

Wi-Fi, WiMAX & WiGig: A Comparative Study

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Abstract - Wi-Fi, WiMax & WiGig came into market promising wireless broadband access solutions for the Future generation of wireless Technology. These three networks can support connection oriented transmissions and better services. This paper represents the correlation amongst WiMax(802.16) and Wi-fi(802.11) based on different parameters i.e., Network architectures, Technologies utilized, Benefits of WiMax, Wi-fi, Communication run, Operating frequency and Data security risks. This paper decides the normal forthcoming changes in the remote advancements. Usually in remote inaccessible areas wired networks are not at all cost effective and we have come so far developing broadband wireless networks which provide us with more capacity as well as coverage. This paper provides detailed technical as well as working differences between 802.11a,b,g(Wi-Fi),802.16(WiMaX) and 802.11ad (WiGig).

Key Words: Wi-Fi, WiGig, WiMAX, AES algorithm, OFDM

1. INTRODUCTION

All the 802.11 specifications utilize the Ethernet Protocol and Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) for way sharing. The first modulation utilized as a part of 802.11 was phase-shift keying(PSK). In any case, different plans, for example, complementary code keying (CCK), are utilized as a part of a portion of the newer specifications. The more up to date modulation methods give higher information speed and decreased vulnerability to interference.

2. Overview of Wi-Fi, WiMAX and WiGig:

2.1.1 The IEEE 802.11a:

IEEE 802.11a is a standard wifi protocol which came into existence in 1998 which had maximum rate of around 54 mbps and have fallback rates ranging upto 48,36,24,18,12,9,6 mbps in channel 12 with frequency around 5ghz in orthogonal frequency division multiplexing[64 channels].

- 802.11a uses a half duplex network
- 802.11a uses a modulation techniques includes BPSK,QPSK
- Encryption technique used in 802.11i and access protocol used is csma/ca
- Never achieved success due to high cost
- Prevalently used in business and larger networks

Advantages of 802.11a:

- Higher speeds
- Prevent signal interference

Disadvantages of 802.11a:

- Higher cost

2.1.2 The IEEE 802.11b:

IEEE 802.11 b is a standard wifi protocol which came into existence in 1998 which had maximum rate of around 11 mbps which is comparable to Ethernet and have fall back ranging from 5.5mbps,2mbps,1mbps in channel 3 with frequency around 25mhz in Direct sequence spectrum

- 802.11b uses a half duplex network
- Bandwidth efficiency is less than 0.44bps
- 802.11b uses a modulation techniques includes QPSK
- Encryption technique used is aes in 802.11i and access protocol used is CSMA/CA
- Cheaper than 802.11 b which made this a commercial success
- Prevalently used in smaller area network like home networks

Advantages of 802.11b:

- Low cost
- Range of Signal is good

Disadvantages of 802.11b:

- Lower speeds

2.1.3 The IEEE 802.11g:

In 2002 and 2003, WLAN items supporting a more up to date standard called 802.11g was developed available on the market. 802.11g endeavors to join the best of both 802.11a and 802.11b. 802.11g supports data transmission up to 54 Mbps, and it utilizes the 2.4 GHz Frequency for higher range. 802.11g is in reverse perfect with 802.11b, implying that 802.11g access focuses will work with 802.11b remote system connectors and the other way around. It uses half duplex network. Modulation techniques include DBPSK, DQPSK, and DSSS. It uses a radio technique orthogonal frequency division multiplexing (OFDM).

Advantages of 802.11g –

Fast most extreme speed; signal range is great and not effectively discouraged.

Disadvantages of 802.11g –

Costs more than 802.11b; apparatuses may interfere on the unregulated signal frequency.

2.1.4 The IEEE 802.16:

WiMAX stands for Worldwide-Interoperability-for-Microwave-Access. It is a wireless communications standard and is defined as IEEE standard 802.16. It can also be used as an alternative broadband instead of using cable and DSL. The IEEE developed the 802.16 in its first version to address line of sight access at spectrum which ranges from 10 GHz to 66 GHz.. It can provide data rate upto 1 Gbps for a fixed station considering the updates. It is a connection-oriented wide area network and can potentially provide broadband access to remote places. It also uses point-to-multipoint (P2MP) architecture. Its delivers broadband seamless quality multimedia services to end users. A WiMAX base-station can cover almost 3,000 square miles which is a large area.

The IEEE 802.16d standard provides four categories for the prioritization of traffic:

- Unsolicited Grant Service
- Real-Time Polling Service
- Non-Real Time Polling Service
- Best Effort

Each of these service classes has its own advantage helping in prioritizing traffic.

1. Unsolicited Grant Service: This supports real-time constant bit-rate (CBR) data flows. Data packets of fixed size will be accepted by the BS at periodic intervals and guarantees for bandwidth and access delay with firm. Unsolicited Grant Service is suitable for applications which require a constant bandwidth and limited delay variation.

2. Real-Time Polling Service: This also supports real-time applications, but offers variable bit-rate and less stringent delay or jitter requirements. The BS also provides transmission opportunities to each SS periodically through a basic polling mechanism. E.g. video conferencing, video streaming.

3. Non-Real-Time Polling Service: It is used for non-real-time applications which requires better than best effort service in terms of bandwidth, but they are not delay sensitive. Examples are file transfer, database applications etc.,

4. Best Effort: Service is provided for the best effort applications with possess elastic traffic like email, web

browsing, telnet. There is no guarantee in terms of bandwidth delay or request access that are offered by the BS. This service has lowest priority

WIMAX FEATURES:

- It uses wireless link with microwave or millimeter waves.
- It uses licensed spectrum
- It provides public network service to fee-paying customers
- It uses point-to-multipoint (P2MP) architecture
- It uses Simple stationary rooftop or tower-mounted
- Antennas are used to provide broadband

2.1.5 The IEEE 802.11ad:

802.11ad, also called WiGig 1.0, is a proposed particular in the 802.11 family appropriate to WLANs (remote neighborhood). 802.11ad speaks to an expansion or refresh of the current 802.11a standard.

Systems utilizing 802.11ad will work in the 60-GHz (gigahertz) band utilizing OFDM (Orthogonal Frequency Division Multiplexing). The upgrades upheld by 802.11ad will encourage concurrent spilling of HD (top notch) video to different customers in vast office conditions, and also faster remote synchronization and reinforcement of expansive records.

New highlights that will exist in 802.11ad, far beyond those proposed for 802.11ac (another improvement to 802.11a), include: Local 802.11a/b/g/n/ac support. Consistent exchanging between 2.4, 5, and 60-GHz groups. Channel width up to 2160 MHz (megahertz). Throughput of up to 7 Gbps (gigabits every second). Built in help for wired connections. Working scope of 10 meters or more. Enhanced functionality for cell phones. Advanced security Features. Support for control administration.

Wi-Gig:

The Wi-Fi Alliance has started testing 802.11ad for interoperability, yet nobody knows how the standard is received. Since the start of the Wi-Fi fever, merchants have showcased each new customer get to innovation from 802.11b completely through the most recent 802.11ac Wave 2 Standard.. WiGig is great, but it doesn't replace Wi-Fi network. We might think that WiGig is far better than Wi-Fi, In the word "gig" it sounds faster, because it is. However, The Idea is to have Wi-Fi for broadband connections and Wi-Gig to wirelessly interconnect home entertainment devices such as PCs, tablets, Pods and so on. Wi-Gig is a kind of wireless HDMI.

Wi-Gig is fast. Wi-Gig operates in the uncluttered 60GHz frequency range and guarantees data transfer rates up to 7Gbps. In the Real-world throughput will be little bit slower, but theoretically using different modulation and beam

forming techniques Wi-Gig can yield speeds of 25Gbps. Wi-Gig can act as a connection layer for devices that can be interconnected via USB, Display Port and HDMI. Selected devices have the correct radios installed, it can be backwards compatible with 802.11 Wi-Fi connections in the 2.4GHz and 5GHz frequency ranges.

Wi-Gig is efficient. Wi-Gig was designed as a lower power technology, and claims to be five times more energy efficient when compared to Wi-Fi. Wi-Gig Uses “Beamforming” technique for best performance, reducing congestion and efficiently pointing the radio signal to the destination. The Wi-Gig Alliance says that beamforming will empower hearty associations past 10 meter extend; there is a great deal of distinction between strong and speedy. Wi-Gig needs to interface with everything. It's simply not interconnecting home excitement gadgets through HDMI, USB et cetera.

Wi-Gig isn't a restrictive standard. It Comes from the Wireless Gigabit Alliance. Wi-Gig is one of the few contending norms. There are a few measures wanting to end up remote equivalent of HDMI: WiGig, WiDi and Wireless HD. WiGig is going to be the official 60GHz wireless standard.

The official IEEE standard for 60GHz wireless communications is 802.11ad, and while it was originally separate from WiGig the WiGig Alliance has been working with the IEEE on standardization. Ultimately we're likely to use WiGig to mean 802.11ad and vice-versa. Not all Wi-Gig equipment are compatible with Wi-Fi networks, which would create a confusion for the Wi-Fi brand.

3. COMPARISION BETWEEN Wi-Fi, WiMAX AND WiGig:

	Wi-Fi	Wi-MAX	Wi-Gig
IEEE Standard	802.11 a, b and g	802.16	802.11 ad
Range	300 meters (or) 100 yards	Around 30 miles, cell radius of 4-6 miles	Around 10-15 meters
Throughput	11Mbps	72Mbps	7Gbps
Scalability	It scales from one to few tens with one subscriber for each (CPE), scalability of 20MHz fixed channel width.	It supports one to few hundreds of Consumer Premises Equipment (CPE)s, channel is flexible and range varies from 1.5MHz to 20MHz.	It supports one to few thousands of Consumer Premises Equipment(CPE), channel has bandwidth of 60MHz.
Bit Rate	2.7bps/Hz in a fixed channel width of 20MHz.	5bps/Hz to 100Mbps/Hz in 20MHz channel.	Upto 7Gbps in 60GHz ISM band.
QoS	It may not have any Quality of Service (QoS), It does not provide ubiquitous broadband.	The Quality of Service (QoS) is good such that it is used for Dynamic bandwidth allocation, It provides ubiquitous broadband.	It supports high-performance wireless implementations of HDMI, Display Port and USB.
Security Mechanism	Its Security mechanism is limited and it is of Wired Equivalent Privacy (WEP) mechanism and pre-shared key.	Its Security mechanism is of Multi-level encryption consists of Extensible Authentication Protocol (EAP)-based authentication, Advanced Encryption Standard (AES), Privacy Key Management (PKM).	It uses Advanced Security using Galois/Counter mode of AES Encryption Algorithm.
Modulation	a-OFDM, b-DSSS, g-OFDM, DSSS	Adaptive Modulation and Scalable OFDMA	SC, OFDM, MCS
Advanced Antenna Technology	N/A	MIMO antenna technology	Beamforming technology
Band Communications	It operates in 2.4GHz and 5.8GHz	It operates in 3.2-3.8GHz	It operates in 2.4GHz, 5GHz and 60GHz

4. CONCLUSION

In this comparative review we conclude that each of these wireless network have their unique importance in a particular field. The quality of WiMax lie in its capacity to address the necessities of present day media transmission systems and the dedication that has been appeared to its advancement and wide acknowledgment by number of driving hardware sellers and administration suppliers. While finishing up the outcomes on Wi-fi there are genuine and quantifiable advantages of utilizing remote systems verses a standard wired system. Most prominent advantage is that there are no wires required. Wi-fi is now the widely used wireless network although Wi-MAX and WiGig are far better in many aspects, their usage in the current technological world is far behind than that of Wi-Fi. The range of WiMAX is high as this is a macro cellular network whereas the Wi-Fi and WiGig comes under small cell network. Throughput, Scalability, Bit Rate, Quality of Service, Security Mechanism, Modulation, Advanced Antenna Technology, Band Communications are sophisticated in the case of WiMAX and WiGig which are needed in this day-to-day advancement of technology. Though providing higher data rates and usage of advanced techniques in communication, range is always considered as one of the important factors when it comes to wide range implementation of these wireless networks. WiGig has limitations that restrict it more uses than traditional Wi-Fi. Connection speed drops according to distance between the devices. Wi-Gig's range is much shorter when compared to Wi-Fi's. As the users on wireless are generally high when it is brought to large scale usage of network, cost of installation of stations is also a very important factor. Hence, further development of specifications of the drawbacks of these networks will be a great use for the development of wireless networks in the future.

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