|| Volume 5 || Issue 5 || May 2020 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

OVERVIEW ON IEEE 802.11AX WI-FI 6 TECHNOLOGY

Vaishnavi U. Pathak[1], Bhavesh S. Nanaware[2], Shreyas Athavale[3], Anup G. Dakre[4]

BE, Department Electronics and Telecommunications Marathwada Mitra Mandal's College of Engineering Pune[1,2]
Wireless Professional, Emerson, Pune[3]
Professor department Electronics and Telecommunications, Marathwada Mitra Mandal's College of Engineering Pune[4]
vaishnavipathak948@gmail.com[1], bhavesh301294@gmail.com[2], shreyasathavale22@gmail.com[3] ,anupdakare@mmcoe.edu.in [4]

Abstract: ***IEEE 802.11 standard is the base of WLAN. Previous generations of Wi-Fi made improvements which more focus on capabilities such as larger bandwidth, high speed, higher capacity, and high efficiency along with the reduction in congestion of networks. This paper aims to provide an overview of 802.11ax Wi-Fi technology going to be used will give a new perspective for communication in wireless networks. 802.11ax i.e. Wi-Fi 6 is also called as HEW. There are many features witch Wi-Fi 6 provides like productivity, flexibility, portability, very low installation cost. Wireless deployments provide mobility to all the connected nodes and devices in the network.***

Keywords: - *Wi-Fi 6,Wireless, Network, Access point, Augmented Reality, Internet of things,802.11ax.*

I. INTRODUCTION

The objective of this paper is to provide an insight into recent developments in the Wi-Fi technology. Now a day's everyone is connected to internet through different network devices. In communication networks wireless technology is become key medium for connectivity of almost every device in the world. As data traffic is increasing day by day the speed and bandwidth should also be increased according to the need that's why new inventions are taking place in the wireless networking. Upcoming standard of Wi-Fi is 802.11ax known as Wi-Fi 6. The main intent of Wi-Fi 6 is to provide wide bandwidth alongside with high speed rate.

1. **Wi-Fi Evolution**

Wi-Fi standards evolved rapidly after 1999 to offer higher throughput by providing speed to users and improved high performance.

802.11n (Wi-Fi 4)

802.11n was the first standard to specify MIMO, which is approved in October 2009 and has an option of 2.4GHz and 5GHz frequencies, with speeds up to 600Mbps.To deliver data across these two frequencies "dual-band" term is used by WLAN

802.11ac (Wi-Fi 5)

Wi-Fi 5 uses MIMO, which has multiple antennas on sending and receiving devices to increase speed and reduce errors. Data rates up to 3.46Gbps will be supported by this standard of Wi-Fi. Some vendors include technologies that support the 2.4GHz frequency via 802.11n, providing support for older versions of devices that may have 802.11b/g/n, for improved data rates it also provides supplementary bandwidth. Current home wireless routers are mostly 802.11ac managed and operated on the 5 GHz frequency.

	802.11n (Wi-Fi 4)	802.11ac Wave 2 (Wi-Fi 5)	802.11ax (Wi-Fi 6)
Released	2009	2013	2019
Bands	2.4GHz & 5GHz	5GHz	**2.4GHz & 5GHz**, spanning to **1GHz - 7GHz** eventually
Channel Bandwidth	20MHz, 40MHz (40MHz optional)	20MHz, **40MHz**, **80MHz, 80+80MHz & 160MHz** (40MHz support made mandatory)	20MHz/40MHz @ 2.4GHz, 80MHz, 80+80MHz & 160MHz @ 5GHz
FFT Sizes	64, 128	**64, 128, 256, 512**	64, 128, 256, 512, **1024, 2048**
Subcarrier Spacing	312.5kHz	312.5kHz	**78.125 kHz**
OFDM Symbol Duration	3.6ms (short guard interval) 4ms (long guard interval)	3.2ms (0.4/0.8ms cyclic prefix)	**12.8ms** (0.8/**1.6/3.2ms** cyclic prefix)
Highest Modulation	64-QAM	**256-QAM**	**1024-QAM**
Data Rates	Ranging from 54Mb/s to 600Mb/s (max of 4 spatial streams)	433Mb/s (80MHz, 1 spatial stream) 6933Mb/s (160MHz, 8 spatial stream)	600Mb/s (80MHz, 1 spatial stream) 9607.8Mb/s (160MHz, 8 spatial stream)
SU/MU-MIMO-OFDM/A	SU-MIMO-OFDM	SU-MIMO-OFDM Wave 1, MU-MIMO-OFDM Wave 2	MU-MIMO-OFDMA

802.11ax (Wi-Fi 6)

802.11ax is known as High-Efficiency WLAN. The goal of 802.11ax aims to improve the performance of WLAN deployments in regions which experience more number of users.

2. **Wi-Fi 6 Benefits**

- Low power consumption and power saving mode for wireless devices
- Improved performance
- Covers wide range
- Increased reliability
- Additional frequency spectrum given for IoT and other devices
- Highest Throughput in dense environment

3. **Wi-Fi 6 Primary Features and improvements**

3.1 OFDMA (Orthogonal Frequency Division Multiple Access)

The transition of 802.11ax to OFDMA from OFDMA allows more efficient data transmission to multiple devices to reuse channel recourses by splitting the entire 20 MHz channel into sub-channels or small RUs (resource units). Each RU includes at least 26 subcarriers and users distinguish by Time-Frequency RUs. To send data to single client 802.11ax AP uses 20 MHz channel or it will split it into 9 clients using 9 RUs. To increase the throughput data modulated into Modulation and Coding Set MCS 10 or 11. Multiple users can simultaneously send data on each time segment it also reduces access delay.

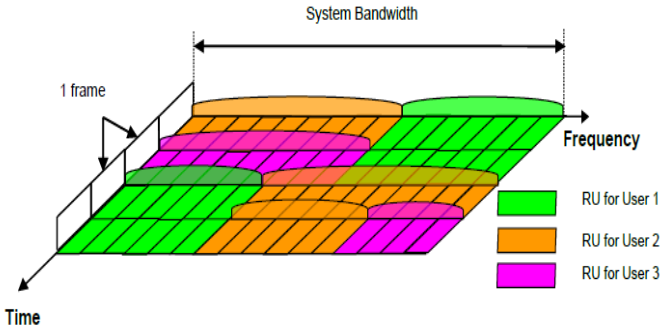

Fig.3.1 OFDMA working mode

3.2 MU-MIMO (Multi-User MIMO)

To transmit independent data streams on a single bandwidth MU-MIMO uses the spatial diversity of channels. MU-MIMO is having Uplink and Downlink directions. The AP can transmit data with multiple terminals at the same time. Downlink MU-MIMO simultaneously receives from multiple transmitters. By combining OFDMA and MU-MIMO allows 802.11ax to achieve increased capacity, coverage improvement, and performance in various environments. It improves overall throughput along with transmission efficiency in multiple users and reduces application delay.

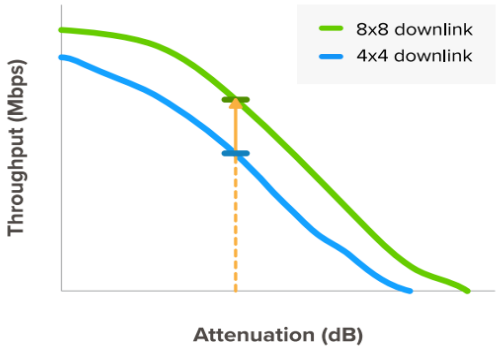

Fig.3.2 Improved RF fidelity for 8x8 vs. 4x4 for client

1024 Quadrature Amplitude Modulation (QAM)

It is a high modulation technique used to increase system capacity, to reduce latency, to improve efficiency in multiuser high-density applications. QAM enables efficient packets to be sent by the modulating phase and amplitude of a signal.802.11ax uses 1024 QAM i.e. each symbol bit transmits 10 bit data (2^10=1024). When a single client is near AP it may possible to achieve 2.5x increase throughput and 1.2 Gbps of stream speed. Along with OFDMA 1024 QAM improves noise threshold, and offer high performance with 20MHz or less bandwidth. 1024 QAM has a very small margin for error because of high signal-to-noise-ratio with 10 bit transmitted per OFDM.

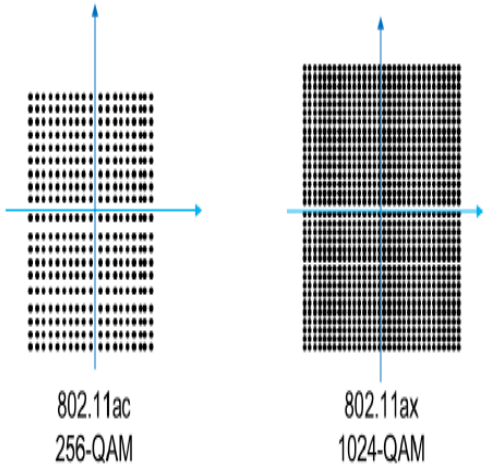

Fig.3.3 Constellation maps of QAM

3.3 BSS Coloring

BSS Coloring is co-frequency transmission identification mechanism. The network performance can be affected by interference. For better performance, it is important to reduce the impacts of interference. If congestion in the network increases throughput decreases. Congestion could affect 40-60% of data rates and required careful channel planning. In 802.11ax PHY packet header contain BSS color field which will assign a color to each channel. Intra-BSS is indicated by same color bit while different color bits indicate inter-BSS. BSS coloring uses Dynamic CCA mechanism. No interference will occur in between two channels of Wi-Fi devices. Data transmission can be done at the same channels with the same frequency by reducing wait time.

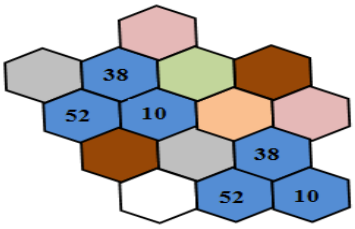

Fig.3.4 Co-channel BSS congestion with same color

3.4 Target Wake Time

Most of the devices are battery operated and extending life of a battery is very critical. TWT is an important recourse scheduling function. TWT is used to reduce the consumption of power and improved the battery life of the devices and medium access contention. TWT allows waking up devices at different periods than the beacon transmission period.

4. Wi-Fi 6 Performance and Throughput

4.1 Performance of Wi-Fi 6 increases using

- Modulation scheme 1024QAM
  High modulation increases data rate
- Spatial streams 8×8 MU-MIMO
  Works when spatial diversity of clients
- Channel bonding 80 &160 MHz
  - 6 channels of 80 MHz
  - 2 channels of 160 MHz
- Airtime efficiency
  Transmission is optimize and combined by using RUs assigned by AP using OFDMA

4.2 Throughput requirements

Higher throughput requirements are leading to increase in traffic of internet increases tremendously since last 32 years. The Wi-Fi networks are dealing with exponentially increasing client rate and density along with high throughput. 4k video streaming consumes 15-18 mbps and 8k video streaming roughly uses 1 Gbps of throughput. Applications such as VR and AR have also increasing use it consumes traffic of 600 Mbps to 1 Gbps. These challenges of bandwidth will also require increasing speed to 2.2x in future years.

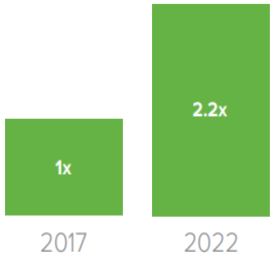

Fig.4.1 - 2017 vs. 2022 Wi-Fi network connection speeds

5. Wi-Fi 6 Advantages and Disadvantages –

Advantages-

1) Compared to 802.11ac 802.11ax offers high network efficiency.

2) It is backwards compatible with devices 802.11n and 802.11ac.

3) It uses OFDMA so multiple users can transmit data at the same. The scheduling based on OFDMA helps to reduce latency in network.

4) It offers robust high efficiency signalling.

5) The Wi-Fi 6 standard is compatible with previous protocols, but for maximum performance it is advisable to use a receiver and transmitter that is compatible with it.

Disadvantages-

1) The Wi-Fi 6 standard is compatible with previous protocols, but for maximum performance it is advisable to use a receiver and transmitter that are compatible with it.

2) The Wi-Fi 6 has comparatively smaller range to the 5GHz network

3) If there is an obstruction present in between router and the devices signals will be more often interrupted.

4) To achieve better performance Frequency synchronization and clock offset correction are important aspects

II CONCLUSION

Wi-Fi has become an important technology in the world. Wi-Fi is providing a connection to access connection to the internet for billions of devices. The main objective of this paper is to get an overview of basic concepts and features of 802.11ax i.e. Wi-Fi 6 with its advantages and disadvantages.

REFERENCES

[1]. Huawei Wi-Fi 6(802.11ax) Technology White paper
[2]. WP_802.11AX.pdf (www.arubanetworks.com)
[3]. qorvo-wi-fi-6-80211ax-whats-it-all-about-white-paper
[4]. https://emarsonindia.com/wp-content/uploads/2020/03/meraki_whitepaper_wifi6.pdf
[5]. https://www.howtogeek.com/368332/wi-fi-6-what%E2%80%99s-different-and-why-it-matters/
[6]. https://www.theverge.com/2019/2/21/18232026/wi-fi-6-speed-explained-router-wifi-how-does-work
[7]. file:///C:/Users/Hp/Downloads/24262-Considering-WiFi-6-WP_v3_English.pdf
[8].https://www.gizbot.com/internet/features/wifi-6-technology-explained-with-pros-and-cons-062578.html
[9]. https://www.networkworld.com/article/3238664/80211-wi-fi-standards-and-speeds-explained.html