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Wi-Fi 802.11 ac vs. 802.11 ad Comparative Study

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Abstract: ***Recently, the wireless connection has become a preferred technology, due to its ease in use and for its mobility; therefore a rapid development has emerged in the wireless technologies. Wi-Fi is the most common technology used today. This paper is a comparative study, it illustrates the basic characteristics of two of the most recent currently used wireless LAN systems 802.11 ac and 802.11ad, this comparison helps users differentiate between these two types for selection.***

Keywords: IEEE 802.11, 802.11ac/ad

1. Introduction

IEEE 802.11 is a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) computer communication in the 2.4, 3.6, 5, and 60 GHz frequency bands They are created and maintained by the IEEE LAN/MAN Standards Committee (IEEE 802). The basic version of the standard was released in 1997, and has had subsequent amendments. The standard and amendments provide the basis for wireless network products using the Wi-Fi brand. While each amendment is officially revoked when it is incorporated in the latest version of the standard, the corporate world tends to market to the revisions because they concisely denote capabilities of their products. As a result, in the market place, each revision tends to become its own standard.[1] The organization is responsible for developing every major Wi-Fi standard, including 802.11b, g, a, n and ac.

2. IEEE 802.11ac

Is a wireless networking standard in the 802.11 family (which is marketed under the brand name Wi-Fi), developed in the IEEE Standards Association process[2]providing high-throughput wireless local area networks (WLANs) on the 5 GHz band. The standard was developed from 2011 through 2013 and approved in January 2014. [3]This specification has expected multi-station WLAN throughput of at least 1 gigabit per second and a single link throughput of at least 500 megabits per second (500 Mbit/s). This is accomplished by extending the air interface concepts embraced by 802.11n: wider RF bandwidth (up to 160 MHz), more MIMO spatial streams (up to eight), downlink multi-user MIMO (up to four clients), and high-density modulation (up to 256-QAM).[4]

Features:
80 MHz channel bandwidths, five to eight spatial streams, 160 MHz channel bandwidths, 80+80 MHz channel bonding and MCS 8/9 (256-QAM)

3. IEEE 802.11ad

IEEE 802.11ad is an amendment that defines a new physical layer for 802.11 networks to operate in the 60 GHz millimeter wave spectrum. This frequency band has significantly different propagation characteristics than the 2.4 GHz and 5 GHz bands where Wi-Fi networks operate. Products implementing the 802.11ad standard are being brought to market under the WiGig brand name. The certification program is now being developed by the Wi-Fi Alliance instead of the now invalid WiGig Alliance. The peak transmission rate of 802.11ad is 7 Gbit/s.[5]

Specification:

The WiGig MAC and PHY Specification, version 1.1 includes the following capabilities [6]:Supports data transmission rates up to 7 Gbit/s – more than ten times faster than the highest 802.11n rate. Supplements and extends the 802.11 Media Access Control (MAC) layer. WiGig devices physical layer enables low power and high performance, guaranteeing interoperability and communication at gigabit rates. Protocol adaptation layers are being developed to support specific system interfaces.Supports beam forming, enabling robust communication at distances beyond 10 meters. The beams can move within the coverage area through modification of the transmission phase of individual antenna elements, which is called phase array antenna beamforming.

WiGig devices widely use advanced security and power management.

However the 802.11ad MAC layer has been updated to address aspects of channel access, synchronization, association, and authentication required for the 60 GHz operation.

4. Difference between 802.11ac and 802. 11ad

Frequency

802.11ac and 802.11ad improves upon the wireless capabilities introduced in 802.11n. 802.11ad using spectrum in the unlicensed 60GHz band, where far more overall bandwidth is available in either the 2.4 or 5GHz bands currently utilized in 802.11. The Wireless Gigabit Alliance (WiGig) initiated the specification development to take advantage of this spectrum, but their work has been rolled into the IEEE 802.11ad draft specification.

Compatibility

Chipsets featuring 802.11ac are fully backwards compatible with previous Wi-Fi standards. This means it works perfectly with 802.11a, 802.11b, 802.11g and 802.11n. 802.11ad is not backward compatible to 11ac and 11n but it is a completely new standard developed to cater extremely high data rate and to provide short range wireless connectivity.

Range

802.11 ac ranges to about 80 m with 3 antennas while 802.11 ad enables more than about 10 meters with beamforming.

Data Rate

802.11ac uses 1.3Gbps while 802.11 ad uses 7Gbps, i.e. 802.11ad is faster 7x than 802.11ac.

5. Results and Discussions

Table 1 802.11 ac **vs** 802.11 ad

Appearance Of Comparison Frequency	802.11 ac 5 Ghz	802.11 ad 60 Ghz	Comment
Compatibility	It Supports Legacy 11n Systems	It Is Not Backward Compatible To 11ac And 11n	But It Is Completely New Standard Developed To Cater Extremely High Data Rate And To Provide Short Range Wireless Connectivity
Data Rate	1.3Gpbs	7Gpbs	802.11adis Very High Speed Throughput Than 802.11ac.
Distance	About 80 M With 3 Antenna	About 10 Meters	802.11 Ad Very High Throughput At Short Distance
Modulation	BPSK,QPSK,16QAM,64 QAM,256QAM	64-QAM	60 Ghz Carrier Provides 10 Times More Cycles To Modulate Than A 6 Ghz Carrier
	Supports 468 Data Subcarriers Per OFDM Symbol	Supports 336 Data Subcarrier Connection	802.Ad Is More Data Subcarriers

The table contains some comparison which is discussed in terms of frequency, compatibility, data rate, distance, modulation and features. One of the considerable benefits of 802.11ad is its high data rate and support of 468 data subcarriers per OFDM symbol.

6. Conclusion

The IEEE 802.11ac and 802.11ad specifications both promise to deliver increased capacity, speed, and performance in different ways, allowing users on-the-go to enjoy even their highest-data-rate applications. The significant difference is that 802.11ad will operate in the 60 GHz band. There are few applications in the 60 GHz band primarily because the signal loss is so high relative to 2.4 GHz and 5 GHz. Higher loss translates into a much shorter transmission range. As a result, 802.11ad will not be capable of supporting transmissions between access points and devices dozens of meters apart. Rather, 802.11ad will be used for in-room wireless connections. 802.11ac follows the evolution of 802.11b to 802.11g to 802.11n; 802.11ad is NOT on that same path. 802.11ad stands alone as a potential HDMI cable replacement or for other short-range, low-user-density applications. Where 802.11ac is effectively “faster WiFi”, 802.11ad is effectively “wireless HDMI”. 802.11ac will bring greater capacity to a large coverage cell while 802.11ad will provide dramatic throughput to a few users in a small area. 802.11ac is a wireless LAN while 802.11ad is a wireless PAN.

The WiGig/11ad standard also specifies an adaptive beamforming option that provides high antenna gains and narrow directionality to minimize interference and the ability to adjust to the surrounding to optimize data rate and link reliability.

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