



## **WiFi Assessment 1 - Module 1**

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

- The Wi-Fi protocol fits into the Physical and Data Link Layers of the OSI model.

### Physical Layer :

- The Physical layer deals with the transmission and receiving of raw bits of data in the wireless medium by the WiFi
- In the Physical Layer it defines how the data is transmitted in the air medium. E.g. by using Modulation and Demodulation techniques such as IEEE 802.11a, and others in the series.
- Physical Layer also defines which frequency band to use such as 2.4GHz, 5GHz etc.
- Basically the physical layer is responsible for converting digital signals to WiFi signals.

### Data Link Layer :

- The data link layer performs the same functions as it does in Ethernet, like Error correction and detection and Framing.
- WiFi particularly operates in the MAC sublayer of the data link layer, which consist of the Framing, Error correction and detection, MAC protocol for CSMA/CD.
- Basically this layer is used to identify the MAC address of the device we are trying to connect with.

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.

In Laptop :

```
Command Prompt
(c) Microsoft Corporation. All rights reserved.
C:\Users\gowth>netsh wlan show interfaces

There is 1 interface on the system:

Name                           : Wi-Fi
Description                     : Qualcomm QCA9377 802.11ac Wireless Adapter
GUID                           : 1459ccfc-63e5-4e81-b7fc-8a0fcb7a78e0
Physical address                : cc:6b:1e:41:4c:45
Interface type                  : Primary
State                           : connected
SSID                           : Airtel_tkgkamal_5G
BSSID                           : f8:c4:f3:c3:f3:d4
Network type                    : Infrastructure
Radio type                      : 802.11ac
Authentication                  : WPA2-Personal
Cipher                         : CCMP
Connection mode                 : Profile
Band                            : 5 GHz
Channel                         : 149
Receive rate (Mbps)             : 433.3
Transmit rate (Mbps)            : 433.3
Signal                          : 70%
Profile                         : Airtel_tkgkamal_5G

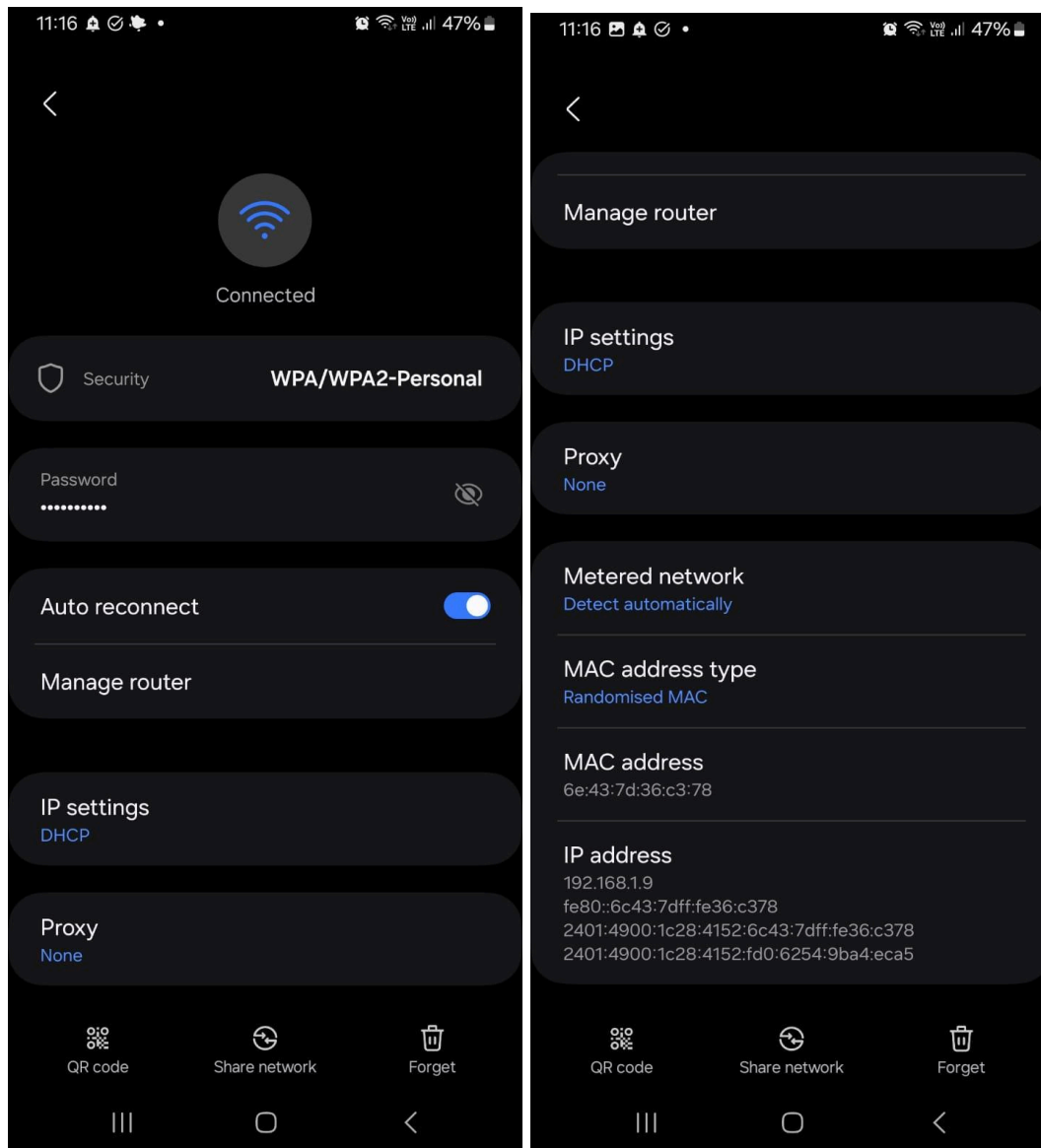
Hosted network status           : Not available

C:\Users\gowth>
```

- Radio Type 802.11ac states that the device is using 5G WiFi
- Band states it is also using 5G network band
- Channel Width is 149 MHz for 802.11ac which has a range between 80MHz to 160MHz.
- Max speed is stated by Receive and Transmit rate which is 433.3 Mbps.
- Signal states the signal strength which is the quality of the strength and it is 70%.
- The GUID (Globally Unique Identifier) is used to uniquely identify the NIC or WiFi adapter.
- SSID is Service Set Identifier is a human readable string to identify the wireless network.
- BSSID is Basic SSID is the MAC address of the Wireless Access Point or the router.
- Physical Address is the MAC address of the end device.
- Authentication is used for ensuring only authorized devices connect to the network. Different protocols are Open Authentication (Passwordless), WPA2-PSK (Pre Shared Key) uses password, WPA3 which has stronger security.
- Cipher is the encryption algorithm used to transmit and receive data securely. E.g. : TKIP, CCMP, GCMP.

- CCMP uses AES encryption in WPA2.
- Connection mode shows how the device is connected to the network. Different types are Profile mode where SSID and passwords are saved to connect, Manual mode where the user has to enter the network details, Auto mode where devices connect automatically based on availability and priority.

In Mobile, the configuration shown is very less as compared to laptop, but we can see it is also connected in WPA2, uses DHCP to obtain IP address, MAC address.



### 3. What is BSS and ESS?

- Basic Service Set (BSS) : It is the basic building block of a WiFi network. It consists of a single access point (AP) and many wireless devices (clients) connected to it. The infrastructure is that devices communicate via the AP and not directly with each other.
- Ex : a wifi home network with one router and many devices is an example of BSS.
- Extended Service Set (ESS) : It is the collection of multiple BSS interconnected through a distributed system (DS), typically via a wired ethernet. It consists of multiple APs, but has the same SSID as all APs in ESS broadcast uses the same SSID. Each AP has its own BSSID, but the SSID remains the same.
- Ex : A corporate office with multiple APs on multiple floors.

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

Wireless Access Points allows wireless devices to connect with wired networks through WiFi. Acts as a central hub for receiving and transmitting the data. The basic functionalities are :

- Wireless Connectivity : Provides a wireless interface for devices to connect.
- Network Bridge : Bridges wireless devices to the wired network.
- SSID Broadcast : SSID for devices to discover
- Authentication Security : Ensures only authorized devices can connect
- Encryption : Protects data transmitted over the network
- Traffic Management : Manages data traffic between devices and the network
- Band Steering : Directs devices to the optimal frequency band.
- Load Balancing : Distributes devices evenly across multiple APs
- Roaming Support : Enables seamless movement between APs.
- Quality of Service : Prioritizes latency-sensitive traffic.
- Monitoring and Diagnostics : Provides insights into network performance
- Guest Network Support : Offers a separate network for guests
- Power over Ethernet : Receives power and data over a single Ethernet cable.
- Firmware Updates : Keeps the AP updated with the latest features and security patches

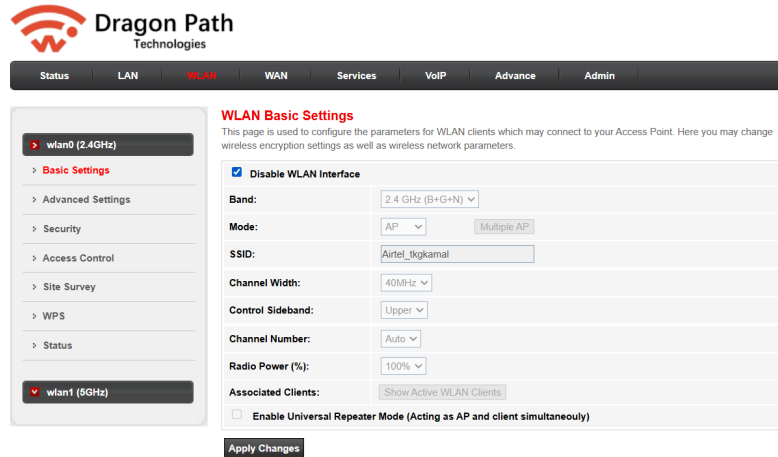
5. Difference between Bridge mode and Repeater mode.

Features	Bridge Mode	Repeater Mode
Purpose	Connects two separate networks	Extends the range of a single network
Connection	Both Wired and Wireless	Wireless only
Network Type	Creates a single network	Repeats the existing network
SSID	Can have a different SSID	Uses the same SSID as the main network
Use Case	Connecting two buildings	Extending Wi-Fi coverage at home
Example	Two offices in different buildings share the same network.	Your home Wi-Fi reaches the backyard

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

Feature	IEEE 802.11a	IEEE 802.11b
Frequency Band	Uses 5GHz, for less crowd and less interference	Uses 2.4GHz, for higher crowd or interference.
Max Speed	Maximum of 54 Mbps (faster due to higher frequency and better modulation)	Maximum of 11 Mbps due to old technology and slower bandwidth.
Range	Short due to high frequency which won't penetrate walls.	Long due to higher bandwidth which can penetrate walls.
Interference	Works better only with less interference.	Can handle more interference.
Compatibility	Not compatible with 802.11b as it is using a different frequency band.	Works with 802.11g as it is using the same band but not with 802.11b.
Use Case	Better for environment with many devices or interference	Better for long range covers.
Overall	Can be used in offices, homes, dense urban areas	Can be used in long distance communication and rural areas.

- 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.



The image shows the 'WLAN Basic Settings' page of the Dragon Path Technologies web interface. The interface has a top navigation bar with tabs: Status, LAN, WLAN (selected), WAN, Services, VoIP, Advance, and Admin. On the left, there is a sidebar with a tree view containing 'wlan0 (2.4GHz)' (selected) and 'wlan1 (5GHz)'. Under 'wlan0 (2.4GHz)', there are sub-items: 'Basic Settings' (selected), 'Advanced Settings', 'Security', 'Access Control', 'Site Survey', 'WPS', and 'Status'. The main content area is titled 'WLAN Basic Settings' and includes a description: 'This page is used to configure the parameters for WLAN clients which may connect to your Access Point. Here you may change wireless encryption settings as well as wireless network parameters.' Below this, there is a checkbox 'Disable WLAN Interface' which is checked. The configuration fields include: 'Band' set to '2.4 GHz (B+G+N)', 'Mode' set to 'AP' with a 'Multiple AP' button, 'SSID' set to 'Airtel\_tkgkamal', 'Channel Width' set to '40MHz', 'Control Sideband' set to 'Upper', 'Channel Number' set to 'Auto', 'Radio Power (%)' set to '100%', and 'Associated Clients' with a 'Show Active WLAN Clients' button. At the bottom, there is an unchecked checkbox 'Enable Universal Repeater Mode (Acting as AP and client simultaneously)' and an 'Apply Changes' button.

```
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Network type        : Infrastructure
Radio type          : 802.11ac
Authentication      : WPA2-Personal
Cipher              : CCMP
Connection mode     : Profile
Band                : 5 GHz
Channel             : 149
Receive rate (Mbps) : 433.3
Transmit rate (Mbps) : 433.3
Signal              : 70%
Profile              : Airtel_tkgkamal_5G

Hosted network status : Not available

C:\Users\gowth>
```



▼ wlan0 (2.4GHz)

▼ wlan1 (5GHz)

▼ Basic Settings

▼ Advanced Settings

▼ Security

▼ Access Control

▼ Site Survey

▼ WPS

▼ Status

#### WLAN Basic Settings

This page is used to configure the parameters for WLAN clients which may connect to your Access Point. Here you may change wireless encryption settings as well as wireless network parameters.

☒ Disable WLAN Interface

Band: 5 GHz (A+N+AC) ▼

Mode: AP ▼ Multiple AP

SSID: Airtel\_tkgkama1\_5G

Channel Width: 80MHz ▼

Control Sideband: Auto ▼

Channel Number: Auto ▼

Radio Power (%): 100% ▼

Associated Clients: Show Active WLAN Clients

☐ Enable Universal Repeater Mode (Acting as AP and client simultaneously)

Apply Changes

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Physical address : cc:6b:1e:41:4c:45
Interface type : Primary
State : connected
SSID : Airtel_tkgkama1
BSSID : f8:c4:f3:c3:f3:d0
Network type : Infrastructure
Radio type : 802.11n
Authentication : WPA2-Personal
Cipher : CCMP
Connection mode : Profile
Band : 2.4 GHz
Channel : 1
Receive rate (Mbps) : 150
Transmit rate (Mbps) : 150
Signal : 100%
Profile : Airtel_tkgkama1

Hosted network status : Not available
```

```
C:\Users\gowth>
```

Key differences :

Features	5GHz	2.4GHz
Speed	Faster speed (433 Mbps)	Slower speed (150 Mbps)
Range	Short range	Long range

Signal Strength	Low (70 %)	High (100%)
Interference	Less	More
Radio Type	802.11ac	802.11n

8. What is the difference between IEEE and WFA?

IEEE is the Institute of Electrical and Electronics Engineers, an organization that develops standards and protocols for various technologies including WiFi. They created 802.11 standards which define the technical specifications and protocols for WiFi.

WFA is WiFi Alliance, an non profit organization that promotes WiFi technology and certifies Wifi products. They mainly ensure that different devices from different manufacturers work well together and certifies devices for compatibility with IEEE standards.

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

Wifi internet backhaul is the part of the network that connects to the LAN or the core network. It determines the internet speed and reliability and affects the latency.

Different types of WiFi Backhaul are :

- Fiber Optic : uses fiber optic cables, very low latency, 10Gbps or more speed.
- DSL (Digital Subscriber Line) : Uses telephone lines, Moderate latency, upto 100Mbps speed.
- Cable : Uses coaxial cable, Moderate latency, upto 1Gbps speed.
- Satellite : High latency and upto 100Mbps speed.
- Wireless : Uses cellular data, speed and latency depends on 4G or 5G
- Microwave : Uses microwave signal, upto 1Gbps speed and low latency.
- Ethernet : uses ethernet cables, upto 10Gbps speed and low latency.

In my home, the internet backhaul properties are :

- ISP : Airtel Fiber
- Speed : upto 1GBps
- Latency : < 10ms
- Reliability : High (99.9% uptime)
- Connection type : Wired (Fiber Optic)
- WiFi Standard : 802.11ac and 802.11n



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

- Infrastructure Mode : Devices connect to a central Access Point (AP) to access the internet or network. Use Case : Home, office, or public Wi-Fi where devices connect to a central router
- Repeater Mode : Extends Wi-Fi coverage by retransmitting the signal from the main router. Use Case : Extending Wi-Fi coverage to dead zones like basements or backyards.
- Bridge Mode : Connects two separate networks wirelessly, often used to link two buildings. Use Case : Connecting two separate networks, such as linking two buildings wirelessly.
- Ad-Hoc Mode : Devices connect directly to each other without an AP for quick file sharing or communication. Use Case : Quick file sharing or gaming between devices without a router.
- Mobile Hotspot Mode : A device (e.g., smartphone) shares its internet connection with other devices. Use Case : Sharing a smartphone's internet with a laptop or tablet on the go.
- Work Group Bridge Mode : Connects non-Wi-Fi devices (e.g., printers) to a Wi-Fi network. Use Case : Connecting wired devices (e.g., printers) to a Wi-Fi network.
- IoT gateway Mode : Connects IoT devices (e.g., sensors, cameras) to a central network or cloud. Use Case : Managing and connecting IoT devices (e.g., smart home gadgets) to the cloud.