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# WIMAX TECHNOLOGY FOR BROADBAND WIRELESS ACCESS: OVERVIEW

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*Abstract*

***The Worldwide Interoperability for Microwave Access (WIMAX) is the latest technology for broadband wireless access communication. It is approved by IEEE 802.16 forum, which is a standard for point to multi-point wireless networking. WiMAX is a standard-based wireless technology that provides high throughput broadband connection services to residential and enterprise customers in an efficient way over long distance. Consequently the basic issues related to WiMAX systems needs to be better understood before their implementation. This paper presents detailed overview of WiMAX system, highlight key network components, pros and cons.***

## I. INTRODUCTION

WiMAX stands for Worldwide Interoperability for Microwave Access. WiMAX is one of the latest broadband wireless technologies around today. WiMAX is a standard-based wireless technology that provides high throughput broadband connection services to residential and enterprise customers in an efficient way over long distance [1]. The Institute of Electrical and Electronics Engineers (IEEE) 802 committee, which sets networking standards such as Ethernet (802.3) and Wi-Fi (802.11), has published a set of standards that describe WiMAX. The first 802.16 standard was developed in 2001, to deal with the Line of Sight (LOS) access at spectrum ranges from 10 GHz to 63 GHz. After a number of updates, it was summarized in standard 802.16d-2004, the provision of air interface for fixed broadband wireless Access system, which is also known as the "Fixed WiMAX". In 2005, support for mobile broadband wireless Access was first introduced in 802.16e-2005, the "Mobile WiMAX". Recently, 802.16-2009, called the "Air Interface for Fixed and Mobile Broadband Wireless Access System", was developed to support both fixed and mobile wireless communications [2].

WiMAX is a part of the advancement from voice-only wireless communications systems to ones that offer extra services like web browsing, streaming media, immediate messaging, and additional content. Being able to bring a wide variety of services also requires a delivery system that is flexible and can proficiently distribute system resources. The 802.16 standard offer adjustable data rate to and from each user while maintaining the required quality of service (QoS). Certain applications require higher error flexibility and latency requirements that directly factor into the QoS. The system resources are allocated and planned vigorously by the base station on a frame by frame basis to go on with the need of the users in the environment [3]. WiMAX is projected to suggest chiefly up to about 40 Mbps speed per channel for both fixed and transferable applications. WiMAX can hold up voice and video as well as Internet data. WiMAX could potentially be deployed in a range of spectrum bands: 2.3GHz, 2.5GHz, 3.5GHz, and 5.8GHz.

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## II. FEATURES OF WiMAX

WiMAX is a wireless broadband with a set of significant features [4-5]:

- **OFDM-based physical layer:** Its physical layer (PHY) has orthogonal frequency division multiplexing that provides excellent resistance to multipath, and permits WiMAX to function in NLOS (Non-line-of-sight) conditions.
- **High data rates:** WiMAX supports very high peak data rates. The peak PHY data rate can be as high as 74Mbps when operates using a 20MHz wide spectrum.
- ***Scalable bandwidth and data rate support*:** WiMAX is capable to support a extensive range of bandwidths. The scalability is implemented by changing the FFT size from 128 to 512, 1024 and 2048 to maintain channel bandwidths of 1.25 MHz, 5MHz, 10MHz and 20 MHz correspondingly.
- **Mobility:** The mobile WiMAX alternative of the system has mechanisms to support secure flawless handovers for delay-tolerant full-mobility applications and also power-saving mechanisms to increase the battery life of handheld subscriber devices.
- **Resource allocation on demand:** Both uplink and downlink resource allocation capacity is shared among several users on a requirement basis, using a burst TDM scheme.
- **Advanced antenna techniques:** The WiMAX allows for the utilization of multiple-antenna techniques, such as beam forming, space-time coding, and spatial multiplexing.
- **Quality-of-service:** Its MAC layer offer a connection-oriented design that is proposed to carry a range of applications, including voice and multimedia services each with essential QoS.
- **Security:** WiMAX supports strong encryption, by means of Advanced Encryption Standard (AES), and has a robust privacy, key-management protocol, mutual device/user authentication, strong traffic encryption, control and management plane message protection and security protocol optimizations for speedy handovers.

## III. WiMAX VARIENTS

There are divergent variants of the WiMAX IEEE 802.16 standard. WiMAX has five variants, which are divided by whether the variant is single carrier (SC) or uses OFDM. They are further broken down into the frequency bands they cover: 2—11 GHz and 10—66 GHz. The IEEE 802.16 standard contains the specification of Physical (PHY) and Medium Access Control (MAC) layer for BWA.
The following paragraphs give a brief overview of each variant [6-7]. Table 1 depicts an summary of these variants.

**Table 1 Variants of WiMAX Physical Layer**

| Designation | Function | LOS/NLOS | Frequency | Duplexing Alternatives |
|---|---|---|---|---|
| Wireless MAN-SC | Point to Point | LOS | 10-66 GHz | TDD, FDD |
| Wireless MAN-SCa | Point to Point | NLOS | 2-11 GHz | TDD, FDD |
| Wireless MAN-OFDM | Point to Multipoint | NLOS | 2-11 GHz | TDD, FDD |
| Wireless MAN-OFDMA | Point to Multipoint | NLOS | 2-11 GHz | TDD, FDD |

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| | | | | |
|---|---|---|---|---|
| Wireless HUMAN | Point to Multipoint | NLOS | 2-11 GHz | TDD |

Table 2 gives an overview of these variants.

**Table 2: Comparison of IEEE standard**

| | IEEE 802.16-2001 | IEEE 802.16a | IEEE 802.16-2004 | IEEE 802.16e-2005 |
|---|---|---|---|---|
| Completed | December 2001 | Jan 2003 | June 2004 | December 2005 |
| Spectrum | 10-66 GHz | 2-11 GHz | 2-11 GHz | 2-6 GHz |
| Propagation Channel Condition | LOS | NLOS | NLOS | NLOS |
| Bit Rate | Up to 134 Mbps (28 MHz channelization) | Up to 75 Mbps (20 MHz channelization) | Up to 75 Mbps (20 MHz channelization) | Up to 15 Mbps (5 MHz channelization) |
| Modulation | QPSK, 16-QAM, 64-QAM | BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM | 256 Subcarrier OFDM, BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM | Scalable OFDMA, QPSK, 16-QAM, 64-QAM, 256-QAM |
| Mobility | Fixed | Fixed | Fixed/Nomadic | Portable/mobile |

## IV. WiMAX STRUCTURE

The function of the PHY layer is to encode the binary digits into signals and to transmit and receive these signals transversely through the communication channel. The WiMAX PHY layer is based on OFDM; which is used to allow high-speed data and multimedia communications and is used by a range of commercial broadband systems. The PHY layer in WiMAX includes different functional stages including; randomizing, forward error correction (FEC), interleaving, and symbol mapping; OFDM symbol in frequency domain, and conversion of the OFDM symbol from the frequency domain to the time domain [9]. Figure 1 shows the transmitter structure of WiMAX system. The Receiver does the inverse process of transmitter.

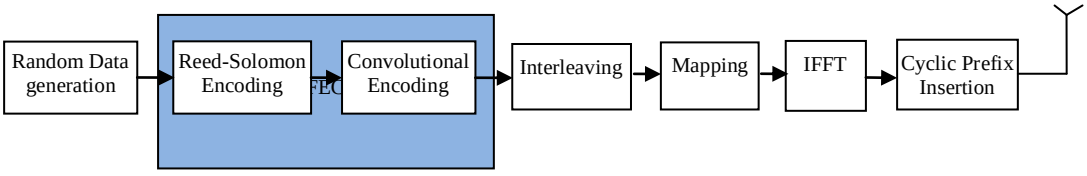


**Figure1: Transmitter Structure of WiMAX.**

Consequently, due to its diverse relevance can be deployed as a substitute to existing infrastructures.

## V. APPLICATIONS OF WiMAX

In mobile wireless configuration, it can substitute cellular networks and also can be used for emerging applications like Mobile TV, streaming audio/video when user is mobile. The key applications can be categorized as follows [10]:

- **Internet Access:** Internet access is a chief requirement in WiMAX technology. WiMAX is faster to deploy, easier to scale and more flexible, so it is competent to serve users not satisfied by wired broadband alternative.
- **Group Communications:** WiMAX structure cover moderately big region and serve many group communications, such as video-conferences. This is achieved with multicast; the key technology of WiMAX.
- **Metropolitan Area Distributed Service:** WiMAX has the ability to provide high data rate transmission in metropolitan area networks (MAN). It provides more value added services in a metropolitan region.
- **Content-Based Distribution:** In content based routing scheme the information sender does not need to specify its destination. The network layer will automatically deliver the message to receivers that are interested in the content of the message.
- **Quality Guaranteed Applications:** WiMAX provide a sufficient quality of service (QoS) guarantee, mainly in terms of bandwidth, data rate, delay and delay jitter. It is difficult to provide such a guarantee in a wireless networks as they are generally error prone.

## VI. CONCLUSION

The rising demand for broadband internet services necessitates the new emerging technology. WiMAX purpose is to distribute wireless broadband access to users with coverage distances in the order of miles. It typically is much easier to install, much easier to adapt and more reliable. This paper broadly describes the WiMAX system for broadband wireless access transmission. The Overview, structure, features and applications are described in this paper. The potential of WiMAX shows that this technology has proven to be an efficient technology for next generation wireless transmission.

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