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Wi-Fi Training Programme

Module 1

Q1. In which OSI layer the Wi-Fi standard/protocol fits.

Ans. Wi-Fi operates at two layers of the OSI model:

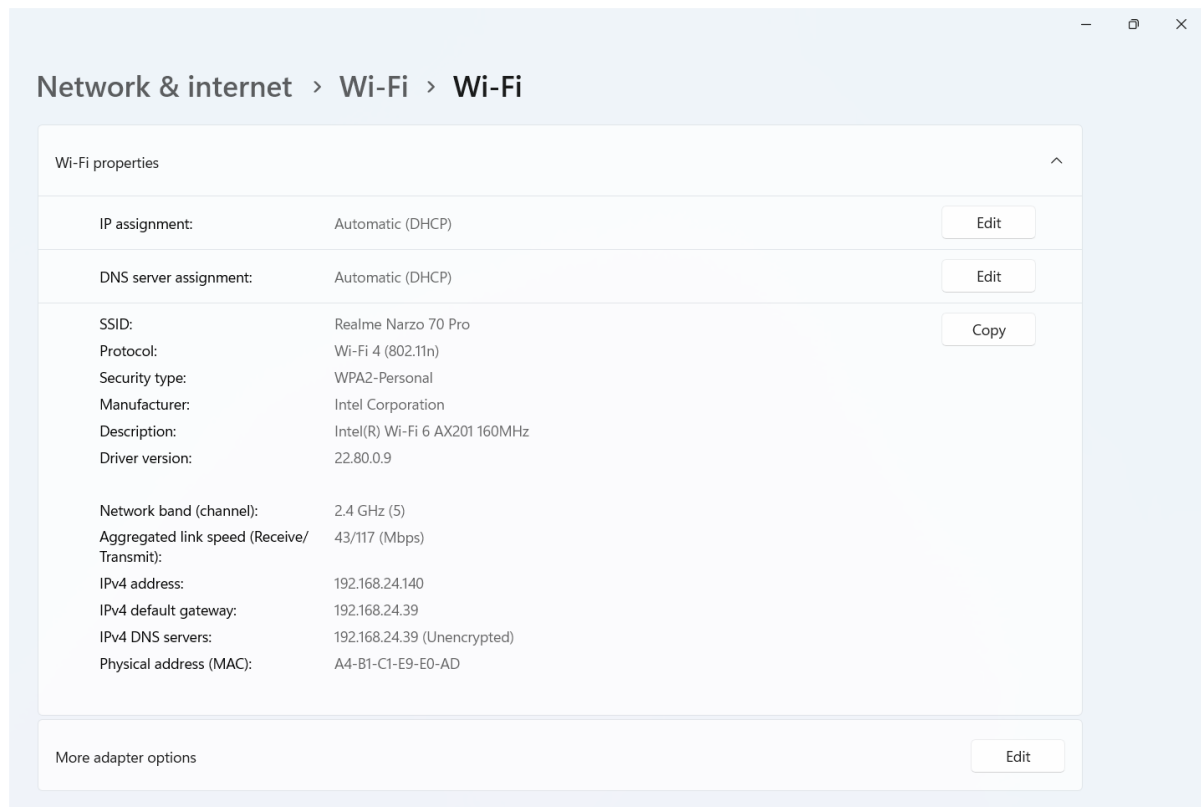
- **Physical Layer (Layer 1):** Deals with wireless transmission over radio waves.
- **Data Link Layer (Layer 2):** In this it is divide into two parts:
  - **Logical Link Control (LLC):** It helps in managing the flow control and error checking.
  - **Media Access Control (MAC):** It defines addressing and access control for better collision avoidance

Q2. 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

Ans. Commonly used Wi-Fi-enabled devices include:

- **Smartphones** - iPhone, Samsung Galaxy, Redmi, One Plus, Realme
- **Laptops** -Dell XPS, MacBook, HP, Lenovo
- **Smart TVs**-Sony Bravia, Samsung Smart TV, LG Smart TV
- **IoT Devices** Smart Bulbs, Alexa, Google Home

## Device: Laptop (Windows) Wireless Properties



### Matching Wi-Fi Generations:

- **802.11n (Wi-Fi 4)** - Supports 2.4GHz & 5GHz, speeds up to 600 Mbps.
- **802.11ac (Wi-Fi 5)** - Works on 5GHz, speeds up to 3.5 Gbps.
- **802.11ax (Wi-Fi 6)** - Latest, operates on both bands, higher efficiency.

### My device working on Wi-Fi 802.11n

Q3. What is BSS and ESS?

Ans.

#### Set of Basic Services (BSS)

A BSS is a tiny Wi-Fi network made up of a single access point (AP) and the connected devices.

Example: Our Laptop, smart TV, and phone are all connected via your home Wi-Fi network.

#### Set of Extended Services (ESS)

A group of several APs connected to one another to cover a greater region is called an ESS.

Example: A college or business with many Wi-Fi routers that provide for smooth internet connection in different rooms.

Key differences:

1. We are still linked to a single router in BSS.
2. We may move between different routers in ESS without losing connectivity.
3. BSS has limited Coverage Area while ESS provides larger Coverage Area.

Q4. What are the basic functionalities of Wi-Fi Accesspoint?

#### **1. Signal Broadcasting and Network Construction:**

→ **Builds a Wi-Fi network:**

An access point sends a Wi-Fi signal, which can be used by devices to join and access the network.

→ **Network Extension:**

Extends the range of a wireless network, making devices capable of connecting in areas that might be beyond the reach of a traditional router.

#### **2. Data Transmission:**

→ **Facilitates two-way data communication:**

Access points enable data transfer between wireless and wired devices, allowing communication and sharing of resources to be done smoothly.

→ **Translates data formats:**

They convert data from wired Ethernet signals to wireless signals and vice versa, enabling wireless devices to access the wired network.

#### **3. Security and Access Control:**

→ **Security Features:**

Most hotspots possess inbuilt security components like encryption (e.g., WPA2/WPA3) and password protection to prevent unauthorized use of the network.

#### **4. Network Access Control and Management**

→ **Access Control:**

Wi-Fi access points can be configured to permit or block particular users or devices to join. It controls who can gain access to the network and adds extra layer of security.

→ **Multiple SSIDs:**

Some access points enable us to have more than one Wi-Fi networks (SSIDs) on a single machine. Example we may establish a guest network separate from our primary network such that our users are not accessing our primary network.

→ **Quality of Service (QoS):**

Wi-Fi access points can prioritize certain types of network traffic. It allocates more bandwidth to activities like video calls or game playing than to less important activities, making them seem smoother.

Q5 Difference between Bridge mode and repeater mode?

Bridge Mode	Repeater Mode
<ul style="list-style-type: none"><li>• Connects two network segments</li></ul>	<ul style="list-style-type: none"><li>• Extends existing Wi-Fi coverage</li></ul>
<ul style="list-style-type: none"><li>• Passes network traffic between networks</li></ul>	<ul style="list-style-type: none"><li>• Amplifies and rebroadcasts signals</li></ul>
<ul style="list-style-type: none"><li>• No signal amplification</li></ul>	<ul style="list-style-type: none"><li>• Increases network range</li></ul>
<ul style="list-style-type: none"><li>• Ideal for connecting separate network infrastructures</li></ul>	<ul style="list-style-type: none"><li>• Potentially reduces network speed</li></ul>
<ul style="list-style-type: none"><li>• Uses separate Subnet</li></ul>	<ul style="list-style-type: none"><li>• Same subnet as the main network</li></ul>
<ul style="list-style-type: none"><li>• Connecting two buildings</li></ul>	<ul style="list-style-type: none"><li>• Boosting home Wi-Fi signal in dead zones</li></ul>

Q6. What are the differences between 802.11a and 802.11b.

Ans.

802.11a	802.11b
1. Frequency: 5 GHz	1. Frequency: 2.4 GHz
2. Max Speed: 54 Mbps	2. Max Speed: 11 Mbps
3. Modulation is OFDM (Orthogonal Frequency Division Multiplexing)	3. Modulation is DSSS (Direct Sequence Spread Spectrum) and CCK (Complementary Code Keying)
4. Less susceptible to interference from devices	4. More susceptible to interference from devices
5. Shorter range	5. Longer range
6. Less penetration through walls	6. Better wall penetration

Q7. 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

## 2.4 GHz

Administrator: Command Prompt

There is 1 interface on the system:

```
Name                : Wi-Fi
Description          : Intel(R) Wi-Fi 6 AX201 160MHz
GUID                 : c4f94b32-8890-4dc6-ba00-c017b802039c
Physical address     : a4:b1:c1:e9:e0:ad
Interface type       : Primary
State                : connected
SSID                 : Realme Narzo 70 Pro
AP BSSID             : fe:17:1f:8e:84:57
Band                 : 2.4 GHz
Channel              : 5
Network type         : Infrastructure
Radio type           : 802.11n
Authentication       : WPA2-Personal
Cipher               : CCMP
Connection mode      : Profile
Receive rate (Mbps)  : 52
Transmit rate (Mbps) : 86.7
Signal               : 96%
Profile              : Realme Narzo 70 Pro
QoS MSCS Configured : 0
QoS Map Configured   : 0
QoS Map Allowed by Policy : 0
```

Hosted network status : Not available

C:\Windows\System32>

## 5 GHz

```
C:\Windows\System32>netsh wlan show interfaces
```

```
There is 1 interface on the system:
```

```
Name                : Wi-Fi
Description          : Intel(R) Wi-Fi 6 AX201 160MHz
GUID                 : c4f94b32-8890-4dc6-ba00-c017b802039c
Physical address     : a4:b1:c1:e9:e0:ad
Interface type       : Primary
State                : connected
SSID                 : Realme Narzo 70 Pro
AP BSSID             : 66:31:29:d7:64:8b
Band                 : 5 GHz
Channel              : 149
Network type         : Infrastructure
Radio type           : 802.11ac
Authentication       : WPA2-Personal
Cipher               : CCMP
Connection mode      : Auto Connect
Receive rate (Mbps)  : 780
Transmit rate (Mbps) : 433.3
Signal               : 99%
Profile              : Realme Narzo 70 Pro
QoS MSCS Configured  : 0
QoS Map Configured   : 0
QoS Map Allowed by Policy : 0

Hosted network status : Not available
```

```
C:\Windows\System32>_
```

**Comparison Table:**

Property	2.4 GHz	5 GHz
Range	Longer	Shorter
Penetration	Better	Weaker
Interference	High	Low
Max Speed	Lower	Higher

- 2.4GHz is better for range and older devices but has slower speeds due to interference.
- 5GHz offers faster speeds and low interference, but weaker signals through walls.

Q8. What is the difference between IEEE and WFA?

**IEEE (Institute of Electrical and Electronics Engineers)**

- Develops technical standards
- Creates 802.11 wireless networking specifications
- Technical protocol development

**WFA (Wi-Fi Alliance)**

- Certifies Wi-Fi product compatibility
- Ensures interoperability
- Promotes Wi-Fi technologies
- Manages Wi-Fi branding

Q9. List down the type of Wi-Fi internet connectivity backhaul, share your home/college's wireless internet connectivity backhaul name and its properties

**Common Backhaul Types:**

**1. Fiber Optic**

- High speed
- Low latency
- Extensive bandwidth

**2. Cable Broadband**

- Shared infrastructure
- Moderate speed
- Cost-effective

**3. DSL**

- Uses telephone lines

- Limited speed
- Widely available

**Example (Home Internet Backhaul):**

- Connection Type: Fiber Optic (Jio Fiber)
- Speed: 100 Mbps
- Stability: Highly Reliable

Q10. List down the Wi-Fi topologies and use cases of each one.

Topology	Description	Use Cases
<b>Infrastructure</b>	Devices connect via an Access Point (AP)	Home & Office Wi-Fi, Enterprise Networks
<b>Ad-hoc</b>	Devices communicate directly without an AP	File sharing, Temporary Networks
<b>Mesh</b>	Multiple APs work together, self-healing network	Large homes, Smart Cities, IoT Networks
<b>Point-to-Point</b>	Direct connection between two wireless devices	Wireless Bridges, Long-Distance Links
<b>Point-to-Multipoint</b>	One AP connects multiple client devices	Public Wi-Fi, Campus Networks, Hotspots