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A Review of VOIP over WiMAX Networks

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ABSTRACT
WiMAX stands for Worldwide Interoperability for Microwave Access. It is a wireless broadband technology, which supports point to multi-point (PMP) broadband wireless access. IEEE Standard for WiMAX is 802.16. It is based on the wireless MAN technology. It is having connectivity at speeds up to 70 Mbps.The main goal of WiMAX is to deliver wireless communications with quality of service in a secured environment. WiMAX, a second-generation protocol, allows higher data rates over longer distances, efficient use of bandwidth, and avoids interference almost to a minimum. WiMAX can be termed partially a successor to the Wi-Fi protocol, which is measured in feet, and works, over shorter distances. In this paper, a brief introduction to the new emerging technology named WiMAX , its performance metrics like Qos, throughput ,efficiency, jitter and packet delay.

Key words: WiMAX , QoS ,jitter, wireless,VOIP .

INTRODUCTION

Worldwide Interoperability for Microwave Access (WiMAX), is a wireless communications technology aiming to provide wireless data over long distances in a variety of ways as an alternative to cable and DSL, from point-to-point links to full mobile cellular type access [1]. It is based on the IEEE 802.16 standard. The name WiMAX was created by the WiMAX Forum, which was formed in 1st April 2001 as an industry-led, not-for-profit organization to promote conformance and interoperability of the standard. The IEEE 802.16/WiMAX is a promising technology for broadband wireless metropolitan area networks (WMANs). The increasing demand of WiMAX for VoIP and high-speed multimedia is due to the simplicity of installation and cost reduction compared with the traditional wired DSL cable[14]. WiMAX supports both packet-oriented data transmission and standard mobile telephony over a large coverage with better performance particularly in terms of throughput than traditional wireless communication standards especially for applications that require high and stable throughput [14]. It has wireless technology optimized for delivery of internet protocol services over a wide area. It has ability to provide services even in areas that are difficult for wired infrastructure to reach and the ability to overcome the physical limitations of traditional wired infrastructure. WiMAX seems to operate likely WiFi but at provides us high speeds over greater distances and for greater number of users. One of killer applications for the 802.16 is Voice over IP (VoIP) service to support bidirectional voice conversation[16]. Protocols that are used to carry voice signals over the IP network are commonly referred to as voice-over-IP (VoIP) protocols[17]. Voice over IP entails that VoIP is based upon IP; hence, the transmission technology is basically in digital form [18]. One example of a rapidly growing voice application is VoIP as can be evidenced from high success rates of applications like Skype [13].Voice over Internet Protocol (VoIP) technology facilitates packet based IP networks to carry digitized voice, it uses Internet Protocol for transmission of

voice as packets over IP networks [23] thereby dramatically improving bandwidth efficiency and facilitates creation of new services. VoIP has enabled service providers to offer telephony services along with traditional data services using the same IP infrastructure and this in turn leads to improvement of business models [22].

This paper is divided into various sections. These sections consists of standards of WiMAX , Protocol Architecture, structural components, services of WiMAX Performance analysis and at the end concludes the paper with a conclusion.

BRIEF SUMMARY OF IEEE STANDARDS OF WIMAX

Certification that denotes interoperability of equipment built to the IEEE 802.16 or compatible standard . The IEEE 802.16 Working Group develops standards that address three types of Usage models:

- IEEE 802.16 (Dec 2001)
- IEEE 802.16a-2004
- IEEE 802.16e(Portable usage model)

The WiMAX umbrella currently includes 802.16-2004 and 802.16e. 802.16-2004. The following table specifies the various parameters among these three models, these parameters can be on the mobility, the range up to which they can operate their network, the channel bandwidth , the bit rate specifies the number of bits it can traverse , cell radius. . The basic characteristics of the various IEEE 802.16 standards are summarized in Table 1[2].

Table 1. Summary of 802.16 Standards [3]

Completion Date	802.16 Dec 2001	802.16a/ 802.16REVd 802.16a:Jan2003 802.16revd: Q3 2004	802.16e 2005
Spectrum	10 to 66 GHz	<11 GHz	<6 GHz
Channel condition	Line-of-Sight only	Non-Line-of-Sight	Non-Line-of-Sight
Bitrate	32 to 134 Mbps	75 Mbps max 20-Mhz channelization	15 mbps max 5-Mhz channelization
Modulation	QPSK16QAM 64 QAM	OFDM 256 subscriber QPSK 16QAM 64QAM	Same as 802.16a
Mobility	Fixed	Fixed	Pedestrian mobility Regional roaming
Channel Bandwidths	20,25 and 28 MHz	Selectable between 1.25 and 20 MHz	Same as 802.16a with uplink subchannels
Typical Cell Radius	1 to 3 miles	3to5miles(30miles max based on tower height, antenna gain and power transmit	1 to 3 miles

IEEE 802.16 PROTOCOL ARCHITECTURE

The IEEE 802.16 protocol architecture is structured into two main layers: the Medium Access Control (MAC) layer and the Physical (PHY) layer, as described in the following:

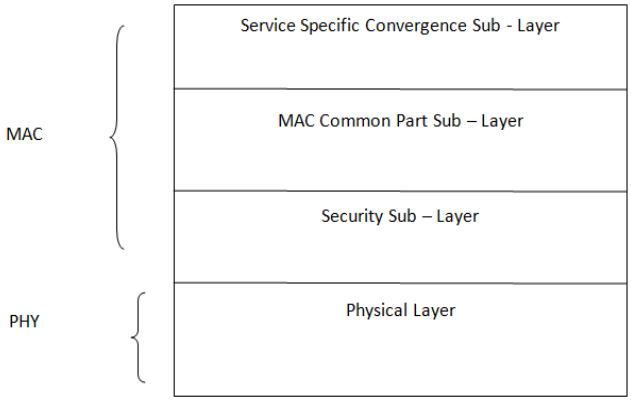

Fig 1. IEEE 802.16e Protocol Architecture

The MAC layer of WiMAX has been standardized, there are certain features that can be tuned and made application and/or channel specific [20],[21]. For example, the MAC layer does not restrict itself to fixed size frames but allows variable-sized frames to be constructed and transmitted. The MAC layer of WiMAX is comprised of three sub layers which interact with each other through the service access points (SAPs), as shown in Fig.2. The first sub-layer is the Service Specific Convergence Sub-layer (CS), which maps higher level data services to MAC layer service flow and connections. The second sub-layer is Common Part Sub-layer (CPS), which is the core of the standard and is tightly integrated with the security sub-layer. This layer defines the rules and mechanisms for system access, bandwidth allocation and connection management. The MAC protocol data units are constructed in this sub-layer. The last sub-layer of MAC layer is the Security Sub-layer which lies between the MAC CPS and the PHY layer, addressing the authentication, key establishment and exchange, encryption and decryption of data exchanged between MAC and PHY layers. Of the three sub layers, the common part sub layer is the core functional layer which provides bandwidth and establishes and maintains connection[19].
The PHY layer provides a two-way mapping between MAC protocol data units and the PHY layer frames received and transmitted through coding and modulation of radio frequency signals.

WIMAX MAIN STRUCTURAL COMPONENTS

A WiMAX network is based on infrastructure network architecture with Base Stations (BS) covering a wide area in a cellular topology. A mobile or fixed Subscriber Station (SS) is connected to a BS through a wireless link[10]. WiMAX devices can include Subscriber Stations (SS) or Mobile Stations (MS), or Base Stations (BS). The BS is a central equipment set providing connectivity, management and control of several SSs situated at varying distances while an SS can represent a building equipped with conventional wireless or wired LAN[15].

WiMAX Base Station: A WiMAX base station consists of indoor electronics and a WiMAX tower similar in concept to a cell-phone tower. A WiMAX base station can provide coverage to a very large area up to a radius of 6 miles. Any wireless device within the

coverage area would be able to access the Internet. WiMAX base station is similar to accessing a wireless access point in a WiFi network, but the coverage is greater.

WiMAX Receiver: A WiMAX receiver may have a separate antenna or could be a stand-alone box or a PCMCIA card sitting in your laptop or computer or any other device. This is also referred as customer premise equipment (CPE).

Backhaul: A WiMAX tower station can connect directly to the Internet using a high-bandwidth, wired connection (for example, a T3 line). It can also connect to another WiMAX tower using a line-of-sight microwave link.

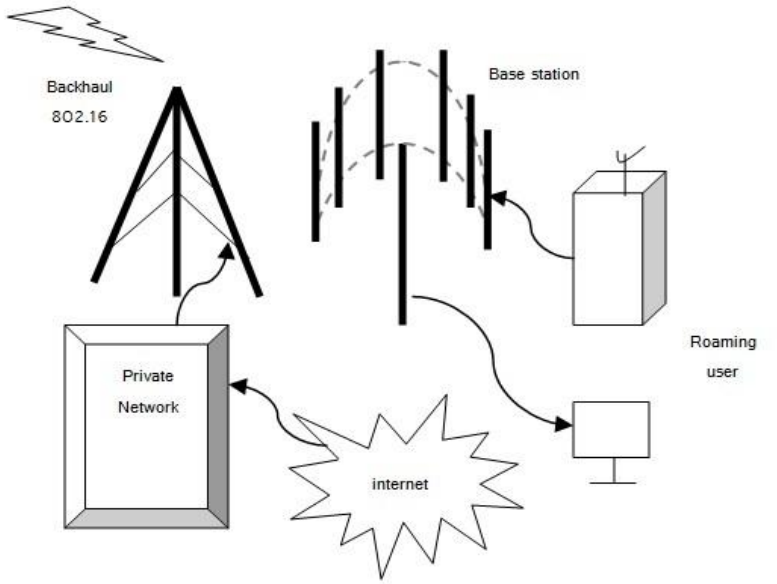

Fig 2. WiMAX Network

SERVICES OF WIMAX

IEEE 802.16e defines five Service Flow (SF) types of data delivery services in air interface [11]:

Unsolicited grant service (UGS): supports real-time applications generating fixed-size data packets on a periodic basis, such as leased-line services or VoIP without silence suppression.

Real-time polling service (rtPS): supports real-time applications transporting variable size data packets on a periodic basis, such as video streaming.

Extended rtPS (ertPS): supports real-time services that generating variable size data packets on a periodic basis, such as VoIP with silence suppression.

Non-real-time polling service (nrtPS): supports delay-tolerant data streams consisting of variable size data packets for which a minimum data rate is required.

Best effort (BE): supports data streams for which no minimum service level is required[12].

To support a wide variety of applications, mobile WiMAX defines five scheduling services listed below [4]:

Table 2.Types of Services[5]

Service Class	Application	QoS Specification
Unsolicited Grant Service (UGS)	VOIP	-Jitter Tolerance -Latency Tolerance -Sustained Rate
Real Time Polling Service (rtPS)	Streaming Audio/Video	-Traffic Priority -Latency Rate -Reserved Rate -Sustained Rate
Extended Real Time Polling Service (Ertps)	VOIP with Activity Detector	-Traffic Priority -Jitter Tolerance -Latency Tolerance -Sustained Rate -Reserved Rate
Non Real Time Polling Service (nertPS)	FTP	-Traffic Priority -Reserved Rate -Sustained Rate
Best Efforts (BE)	Data Transfer, Web Browsing	-Transfer Rate -Sustained Rate

PERFORMANCE ANALYSIS IN WIMAX

There are various performance measures which we are keeping in our mind while calculating its efficiency like throughput, jitter, delay, end-to-end delay [4].

1. ***Throughput:*** In any communication networks, such as Ethernet or packet radio or mobile WiMAX network, throughput or network throughput is the average rate of successful message delivery over a communication channel. So this means more message delivered over Channel will make network more reliable and fast. [5]

2. ***Network delay :*** The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is typically measured in multiples or fractions of seconds. Delay may differ slightly, depending on the location of the specific pair of communicating nodes[6].

3. ***MOS in VoIP :*** A VoIP application typically works as follows, first, a voice signal is sampled, digitized, and encoded. The encoded data (called frames) is/are packetized and transmitted using RTP/UDP/IP. At the receiver's side, data is de-packetized and forwarded to a playout buffer, which smoothes out the delay incurred in the network. Finally, the data is decoded and voice signal is subjective and therefore is measured by mean opinion score (MOS). MOS is a subjective quality score that ranges from 1 (worst) to 5 (best) [7].

4. ***Jitter:*** Jitter is calculated as the signed maximum difference in one way delay of the packets over a particular time interval
[8]. Generally, jitter is defined as the absolute value of delay difference between selected packets.

5. ***Packet loss:*** Packet loss is another factor that can degrade the performance of VoIP. The packet loss can occur if packets are lost during the transmission or if the packets arrive too late to be useable by the receiving application[9].

CONCLUSION

In this paper we have studied various features of WiMAX. In this paper various IEEE standards of WiMAX , its servies, architecture , structure,brief introduction about VoIP and how to analyse the performance has been discussed .This paper can be helpul for people who are new to WiMAX and want to do work on it. Now in future we have a lot to do study on the basis of its features or by evaluating its performance.

In future work we can do efforts to increase its efficiency and to improve its performance by working under various simulating networks.

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