

Merging of WIBRO Technologies: Wi-Fi and Wimax– A Review

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Abstract: Wireless technology is a modern and very vast research to networks that use cables. This technology enables the user to deploy a computer network without needing to run cable throughout the facility. In recent years, wireless networking has become more wide, accessible, inexpensive, and user-friendly. Home users are adopting wireless technology in huge numbers. Up and about laptop users often find free wireless connections in places like coffee shops and airports, also known as hotspots. This paper will explain various wireless broadband technologies (WiBro) such as IEEE 802.11 and IEEE 802.16. Also we will compare technologies pros and cons individually. At last, to provide better services to customer we will review fusion of these WiBro technologies and its benefits.

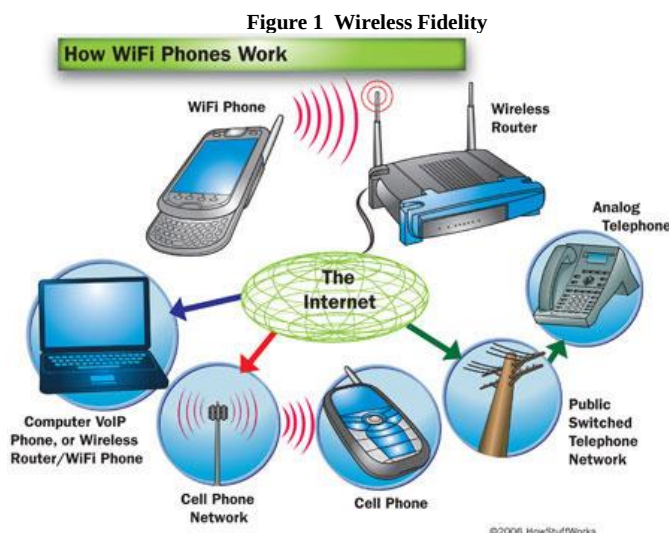
Keywords: Wi-Fi, Wimax, their comparison, benefits and disadvantages, and integrated Wi-Fi and Wimax.

I. Introduction

Wireless technologies have advanced with great speed in the past few years. Today, with over 165 million cell phone professionals universal, organizations use wireless technologies to solve business problems and make advantages over competitors. The three most important broadband wireless technologies are IEEE 802.11(Wi-Fi), IEEE 802.16(Wimax), and Wireless Mesh Network (WMN). Wimax and Wi-Fi have emerged as promising broadband with complementary features enable the use of Wimax as a backhaul service to connect multiple dispersed Wi-Fi hotspots to the Internet.

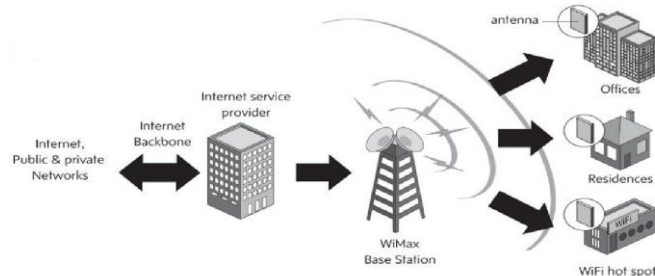
Wi-Fi stands for Wireless Fidelity, which is a wireless technology based on a sequence of specifications from the Institute of Electrical and Electronics Engineers (IEEE) called 802.11. Wi-Fi works on unlicensed radio frequency, mostly in the 2.4GHz band and is Wi-Fi is one of the most popular wireless standards currently employed [7]. The working of Wi-Fi is shown in figure 1. There are several types of Wi-Fi:

- 802.11a (offering transmission speeds of 24mbps to 54mbps).
- 802.11b (offering transmission speeds ranges from 6mbps to 11mbps).
- 802.11g (offering transmission speeds ranges from 24mbps to 54 mbps).
- 802.11n (offering transmission speeds ranges from 50mbps to 100mbps) is a proposed design which will sooner become a Wi-Fi standard, when it's finalized by the IEEE, and when the Wi-Fi Alliance completes its interoperability testing.



Wimax stands for Worldwide Interoperability for Microwave Access is an emerging broadband wireless technology for providing Last mile solutions for supporting higher bandwidth and multiple service classes with various quality of service requirement. Wimax is based on the standard family defined by IEEE 802.16 which provides coverage of upto 30 miles (last mile) compared to other technologies. It also provides efficient handover procedure and power control mechanism by introducing the sleeping mode for mobile stations. Wimax supports as well as connect data, legacy voice systems, VoIP, TCP/IP, applications with different quality of services classes, and dissimilar level of guarantees. The working of Wimax is shown in figure 2.

Figure 2: WIMAX



There are several types of Wimax:

- 802.16-2004 also known as 802.16d refers to the functioning party that has developed the standard. Since it has no support for mobility so it is referred to as Fixed Wimax.
- 802.16e-2005, also known as 802.16e, is an alteration to 802.16-2004. It initiated support for mobility, among other things, and is therefore also known as Mobile Wimax.
- 802.16j-2009, also known as Multihop Relay specification, for 802.16. The system function that enables mobile stations to communicate with a base station through intermediate relay stations ^{[9] [10] [11]}.

II. Analysis of IEEE 802.11 and IEEE 802.16

IEEE 802.11 is a set of principles for implementing wireless local area network (WLAN) computer communication in the 2.4, 3.6, 5 and 60 GHz frequency bands. These are formed and maintained by the IEEE LAN/MAN Standards Committee (IEEE 802). Wi-Fi can be used by private computer, video-game console, smart phone, tablet, or digital audio player devices which can connect to a network resource such as the Internet via a wireless network access point. This connection was established from one system to another directly without any intermediate node. This mode of connection is known as ad-hoc network ^[12].

IEEE 802.16 is a series of Wireless Broadband standards and is authoritatively called wireless metropolitan network in IEEE. It has been commercialized under the name Wimax by the Wimax Forum industry alliance. The vendors and service providers who founded the Wimax Forum believe that it will be widely deployed in a manner similar to that of Wi-Fi. Standardization will not only reduce equipment and component costs, which will enable mass production, but it will also allow interoperability between the equipment of different vendors ^[2].

A. Pros of Wi-Fi

The following are the benefits of IEEE 802.11 standard Wi-Fi:

- *Unmatched mobility and elasticity:* Wi-Fi introduced various types of utilities such as music streamers that transmit your music to speakers without any wire you can also play music from the remote computer or any other attached to the network.
- *Fortress Technology:* Wi-Fi providing secure wireless solutions supports the growth and release of a prototype mobile ad hoc wireless network for use in the wireless strategic skirmish.
- *Scalable System and Robust Performance:* Wi-Fi Technology itself smart enough to provide security to your personal computer but also offer an easy way of network installation.
- *Faster and secure:* With Wi-Fi you can get high speed of internet because it is very fast. Wi-Fi security system for threats makes it more renewable and its tool protect your VPN and secure web page.
- *Elimination of unsightly cables:* Wi-Fi allows cheaper deployment of local area networks (LANs) and also spaces where cables cannot be run, such as outdoor areas and historical buildings, can host wireless LANs.
- *Reduced cost:* The price of a single wireless adapter is reducing almost every day, so making a large network area by means of Wi-Fi is the most reasonable way.

- *Hotspots*: Wi-Fi helps in increasing revenues in businesses like restaurants and other public places by creating hotspots to create a centre of attention for customers. This can be achieved at a low cost by a one time investment in the Wi-Fi infrastructure.

B. Pros of Wimax

The following are the benefits of IEEE 802.13 standard

Wimax:

- *Coverage*: Wimax single station can operate and provide coverage for hundred of users at an instance and manage sending and receiving of data at very high speed with full of network security.
- *High Speed*: Wimax provides customers with high speed connectivity over long distance and high speed voice which makes it more demanded in hardly populated areas plus compacted areas.
- *Cheap network*: Wimax is a well known wireless network now days because it provides a low cost network substitute to internet services.
- *Rich Features*: Wimax Technology is offering rich features which make it useful. Wimax offers backhaul, triple-play and deployment.
- *Security*: Security feature of Wimax technology offers very high security because of encryption system used by Wimax. The Wimax is offering exclusive homeland security .Now you can exchange your data on whole network without any fear of losing data.
- *Mobility*: The basic and most important feature of Wimax technology is to support mobility applications as VoIP. It fully supports mobile applications including channel inference, sub-channelization, power control etc.

C. Cons of Wi-Fi

The following are the disadvantages of Wi-Fi are:

- To keep Wi-Fi secure takes much more effort as well as hard work, access points of Wi-Fi do not set out encryption methods. Secure Wi-Fi network can be easily attacked by hackers to steal private information.
- Interoperability or interference issues between brands or deviations in the network or technology can cause limited connection or lower throughput speeds.

D. Cons of Wimax

The following are the disadvantages of Wimax are:

- In the entire wireless technology the bandwidth is shared between users in a particular radio sector. Therefore working could go down if more than one user exists in a single sector.
- The other limitation is any user nearer to the tower can get high speed which is up to 30Mbit/s but if a user exists at the cell edge from the tower can obtain only 14Mbit/s speed.

III. Comparison of IEEE 802.11 Wi-Fi and IEEE 802.16 WIMAX

There is tons of confusion among both Wimax and Wi-Fi technologies. Many reasons exist for that; one could be both technologies starts with W letter that makes some people think that they both are same technologies with different names. They both belong from standard setter IEEE and there standards first three letter are same 802, and both Wi-Fi and Wimax technologies belong from Wireless connectivity family. Here we will be explained how much they are different from each other when considered practically.

1. The basic difference between Wimax technology and Wi-Fi technologies are cost, speed, distance and so on. Wimax coverage is about 30 miles and Wi-Fi coverage is very limited to some small area.
2. Wimax network provides QoS (Quality of Service) therefore a large number of people get access to tower at the same time. Unlike Wi-Fi user have to sort of fight to stay on connected with a specified access point.
3. Wimax network execute a connection oriented MAC while Wi-Fi runs on the CSMA/CA protocol, which is wireless and contention based.

We had shown its comparison in a tabular form as per following parameters in table no 1.

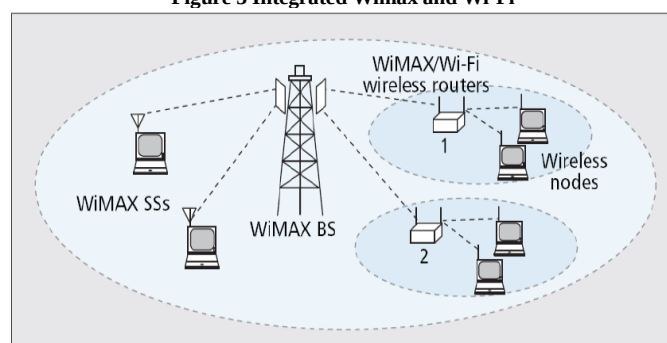
Table 1 Comparison of Wimax and Wi-Fi

<u>Comparison Parameters</u>	<u>Wi-Fi</u>	<u>WIMAX</u>
Standard	802.11	802.16
Versions	a, b, g, n	d, e , j
Primary Application	Mobile internet, Wireless LAN	Mobile internet, Broadband Wireless Access
Access Protocol	CSMA/CD	Request/ Grant
Handshaking	Connection-oriented	Connection-less
Frequency Band	2.4 GHz, 5 GHz	Licensed/ Unlicensed 2 GHz to 5 GHz
Half/ Full Duplex	Half	Full
Channel Bandwidth	20-25 MHz	Adjustable 1.25 MHz to 20 MHz
Downlink	300(4*4 configuration in 20 MHz bandwidth) or 600(using 4*4 configuration in 40 MHz bandwidth)	128(in 20 MHz bandwidth)
Uplink	300(4*4 configuration in 20 MHz bandwidth) or 600(using 4*4 configuration in 40 MHz bandwidth)	56(in 20 MHz bandwidth)

IV. Merged Wi-Fi and Wimax

In recent years, integrated wireless networks and spectrum sharing in such networks have been researched actively ^[8]. The integration of Wi-Fi and Wimax has become increasingly common in urban areas where they work in tandem to provide mobile services and a variety of applications. Presently, integrating Wi-Fi and Fixed Wimax is the most practical way to deploy large-scale wireless networks in cities that require wireless broadband connectivity ^[5].

Figure 3 Integrated Wimax and Wi-Fi



The Wimax base station charges the Wi-Fi APs/routers for sharing the licensed Wimax spectrum to provide mobile broadband Internet access to the Wi-Fi clients. The Wimax subscriber stations have fixed bandwidth demand. The Wi-Fi networks have elastic (i.e., time varying) demand depending on the number of nodes and their preferences^[3].

The main difficulty regarding expanded coverage is that Wimax broadband wireless technology is not available in all regions. Wimax, precisely speaking, represents the future of the broadband wireless communications because it offers a variety of services to users, regardless of location. One important strategy to gain greater access to wireless services is to employ multihop Wi-Fi networks to access Wimax technology through a gateway. Although the attempts of interconnectivity of Wimax and Wi-Fi technologies have existed for several years, there are still many challenges to seamlessly exploit its potential^[5].

V. Conclusion

The performance of Wi-Fi in comparison to Wimax is good response of a wireless network. The issue in Wi-Fi network is overcome by the Wimax network. Compare with Wi-Fi network and Wimax technology is more secure, reliable service. So merging these two technologies gives us better result and response with respect to quality of service, mobility, coverage, and feasibility. Together, Wimax and Wi-Fi are ideal partners for service providers to deliver opportune, reasonable mobile broadband Internet services in added places. Both are open IEEE wireless standards built from the ground up for Internet Protocol (IP)-based applications and services. By combining Wimax and Wi-Fi access together, service providers can deliver high-speed Internet connectivity that subscriber desire in more places. And Wimax and Wi-Fi technology synergies enable seamless integration into laptops, customer equipment devices, and a new category of devices called mobile internet devices.

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