Wireless fidelity systems

Wi-Fi is a wireless networking technology, by which we can access networks or connect with other computers or mobile using a wireless medium. In Wi-Fi, data are transferred over radio frequencies in a circular range.

Wi-Fi, a brand name given by the Wi-Fi Alliance (formerly Wireless Ethernet Compatibility Alliance), is a generic term that refers to the communication standard for the wireless network which works as a Local Area Network to operate without using the cable and any types of wiring. It is known as **WLAN**. The communication standard is **IEEE 802.11**. Wi-Fi works using Physical Data Link Layer.

Nowadays in all mobile computing devices such as laptops, mobile phones, also digital cameras, smart TVs has the support of Wi-Fi. The Wi-Fi connection is established from the access point or base station to the client connection or any client-to-client connection within a specific range, the range depends on the router which provides the radio frequency through Wi-Fi. These frequencies operate on 2 types of bandwidth at present, 2.4 GHz and 5 GHz.

All the modern laptops and mobiles are capable of using both bandwidths, it depends on the Wi-Fi adapter which is inside the device to catch the Wi-Fi signal. 2.4 GHz is the default bandwidth supported by all the devices. 2.4 GHz can cover a big range of areas to spread the Wi-Fi signal but the frequency is low, so in simple words, the speed of the internet is less and 5 GHz bandwidth is for a lower range of area but the frequency is high so the speed is very high.

Let's say, if there is an internet connection of 60 MB/s bandwidth, then for 2.4 GHz bandwidth, it provides approx 30 to 45 MB/s of bandwidth connection and for 5 GHz bandwidth, it provides approx 50 to 57 MB/s bandwidth.

History:

The concept of Wi-Fi is very old but its implementation is not so old. At first **ALOHA System** is a wireless network system that is used to connect Hawaii island via a network in the year 1971. Where the protocol is used for this was ALOHA protocol and the network used packet transfer. Later it's converted to IEEE 802.11 protocol.

Then in 1985, the Federal Communications Commission (FCC) released a new network for general uses which works on 900 Mhz, 2.4 GHz, and 5.8 GHz bandwidth. This is known as the *ISM band*. Also, IBM introduced a *Token Ring LAN* network for connecting several computers, it can transfer data at 4 Mb/s speed.

Then in 1988, a wireless cashier system was invented based on the Token Ring LAN network known as *waveLAN*, it operates at 900MHz or 2.4 GHz band and offers speeds of 1 to 2 Mbps. Then it was converted to *IEEE 802.11LAN/MAN* standards in 1989.

Then in 1990, IEEE 802.11 Working Group for Wireless LANs is established by **Vic Hayes**, who was known as the **"Father of WiFi"**.

Then in 1994, *Dr. Alex Hills* introduced a research project on the wireless network, which provided coverage of the network to 7 buildings wirelessly.

Then in 1996 *Commonwealth Scientific and Industrial Research Organization (CSIRO)* introduced a wireless network based on the same protocol 802.11, later it was known as IEEE 802.11a standards.

Then after all this in 1997 the first version of Wi-Fi is released officially which is 802.11 and it can support a maximum of 2 Mb/s link speed. Then in 1999, the link speed is increased to 11 Mb/s over the 2.4 GHz frequency band, this version is known as 802.11b Then after a month, the IEEE 802.11a standard is approved officially, which provides up to 54 Mb/s link speed over the 5 GHz band, but the signal range is weaker than the 2.4 GHz band.

Then in 2003, the speed is increased in a new version, known as 802.11g. The speed offers up to 54 to 108 Mb/s over 2.4 GHz. After this two more versions were introduced that are, 802.11i and 802.11e. In 802.11i, the security mechanism was increased and in 802.11e, Voice over Wireless LAN and multimedia streaming are involved.

Then in 2009, 802.11n is developed, which supports both 2.4 GHz and 5 GHz radiofrequency. And these are used simultaneously by dual-band routers and can reach maximum speeds of 600 Mbps.

Then in 2014, a new version was introduced that offers a potential speed of 1733 Mb/s in the 5 GHz band. This version is known as 802.11ac. Till now this is the latest version of Wi-Fi.

Applications of Wi-Fi :

Wi-Fi has many applications, it is used in all the sectors where a computer or any digital media is used, also for entertaining Wi-Fi is used. Some of the applications are mentioned below –

- Accessing Internet: Using Wi-Fi we can access the internet in any Wi-Fi-capable device wirelessly.
- We can stream or cast audio or video wirelessly on any device using Wi-Fi for our entertainment.
- We can share files, data, etc between two or more computers or mobile phones using Wi-Fi, and the speed of the data transfer rate is also very high. Also, we can print any document using a Wi-Fi printer, this is very much used nowadays.
- We can use Wi-Fi as **HOTSPOTS** also, it points Wireless Internet access for a particular range of area. Using Hotspot the owner of the main network connection can offer temporary network access to Wi-Fi-capable devices so that the users can use the network without knowing anything about the main network connection. Wi-Fi adapters are mainly spreading radio signals using the owner network connection to provide a hotspot.

- Using Wi-Fi or WLAN we can construct simple wireless connections from one point to another, known as Point to point networks. This can be useful to connect two locations that are difficult to reach by wire, such as two buildings of corporate business.
- One more important application is **VoWi-Fi**, which is known as **voice-over Wi-Fi**. Some years ago telecom companies are introduced VoLTE (Voice over Long-Term Evolution). Nowadays they are introduced to VoWi-Fi, by which we can call anyone by using our home Wi-Fi network, only one thing is that the mobile needs to connect with the Wi-Fi. Then the voice is transferred using the Wi-Fi network instead of using the mobile SIM network, so the call quality is very good. Many mobile phones are already getting the support of VoWi-Fi.
- Also using W-Fi a whole city can provide network connectivity by deploying routers at a specific area to access the internet. Already schools, colleges, and universities are providing networks using Wi-Fi because of its flexibility.
- Wi-Fi is used as a *positioning system* also, by which we can detect the positions of Wi-Fi hotspots to identify a device location.

Types of Wi-Fi:

Wi-Fi has several types of standards, which are discussed earlier, here just the name of the standards are defined,

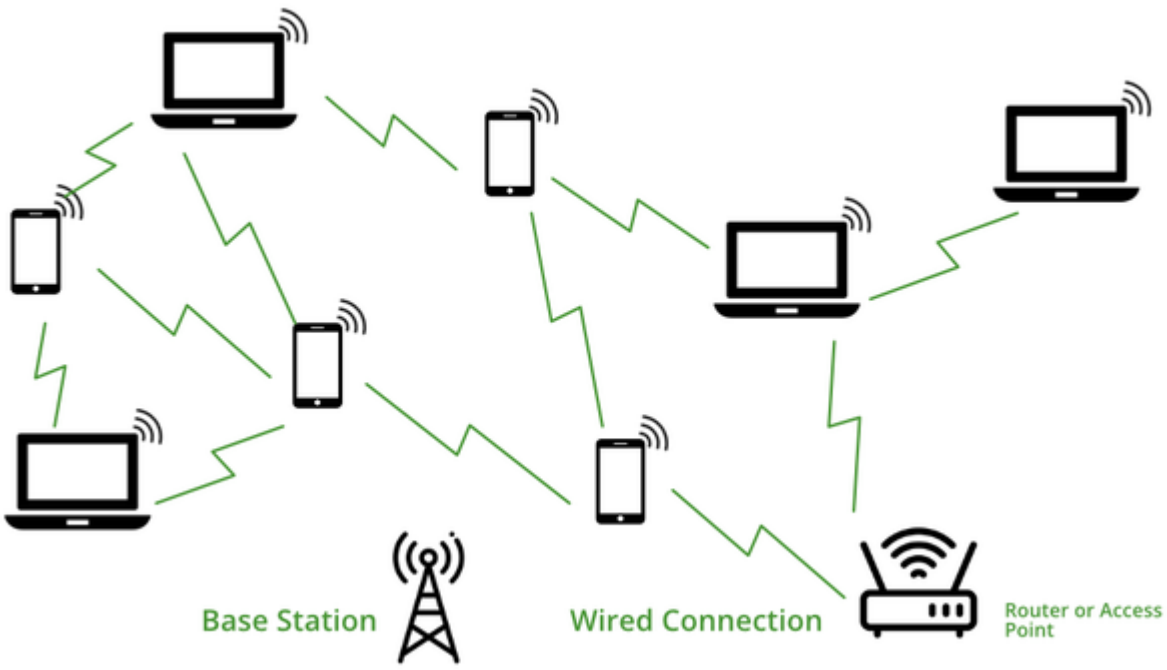
Standards	Year of Release	Description
Wi-Fi-1 (802.11b)	**1999**	**This version has a link speed from 2Mb/s to 11 Mb/s over a 2.4 GHz frequency band**
Wi-Fi-2 (802.11a)	**1999**	**After a month of release previous version, 802.11a was released and it provide up to 54 Mb/s link speed over 5 Ghz band**
Wi-Fi-3 (802.11g)	**2003**	**In this version the speed was increased up to 54 to 108 Mb/s over 2.4 GHz**
802.11i	**2004**	**This is the same as 802.11g but only the security mechanism was increased in this version**
802.11e	**2004**	**This is also the same as 802.11g, only Voice over Wireless LAN and multimedia streaming are involved**
Wi-Fi-4 (802.11n)	**2009**	**This version supports both 2.4 GHz and 5 GHz radio frequency and it offers up to 72 to 600 Mb/s speed**
Wi-Fi-5 (802.11ac)	**2014**	**It supports a speed of 1733 Mb/s in the 5 GHz band**

A new version will release in 2020 named 802.11ax developed by Huawei, which can support, a maximum of 3.5 Gb/s. it will know Wi-Fi 6.

How does Wi-Fi work?

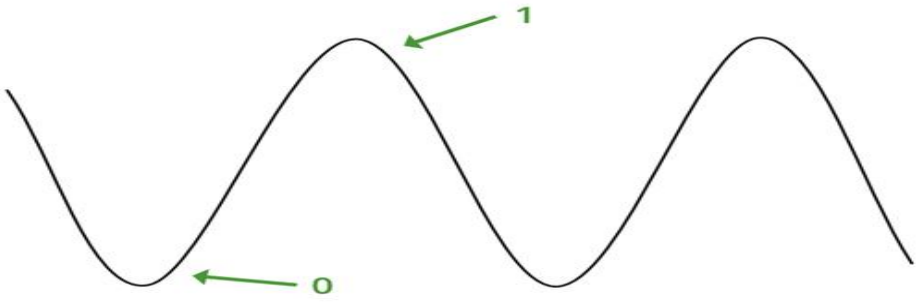
Wi-Fi is a wireless technology for networking, so it uses Electromagnetic waves to transmit networks. We know that there are many divisions of Electromagnetic waves according to their frequency such as X-ray, Gamma-ray, radio wave, microwave, etc, in Wi-Fi, the radio frequency is used. For transmitting Wi-Fi signal there is three medium,

- **Base station network or an Ethernet(802.3) connection:** It is the main host network from where the network connection is provided to the router.
- **Access point or router:** it is a bridge between a wired network and a wireless network. It accepts a wired Ethernet connection and converts the wired connection to a wireless connection and spreads the connection as a radio wave.
- **Accessing devices:** It is our mobile, computer, etc from where we use the Wi-Fi and surfing internet.

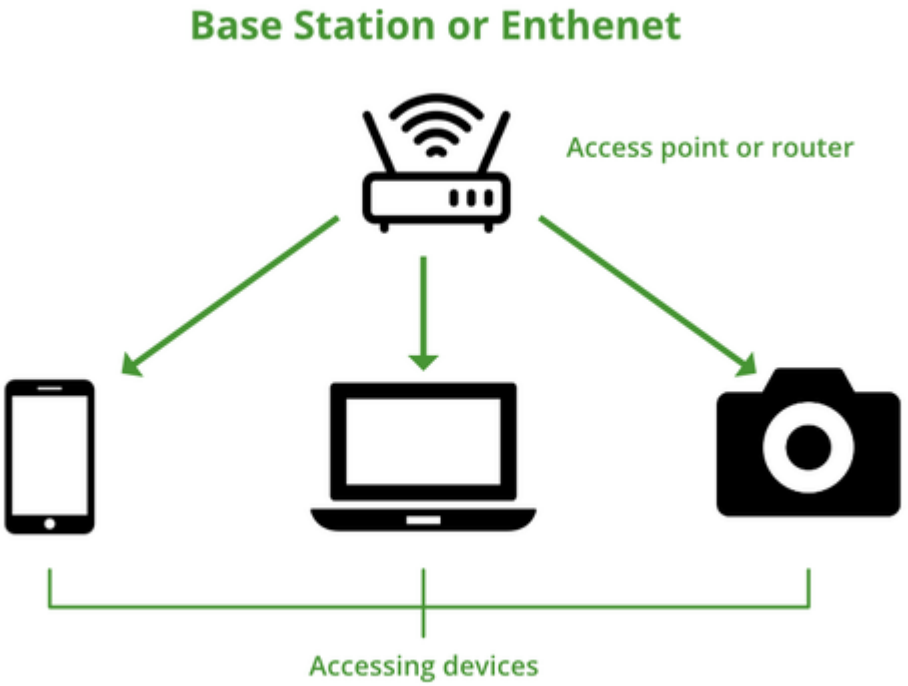


Working of Wi-Fi

All the electronics devices read data in binary form, also router or our devices, here routers provide radio waves and those waves are receive by our devices and read the waves in binary form. We all know how a wave looks like, the upper pick of the wave is known as 1 and the lower pick of the wave is known as 0 in binary. Like below:



Data transmission



Base Station

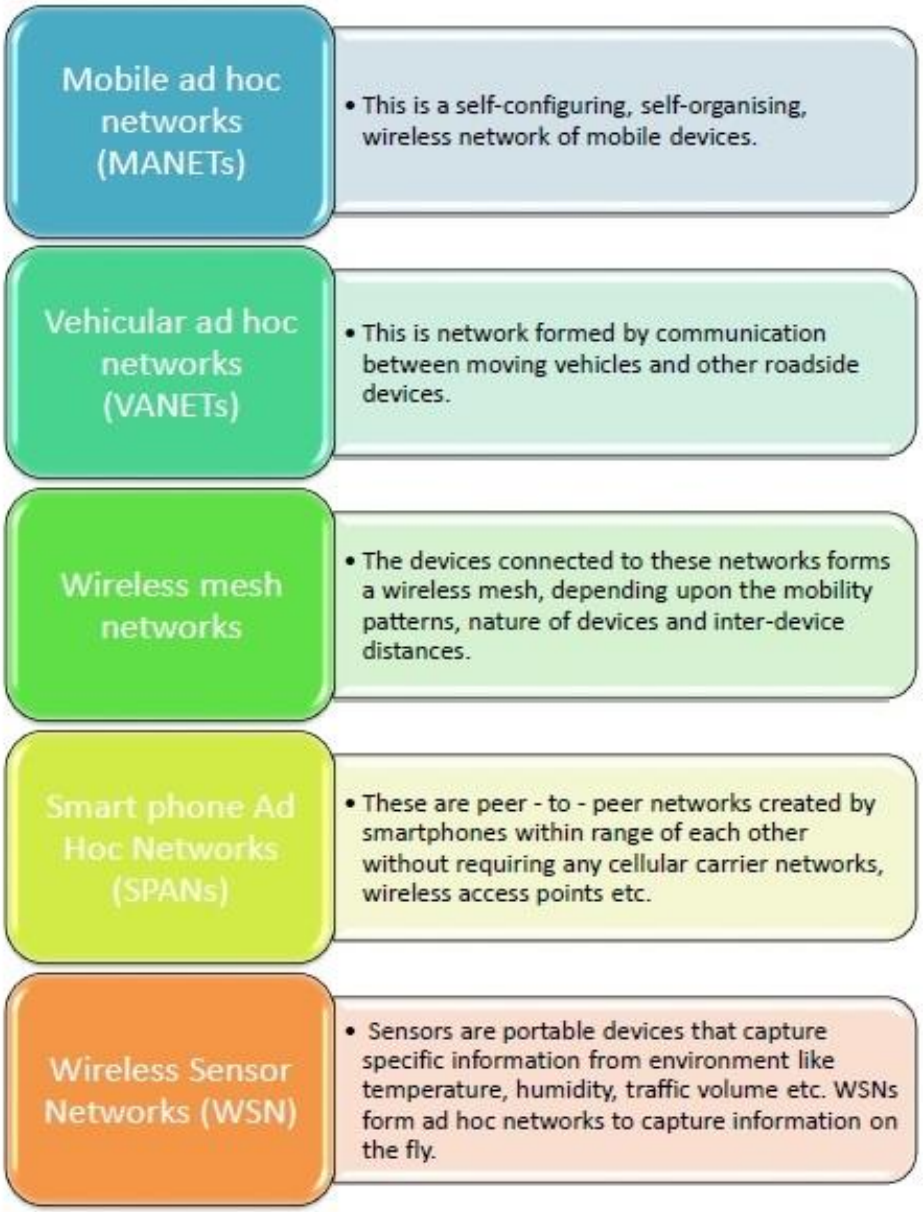
Advantages of Wi-Fi

- It is a flexible network connection, no wiring complexities. Can be accessed from anywhere in the Wi-Fi range.
- It does not require regulatory approval for individual users.
- It is salable, can be expanded by using Wi-Fi Extenders.
- It can be set up in an easy and fast way. Just need to configure the SSID and Password.
- Security in a high in Wi-Fi network, its uses **WPA** encryption to encrypt radio signals.

- It is also lower in cost.
- It also can provide Hotspots.
- it supports roaming also.

Disadvantages of Wi-Fi

- Power consumption is high while using Wi-Fi in any device which has a battery, such as mobile, laptops, etc.
- Many times there may be some security problems happening even it has encryption. Such as many times has known devices become unknown to the router, Wi-Fi can be hacked also.
- Speed is slower than a direct cable connection.
- It has lower radiation like cell phones, so it can harm humans.
- Wi-Fi signals may be affected by climatic conditions like thunderstorms.
- Unauthorized access to Wi-Fi can happen because it does not have a firewall.
- To use Wi-Fi we need a router, which needs a power source, so at the time of power cut, we cannot access the internet.


Mobile ad hoc networks (MANETs)
• This is a self-configuring, self-organising, wireless network of mobile devices.
Vehicular ad hoc networks (VANETs)
• This is network formed by communication between moving vehicles and other roadside devices.
Wireless mesh networks
• The devices connected to these networks forms a wireless mesh, depending upon the mobility patterns, nature of devices and inter-device distances.
Smart phone Ad Hoc Networks (SPANs)
• These are peer - to - peer networks created by smartphones within range of each other without requiring any cellular carrier networks, wireless access points etc.
Wireless Sensor Networks (WSN)
• Sensors are portable devices that capture specific information from environment like temperature, humidity, traffic volume etc. WSNs form ad hoc networks to capture information on the fly.