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Wi-Fi 6 802.11ax

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Abstract: ***A new update in the era of wireless communication has just been announced. The 6th generation Wi-Fi hence known as Wi-Fi-6 [802.11ax] expected to have high energy performance and stated HEW (High Efficiency WLAN). The purpose of this paper is to introduce Wi-Fi -6 with all it's Technical Improvements, Features, advantages and disadvantages.***

1. Introduction

Wi-Fi 6 is the next generation standard in WiFi technology. Wi-Fi 6 also known as "AX WiFi" or "802.11ax WiFi" builds and improves on the current 802.11ac WiFi standard. Wi-Fi 6 was originally built in response to the growing number of devices in the world. If you own a VR device, multiple smart home devices, or simply have a large number of devices in your household, then a Wi-Fi 6 router might just be the best WiFi router for you. In this guide, we'll go over Wi-Fi 6 routers and break down how they're faster, increase efficiency, and are better at transferring data than previous generations.

Wi-Fi 6 was developed by the Institute of Electrical and Electronics Engineers (IEEE), the world's largest association of technical professionals. Along with a lot of other functions (its stated mission is "to advance technology for the benefit of humanity"), the IEEE is basically the keeper of Wi-Fi, with committees responsible for developing it and establishing industry standards.

2. Technical Improvements & Features

The 802.11ax amendment will bring several key improvements over the previous generation Wi-Fi. 802.11ax addresses frequency bands between 1 GHz and 6 GHz. Therefore, unlike 802.11ac, 802.11ax will also operate in the unlicensed 2.4 GHz band. To meet the goal of supporting dense 802.11 deployments, the following features have been approved

2.1Orthogonal frequency-division multiple access (OFDMA)

The Centrally controlled medium access with dynamic assignment of 26, 52, 106, 242(?), 484(?), or 996(?) tones per station. Each tone consists of a single subcarrier of 78.125 kHz bandwidth. Therefore, bandwidth occupied by a single OFDMA transmission is between 2.03125 MHz and ca. 80 MHz bandwidth.

OFDMA segregates the spectrum in time-frequency resource unit . A central coordinating entity (the AP in 802.11ax) assigns RUs for reception or transmission to associated stations.

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Through the central scheduling of the RUs contention overhead can be avoided, which increases efficiency in scenarios of dense deployments

2.2 Multi-User MIMO (MU-MIMO)

In 802.11ax MU-MIMO is available in Downlink and Uplink direction. with Downlink MU MIMO a device may simultaneously receive from multiple transmitters. Whereas OFDMA separates receivers to different RUs, with MU MIMO devices are separated to different spatial streams. In 802.11ax, MU MIMO and OFDMA technologies can be used simultaneously. To enable uplink MU transmissions, the AP transmits a new control frame (Trigger) which contains scheduling information (RUs allocations for stations, modulation and coding scheme (MCS) that shall be used for each station). Furthermore, Trigger also provides synchronization for an uplink transmission, since the transmission starts Short Interframe Space after the end of Trigger.

2.3 Trigger-based Random Access

Allows performing UL OFDMA transmissions by stations which are not allocated RUs directly. In Trigger frame, the AP specifies scheduling information about subsequent UL MU transmission. However, several RUs can be assigned for random access. Stations which are not assigned RUs directly can perform transmissions within RUs assigned for random access. To reduce collision probability (i.e. situation when two or more stations select the same RU for transmission), the 802.11ax amendment specifies special OFDMA back-off procedure. Random access is favorable for transmitting buffer status reports when the AP has no information about pending UL traffic at a station.

2.4 Spatial frequency reuse

Coloring enables devices to differentiate transmissions in their own network from transmissions in neighboring networks. Adaptive Power and Sensitivity Thresholds allows dynamically adjusting transmit power and signal detection threshold to increase spatial reuse.

Without spatial reuse capabilities devices refuse transmitting concurrently to transmissions ongoing in other, neighboring networks. With coloring, a wireless transmission is marked at its very beginning helping surrounding devices to decide if a simultaneous use of the wireless medium is permissible or not. A station is allowed to consider the wireless medium as idle and start a new transmission even if the detected signal level from a neighboring network exceeds legacy signal detection threshold, provided that the transmit power for the new transmission is appropriately decreased.

2.5 Target Wake Time (TWT)

TWT reduces power consumption and medium access contention.TWT is a concept developed in 802.11ah. It allows devices to wake up at other periods than the beacon transmission period. Furthermore, the AP may group device to different TWT period thereby reducing the number of devices contending simultaneously for the wireless medium

2.6 BSS Coloring

BSS Coloring is a method for addressing this medium contention overhead due to overlapping basic service sets (OBSS) and spatial reuse. 802.11ax radios can differentiate between BSS's by adding a number (color) to the PHY header and new channel access behavior will be assigned based on the color detected. The same color bit indicates an intra-BSS while different color bits indicate inter-BSS. Inter-BSS detection means that a listening radio treats the medium as busy and must defer. However, adaptive CCA implementation could raise the signal detect (SD) threshold for inter-BSS frames while maintaining a lower threshold for intra-BSS traffic. BSS Coloring could potentially decrease the channel contention problem that is a result of existing 4 dB signal detect (SD) thresholds. The goal of BSS Coloring is to increase reuse, while not causing a significant reduction in selected MCS due to interference. The bottom line here is that the medium is only busy when my color is detected, which ultimately helps mitigate OBSS

3. Advantages of Wi-Fi-6

3.1 Offers more reliable Wi-Fi

A. more consistent and dependable network connection provides a seamless experience for clients, Internet of Things(IOT),and all apps especially voice and video.

3.2 Increase your network capacity

As wireless demands increase and include more IoT devices, Wi-Fi 6 (802.11ax) handles more data across the airways than previous Wi-Fi standards. It also handles more active clients per access point.

3.3 Boost speed and bandwidth

Wi-Fi 6 achieves speeds up to 4 times faster than previous Wi-Fi standards, improving the user experience and performance of bandwidth-hungry apps like voice, video, and collaboration.

3.4 Improve the 2.4-GHz band

The last upgrade for 2.4 GHz was 10 years ago. Wi-Fi 6 brings new improvements to the 2.4-GHz band that make your wireless work better with IoT devices that require more energy efficiency and better Wi-Fi coverage.

4. Disadvantages of Wi-Fi-6

4.1 Noise Oscillation

OFDM subcarrier spacing is narrower at 78.125 KHz. This means good phase noise oscillators and highly linear RF front ends are essential.

4.2 Clock Frequency

As 1024-QAM is used to achieve higher data rates, EVM specification is tight. Tight frequency synchronization and clock offset corrections are required to achieve better performance. Moreover WiFi 6 stations maintain frame timing based on their clocks. This is essential as their transmissions should be as per trigger frames and scheduling.

4.3 Signal Disturbance

The Wi-Fi 6 has a smaller range compared to the 5GHz network, and the signals will be interrupted more often if there is an obstruction between the router and the device.

5. Conclusion

All these technology enhancements are for the people so it is mandatory for them to understand the basic concept along with pros and cons so that, they will have clear visibility of what they are going to use and invest time & money in, this was the main objective of this paper.

References

[1] https://en.wikipedia.org/wiki/IEEE_802.11ax
[2] https://www.tp-link.com/us/wifi6/
[3] https://www.theverge.com/2019/2/21/18232026/wi-fi-6-speed-explained-router-wifi-how-does-work
[4] https://blog.aerohive.com/what-is-bss-coloring-in-802-11ax/
[5] https://www.gizbot.com/internet/features/wifi-6-technology-explained-with-pros-and-cons-062578.html