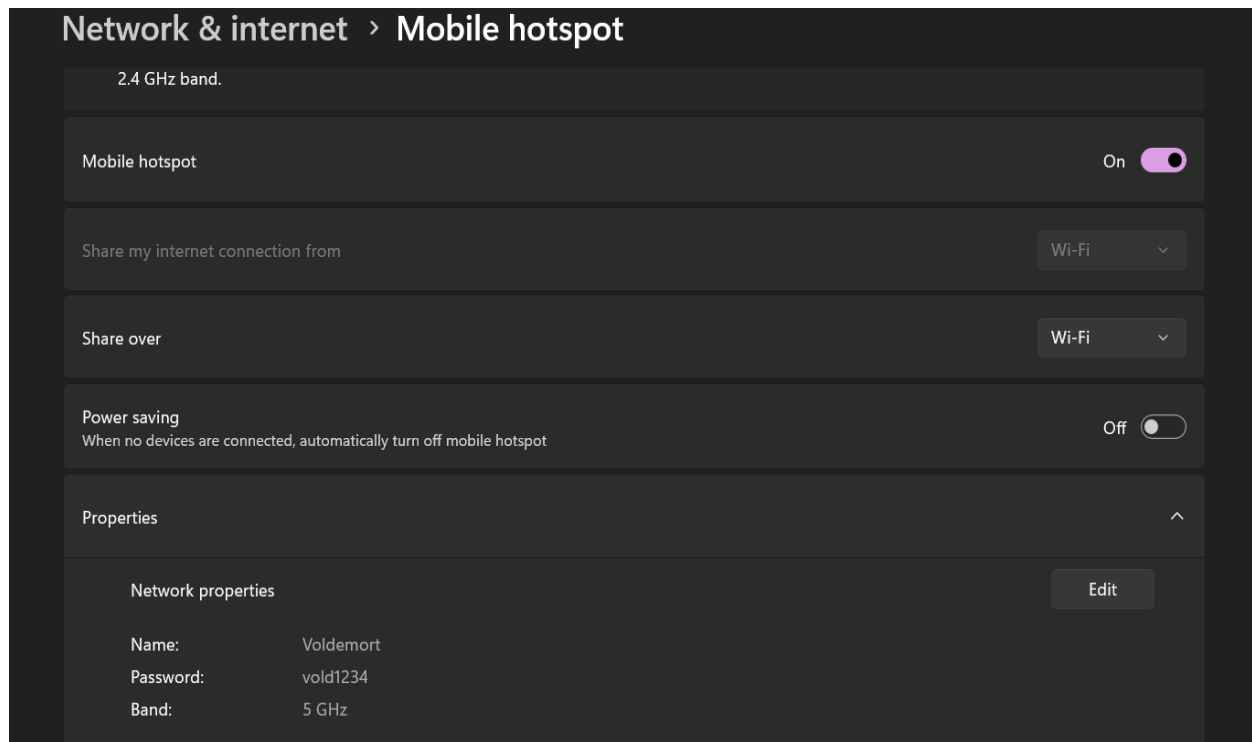
Problem8:

IEEE defines networking standards like 802.11 (Wi-Fi), 802.3 (Ethernet), etc.

IEEE focuses on technical specifications for communication protocols.

IEEE ensures Wi-Fi technologies follow a structured framework.

Example: IEEE 802.11ax (Wi-Fi 6) sets rules for Wi-Fi 6 operation.

WFA is a consortium that certifies Wi-Fi products for interoperability.

WFA ensures devices from different manufacturers work together seamlessly.

WFA handles Wi-Fi branding like "Wi-Fi 6 Certified".

Example: A router with WFA certification guarantees compatibility with Wi-Fi devices.

IEEE develops standards, while WFA certifies and promotes Wi-Fi devices.

Problem9:

Fiber Backhaul – High-speed, low latency, used for broadband ISPs.

Ethernet Backhaul – Uses wired Ethernet to connect routers/APs, stable and fast.

Cellular Backhaul – Uses mobile networks, suitable for rural or temporary setups.

Satellite Backhaul – Used in remote areas, higher latency, dependent on satellite coverage.

Microwave Backhaul – Wireless point-to-point links, used in telecom infrastructure.

DSL (Digital Subscriber Line) Backhaul – Uses telephone lines, slower than fiber.

Cable Backhaul – Uses coaxial cable, common in home broadband setups.

Problem10:

IBSS – Device-to-device communication without an access point (e.g, file sharing, temporary networks).

BSS – Standard Wi-Fi setup with a single AP (e.g, home and office networks).

ESS – Multiple APs with the same SSID for seamless roaming (e.g, large offices, hotels, malls).

Mesh Network – Self-healing, scalable Wi-Fi with multiple nodes relaying data (e.g, smart homes, large campuses, IoT networks).

Point-to-Point Wireless Bridge – Connects two distant locations wirelessly (e.g, building-to-building connections).

Point-to-Multipoint Wireless Network – One AP serving multiple locations (e.g, rural broadband, wireless ISPs).