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Wi-Fi & WiMAX: Wireless Technology

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Abstract: Wireless means transmitting signals using radio waves as the medium instead of wires. A Wireless network has offered us an alternative solution for such problem of information access. Today wireless is very popular technology that is giving shape to more convenient and cost-effective world. This paper presents a comparison and integrity of the wireless technology Wi-Fi (IEEE 802.11) and WiMAX (IEEE 802.16). It provides detailed technical differences between Wi-Fi (IEEE 802.11) and wireless networks WiMAX (IEEE 802.16). This technology is measured by the different parameters. The Conclusion of this paper is to state which technology is best and cost-effective solution to end users.

Keywords: Wireless Technology, Wi-Fi, WiMAX

INTRODUCTION:

Wi-Fi and WiMAX are two broadband technologies but these technologies may have few similarities, and they differ in the technical execution and ultimately their business case is very different. Many expert communication engineers have developed various wireless standards in a stratified way. Some wireless standards are Bluetooth, Wi-Fi and WiMAX. Bluetooth based on IEEE 802.15, Wi-Fi based on IEEE 802.11 standards and WiMAX based on IEEE 802.16. However, these all are IEEE standards. WiMAX is similar to the wireless standard known as Wi-Fi, but on a larger scale and at faster speeds. If we compare between the Wi-Fi and WiMAX then Wi-Fi offer local network access for a few hundred feet with the speed of up to 54 Mbps but a single WiMAX antenna expected to have a range of up to 40 miles with the speed of 70 Mbps or more.

The main goal of WiMAX is to offer cheap and fast connectivity of both voice and data communication. The purpose of this paper is to offer a technical, commercial and market comparison of Wi-Fi and WiMAX technologies to highlight as to which technology will be better to build a wireless access infrastructure. In this paper first we describe the overview of both the technologies (WiMAX, Wi-Fi) but after that, we differentiate the both technologies.

OVERVIEW OF THE TECHNOLOGIES

Wi-Fi:

Wi-Fi Technology is formerly known as Wireless fidelity. Basically, Wi-Fi provides networking of computers and digital devices without the need for wires. This technology uses and its availability in both residential homes and public places. It one of the most popular data transmission technology available today. Wi-Fi uses a radio technology known as 802.11. Using high frequencies these radio technologies can send data over short distances. 802.11 run on either 2.4GHz or 5GHz depending on its type. There are four major types of Wi-Fi technology. In this technology, known as 802.11a, 802.11b, 802.11g, and 802.11n and the two most common and oldest types are 802.11b and g, which run at a frequency of 2.4GHz. If we talk about in these types of technology than these type of technologies has a different transmission speed for ex: 802.11b has a maximum transmission speed of about 11Mbps, while 802.11g can send data at speeds up to 54Mbps. The next version of Wi-Fi was 802.11a and it operates on a frequency of 5GHz and allowed data transmission at speeds of up to 54Mbps. It is not backward compatible with 802.11b or g, due to its operation on a different frequency, thus limiting its use. 802.11n is the newest version of the technology and it is backward compatible with devices running 802.11b or g. It operates up to 450Mbps speeds on either 2.4GHz or 5GHz, either on a single channel or two channels (refer **Table 1**).

Table 1

STANDARD	PROPERTIES
IEEE 802.11b	1. High data rates of 11Mbps with a range of 100m to a max of few hundred meters. 2. Operates on a 2.4GHz unlicensed band. 3. It uses the DSSS modulation technique that is more reliable than the FHSS.
IEEE 802.11g	1. Operates on a 2.4GHz band and has corresponding range & properties 802.11b. 2. It has a data rate of 54Mbps. 3. It has backward compatibility with 802.11b 4. It uses OFDM, making the 802.11b devices not able to pick the signal from the 802.11g devices.
IEEE 802.11a	1. Operates in the 5GHz band with a maximum data rate of 54Mbps. 2. It can not co-exist with 802.11b and 802.11g standards as they operate on different frequency bands.

On dual channel devices, data transmission can exceed up to 450Mbps limit. A user with a mobile computing device such as a laptop, cell phone, or PDA which is Wi-Fi enabled can connect to the global Internet when it is within in a range of an access point (**as shown below Image 1**). The region which is covered by one or more access points called a hotspot. Hotspots can range from a single room to thousands of square feet's of overlapping hotspots.

Image 1

WiMAX:

WiMAX (Worldwide Interoperability for Microwave Access) is characterized under the IEEE 802.16 standard. It is a broadband wireless access technology that provides fixed, nomadic, reliable and mobile communication across wired and wireless connectivity. The 802.16 standard was created to attend to specifications for wireless Metropolitan Area Networks (WMANs). There are two main types of WiMAX:

(a)802.16-2004(Fixed WiMax) - 802.16-2004 transmission to stationary devices and replaces earlier specifications i.e. 802.16 and 802.16a.

(b)802.16e or 802.16-2005 (mobile WiMAX) - 802.16e is an extension of 802.16 -2004 for mobile use in the 2 to 6 GHZ band. It allows people to communicate while walking or riding in cars and provides a mobile voice over IP and higher speed data alternative to the cellular networks (GSM, TDMA, CDMA). In WiMAX central modulation technique is OFDM (i.e. Orthogonal Frequency Division Multiplexing), and both systems utilize MIMO (i.e. multiple inputs multiple outputs) techniques.

Defining two scenarios for a wireless deployment as shown below in **Image 2:**

(a) point-to-point (P2P):- Point to point is used where there are two points of interest (mainly the sender and receiver) This is also a scenario for backhaul or the transport from the data source to the subscriber or for a point for distribution using point to multipoint architecture. Backhaul radios comprise an industry of their own within the wireless industry. In this point to point technology, the architecture calls for a highly focused beam between two points range and throughput of point-to point radios will be higher than that of point-to-multipoint products.

(b) point-to-multipoint(PMP):- Point-to-multipoint is as the name suggests a distribution from a single point to multiple receivers. In the Point-to-multipoint technique, a sender sends data to multiple receivers with used many types of security (authentication, authorization). It means one base station can service hundreds of dissimilar subscribers in terms of bandwidth and services offered.

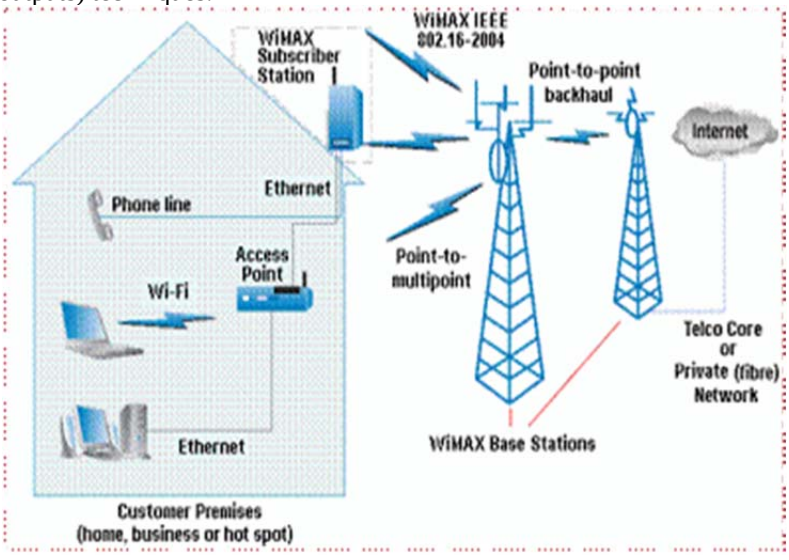

Image 2

KEY CHARACTERISTICS OF WIRELESS TECHNOLOGY

An integrated technology (WiMAX or Wi-Fi) is needed to create the desired infrastructure for a better solution. The key characteristics of the next generation wireless technology (WiMAX and Wi-Fi) are evaluated in this research paper are efficiency, maximum range, dependability, security, market issue and mobility.

(a) Efficiency

Efficiency is a major issue to determine what type of applications can be run on a network Efficiency of wireless technology is measured in terms of bandwidth and latency. In Efficiency, bandwidth is defined two terms: A short bandwidth and a large bandwidth. A short bandwidth network is only feasible for small applications and a large bandwidth network is used for more powerful applications. Short bandwidth support simple data application, for example, surfing on internet or file transfer and a higher bandwidth network is used for voice propagation and video navigation such as gaming devices. Another major issue in the case of real-time applications like voice is latency which is a very crucial issue.

(b) Maximum Range

Maximum range is calculated from the distance between the two base stations, like a cell phone. maximum coverage range of wireless technology is very much crucial according to cost since operators can reduce their initial capital investments if they can give the coverage in the same area with a smaller number of base stations. Another major issue that must be considered here is that the technology must have the capability to support hand-off between base stations without losing connection from the global world.

(c) Dependability

Dependability is measured by some metrics like average number of packet loss, average number of disconnects of calls. Dependability is defined as how much a wireless technology is dependable to the end user. Dependability is very crucial because some applications may require a reliable connection. If a connection is not dependable, in that case, packets may loss and that affect the network for that reason the speed of the network will decrease. This would have certainly impact on the performance of any applications, hence decreasing the applications that will use on the wireless network.

(d) Security

User exchange many personal data on the internet that why end user wants security. Security is obtained from the level of encryption of the data and the authentication of the device is provided by each technology. For many applications such as exchanging bank information require a secure connection to transmit confidential information. Security is the main characteristics of the wireless technology. We use many types of techniques to secure data.

(e) Mobility

It is the speed of the mobile access point at which the technology can remain connected to the global world without losing packets or service interruption. A wireless infrastructure environment needs to be mobile to provide connection to the end user at any place they visit.

(f) Market Comparison

The popularity of any technology is determined by the market. Mainly markets certify a technology whether it is accepted by the end user or not. So based upon the market we can decide which technology is most attractive to the wireless world. Devices in the market have demonstrated up to 11dB of variance across these performance parameters.

Operators should evaluate the device performance balanced with the device cost and, most importantly, the impact on the total cost of ownership of the WiMAX network.

Comparison between Wi-Fi & WiMAX:

Feature	WiMax (802.16a)	Wi-Fi (802.11b)	Wi-Fi (802.11a/g)
Primary Application	Broadband Wireless Access	Wireless LAN	Wireless LAN
Frequency Band	Licensed/Unlicensed 2 G to 11 GHz	2.4 GHz ISM	2.4 GHz ISM (g) 5 GHz U-NII (a)
Channel Bandwidth	Adjustable 1.25 M to 20 MHz	25 MHz	20 MHz
Half/Full Duplex	Full	Half	Half
Radio Technology	OFDM (256-channels)	Direct Sequence Spread Spectrum	OFDM (64-channels)
Bandwidth Efficiency	<=5 bps/Hz	<=0.44 bps/Hz	<=2.7 bps/Hz
Modulation	BPSK, QPSK, 16-, 64-, 256-QAM	QPSK	BPSK, QPSK, 16-, 64-QAM
FEC	Convolutional Code Reed-Solomon	None	Convolutional Code
Encryption	Mandatory- 3DES Optional- AES	Optional- RC4 (AES in 802.11i)	Optional- RC4 (AES in 802.11i)
Mobility	Mobile WiMax (802.16e)	In development	In development
Mesh	Yes	Vendor Proprietary	Vendor Proprietary
Access Protocol	Request/Grant	CSMA/CA	CSMA/CA

APPLICATION OF WI-FI AND WIMAX:

WiMax and Wi-fi are two main applications of wireless. If we compare between these two technologies than WiMAX application is most effective today. WiMAX technology provides some applications to present data, video, voice, mobile and internet access. WiMAX can run in both licensed and unlicensed spectrum where Wi-Fi mainly operates on unlicensed frequency bands. Wi-Fi has latency in the range of 50 ms hence bit higher latency. In WiMAX, the channel bandwidths are in the range of 1.25 MHz to 20 MHz .If Wireless technology (Wi-Fi and WiMax) can be integrated and overlay, it means that WiMAX and Wi-Fi will support each other. WiMAX and Wi-Fi operators can be applied various configurations if they were integrated are as follows:

(A) Backhaul: It is the first configuration, in this, we combined these two technologies then WiMAX functioning as a backhaul while Wi-Fi connected directly to the subscriber.

(B) Backhaul inter WI-FI mesh network: WiMAX has been used directly as a part of Wi-Fi Mesh Network. Wi-Fi network automatically will be more reliable in a wider coverage area and reduce cost connection that is caused by cable drawing in each AP installation when In this network Subscriber Terminal of WiMAX is put on access point of Wi-Fi Mesh Network. The solution in this network can increase performance and robustness of the Wi-Fi network.

(C) Wi-Fi and WiMAX full integrated: WiMAX coverage is overlapping with Wi-Fi coverage. It gives better service choices, more flexible to the changes of network and is more user-friendly with connection ease compatible with a terminal that has been owned. The Combination of both these technologies in any of the three configurations shown and discussed above gives sufficient solution, especially for data communication system that is a still problem now a days.

CONCLUSION AND FUTURE WORK:

This paper has studied two wireless standard technologies: Wi-Fi and WiMAX. Wi-Fi stands for Wireless fidelity (IEEE 802.11) and WiMAX is short for the Worldwide Interoperability for Microwave Access known as IEEE 802.16. In these two technologies for in terms of how they could be applied to the creation of a wireless access infrastructure. Limited range and data capability of Wi-Fi helps WiMAX to make a promise of taking high-speed wireless out of home to the road and everywhere. The main advantage of the WiMAX technology is that it is flexible. In this paper, we define detailed technical comparative analysis between the 802.11 (Wi-Fi) and 802.16 (WiMAX) wireless networks that provide an alternative solution to the problem of information access. So in this paper work has proved that the WiMAX is not to replace Wi-Fi in its applications but rather to supplement it in order to form a wireless network web. In Wi-Fi, the system uses contention access - all subscriber stations that want to pass data through an access point have to compete for the access point's attention on a random basis. This can cause distant nodes to be repeatedly interrupted by closer nodes. The further away you are, the less reliable your service. This problem makes services such as VoIP or IPTV difficult to work properly with Wi-Fi because they depend on a constant and relatively stable access system.

REFERENCES:

[1]. IEEE Standard 802.16 for Global Broadband Wireless Access http://ieee802.org/16/docs/03/C8021603_14.pdf. In this paper WiMAX looks like a strong contender to build wireless access infrastructure

[2]. Intel, "White Paper: Understanding Wi-Fi and WiMAX as Metro-Access Solutions", http:// www.intel.com/netcomms/technologies/wimax/304471.pdf, last visited February 24, 2007IEEE802.16e/m

[3]. Whitepaper published in the Broadband Wireless Report of International Engineers Consortium. Title: "WiMax – The next generation of wireless communication?" ISBN: 978-1-931695-30-x.

[4]. Zakhia Abichar, Yanlin Peng, and J. Morris Chang, WiMax: The Emergence of Wireless Broadband, IEEE IT professional, Volume: 8, Issue: 4, July-Aug 2006, Pages: 44 – 48.

[5]. Nicolas Fourty, Thierry Val, Philippe Fraisse, Jean-Jacques Mercier, "Comparative analysis of new high data rate wireless communication technologies "From Wi-Fi to WiMAX"," icas-icns, p. 66, Joint International Conference on Autonomic and Autonomous Systems and International Conference on Networking and Services - (icas-icns'05), 2005."

[6]. WiMAX, "IEEE 802.16a Standard and WiMAX Igniting Broadband Wireless Access",http://www.wimaxforum.org/technology/downloads/WiMAXWhitepaper.pdf, last visited February 24, 2007.

[7]. ARCchart ltd,"Blue Print: WiMAX: The Critical Wireless Standard, a monthly report October 2003 Part of the BluePrint Wi-Fi subscription package http://www.researchandmarkets.com/reports/16342/blueprint_wi_fi_the_only_weekly_publication.pdf, last visited February 22, 2007.

[8]. Fawzi Behmann , Impact of Wireless (Wi-Fi, WiMAX) on 3G and Next Generation — An Initial Assessment, IEEE International Conference on Electro Information Technology , 22-25 May 2005, Pages: 1 – 6.

[9]. Michael F. Finneran, "WiMax versus WI—FI A comparison of Technologies, Markets and Business Plan", dBrn Associates, Inc, http://www.searchnetworking.techtarget.com/searchNetworking/downloads/Finneran.pdf, last visited February 20, 2007.

[10] White paper published in WiMax forum Tittle: "WiMAX and Health" http://resources.wimaxforum.org/sites/wimaxforum.org/files/document_library/wimax_2008web.pdf

[11] White paper Title: "RF Spectrum Utilization in WiMAX" http://www.fujitsu.com/downloads/MICRO/fme/wimax/whitepapers/wpbwaRF_wp04.pdf

[12] White Paper Title: "Optimizing your WiMax Device Investment" http://www.motorolasolutions.com/web/Business/Products/_Documents/_Static%20files/Optimizing_Your_WiMAX_Device_Investment_White_Paper.pdf

[13] White Paper Title: Building End-to-End WiMAX Networks http://senzafiliconsulting.com/downloads/SenzaFili_for_Alvarion_BuildingWMXE2E.pdf