International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

A Review on IEEE 802.16 Standards and their Comprehensive Analysis on WiMAX

Stuti Upadhyaya[1], Deepak Bicholia[2]

[1]Research Scholar, Dept. of Electronics & Communication Engineering, Institute of Engineering & Science, IPS Academy, Indore (M.P.) India
[2]Asst. Prof., Dept. of Electronics & Communication Engineering, Institute of Engineering & Science, IPS Academy, Indore (M.P.) India

Abstract: ***IEEE protocol 802.16(d) i.e. fixed wimax provides to offer mobile broadband services even at a vehicular speed of up to 120 km/hr. In wimax quality of services provided through scheduling of the different types of service classes like BE, ertPS, nrtPS, rtPS and UGS. Scheduling algorithm are round robin, Weighted Round Robin (WRR) and Weighted Fair Queuing (WFQ). The performance is observed at end-to-end delay, throughput and packet delivery ratio among 2 to 10 number of nodes.***

Keywords: IEEE 802.16, WiMAX, QoS, Scheduling, throughput, packet delivery ratio

1. Introduction

WiMax stands for worldwide interoperability for microwave access**.** It is a telecommunications protocol that provides fixed and mobile Internet access. WiMAX is a wireless digital communications system, also known as IEEE 802.16 that is intended for wireless "metropolitan area networks". WiMAX can provide broadband wireless access (BWA) up to 30 miles (50 km) for fixed stations, and 3 – 10 miles (5 - 15 km) for mobile stations. In contrast, the WiFi / 802.11 wireless local area network standard is limited in most cases to only 100 - 300 feet (30 - 100m). To understand the WiMAX technology, the term Wireless mesh network is there. Wireless mesh networks (WMNs) consist of mesh routers and mesh clients, where mesh routers have minimal mobility and form the backbone of WMNs. They provide network access for both mesh and conventional clients. WiMAX technology enables ubiquitous delivery of wireless broadband service for fixed and/or mobile users, and became a reality in 2006 when Korea Telecom started the deployment of a 2.3 GHz version of mobile WiMAX service called WiBRO.[1]

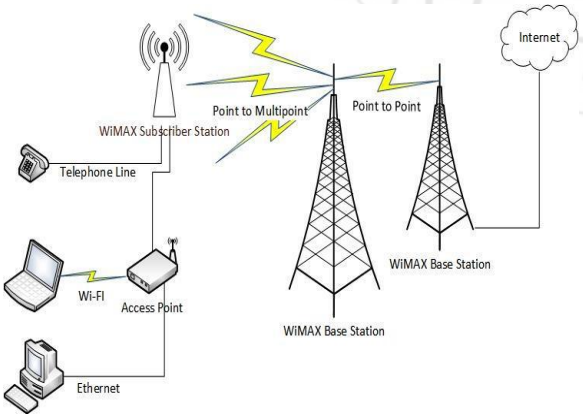

Figure 1: Overview of WiMAX

2. WIMAX Standards

The IEEE specifications are required to understand the family of IEEE standards. As 802.16 is one of the IEEE standard specification used for WiMAX technology, there are some factors that affects the performance of WiMAX according to bandwidth, rate, and speed etc. A member of the IEEE802 family of specifications:

- IEEE802.16-2004 includes P2P, P2MP and mesh access networks.
- During 2005 IEEE 802.16e includes mobility.
- During 2005 MIB standardized as well.
- IEEE802.16 is supported by the industry group WiMAX.
- IEEE802.11 is supported by the industry group Wi-Fi.[2]

Working

A WiMax network has a number of initial base stations and associated antennas communicating by wireless to a much larger number of client devices a point to multipoint configuration. Base stations are either directly wired to the Internet or use WiMax links to other base stations that are so connected. Client devices initially are generally small, building - mounted antenna/transreceiver systems to which in building LANs (such as WLANs) are connected. But future clients - depending on the frequency bands used - will often integrate into end user devices, such as notebook PCs and, eventually, mobile devices, such as smart phones. Each base station provides wireless coverage over an area called a cell. Although the maximum radius of a cell is theoretically 50 km , typical deployments will used cells of radii from 3 to 10 Km. As with conventional cellular mobile networks, the base-station antennas can be omni directional, giving a circular cell shape, or directional to give a range of linear or sectoral shape for point - to point use or for increasing the network's capacity by effectively dividing large cells into several smaller sectoral areas. Practically wimax is faster as compared to wifi in most of the cases for users. WiMAX could potentially erase the suburban and rural blackout areas that currently have no broadband Internet access because phone and cable companies have not yet run the necessary wires to those remote locations.[3]

A WiMAX system consists of two parts:

1) WiMAX Base Station Tower: A single WiMAX tower can provide coverage to a very large area - as big as 3,000 square miles (~ 8,000 square km).

2) WiMAX Receiver: The receiver and antenna could be a small box or PCMCIA card, or they could be built into a laptop the way WiFi access is today.

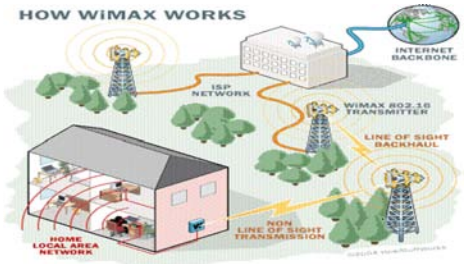

Figure: WiMAX Working

3. Modulation Techniques

Modulation is varying of physical characteristics by adjusting the of a sinusoidal carrier, either the frequency, phase or amplitude, or a combination of some of these. Four modulations are supported by the IEEE 802.16 standard: BPSK, QPSK, 16-QAM and 64-QAM.[4]

1. Binary Phase Shift Keying (BPSK)

The BPSK is a binary digital modulation; i.e. one modulation symbol is one bit. This gives high immunity against noise and interference and a very robust modulation.

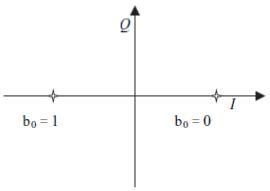

Figure: BPSK constellation

2. Quadrature Phase Shift Keying (QPSK)

When a higher spectral efficiency modulation is needed, i.e. more b/s/Hz, greater modulation symbols can be used. For example, QPSK considers two-bit modulation symbols. The QPSK modulation is therefore less noise resistant than BPSK as it has a smaller immunity against interference.

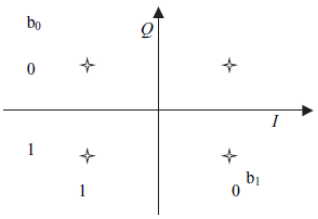

Figure: QPSK constellation

3. Quadrature Amplitude Modulation (QAM): 16-QAM and 64-QAM

The QAM changes the amplitudes of two sinusoidal carriers depending on the digital sequence that must be transmitted; the two carriers being out of phase of $+\pi/2$, this amplitude modulation is called quadrature. Both 16-QAM (4 bits/modulation symbol) and 64-QAM (6 bits/modulation symbol) modulations are included in the IEEE 802.16 standard. The 64-QAM is the most efficient modulation of 802.16. 6 bits are transmitted with each modulation symbol.[5]

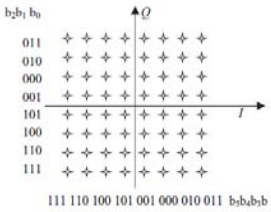

Figure: 64 - QAM Constellation

4. OFDM Technology

Orthogonal frequency division multiplexing (OFDM) is one of the multi-carrier modulation (MCM) techniques that transmit signals through multiple carriers. These carriers (subcarriers) have different frequencies and they are orthogonal to each other. OFDM divides a wideband channel into narrowband sub channels to mitigate ISI.[6]

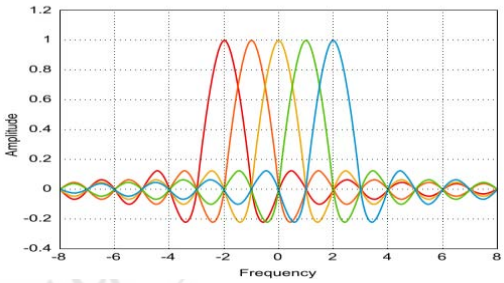

Figure: Orthogonal waveforms

The orthogonality between two signals can be given as:

$$\int_0^T \cos(2\pi f_n t) \times \cos(2\pi f_m t)\, dt = \delta(n - m)$$ **[7]**

IFFT subcarriers can be expressed as:

$$f(k) = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} F(n) exp\left(\frac{j2\pi kn}{N}\right)$$ [8]

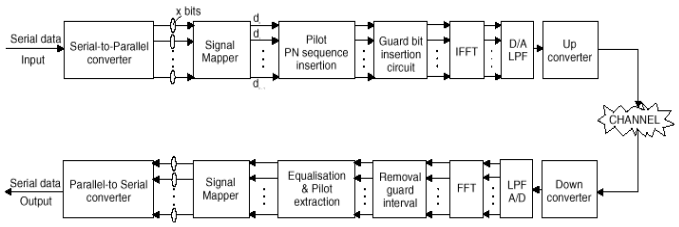

Figure: Block diagram of OFDM

5. Scheduling

The wimax standard provides specification for different services, but does not specify any scheduling algorithm. A few scheduling algorithms are: [9]

Round Robin (RR): The procedure of RR scheduler works in rounds by serving the first packet in each priority queue in sequence according to their precedence till all queues are served and then it restarts over to the second packet in each queue.[10]

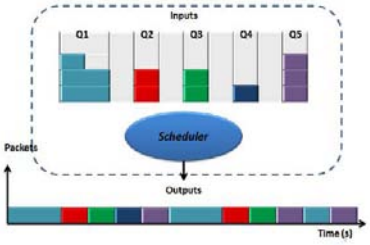

Figure: Round Robin

Weighted Round Robin (WRR): It is a work-conserving algorithm in which it will continue allocating bandwidth to the SSs as long as they have backlogged packets. The WRR algorithm assigns weight to each SS and the bandwidth is then allocated according to the weights. Since the bandwidth is assigned according to the weights only, the algorithm will not provide good performance in the presence of variable size packets.[11]

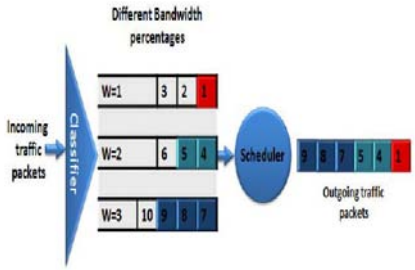

Figure: Weighted Round Robin

Weighted Fair Queuing (WFQ): It is a packet-based approximation of the Generalized Processor Sharing (GPS) algorithm. GPS is an idealized algorithm that assumes a packet can be divided into bits and each bit can be scheduled separately. The WFQ algorithm results in superior performance compared to the WRR algorithm in the presence of variable size packets. The finish time of a packet is essentially the time the packet would have finished service under the GPS algorithm. The disadvantage of the WFQ algorithm is that it will service packets even if they wouldn"t have started service under the GPS algorithm. This is because the WFQ algorithm does not consider the start time of a packet.[12]

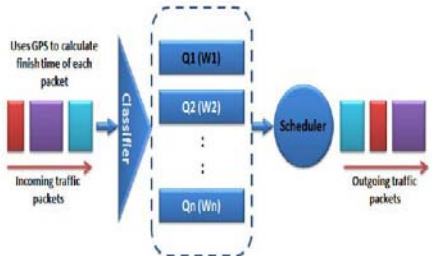

Figure: Weighted Fair Queuing

6. Conclusion

Conclusion already quoted „Study the past if you would define the future". Therefore, an in-depth investigation, historical review of WiMAX standard and an overview of the state-of-the- art mobile WiMAX technology and its development is provided in this paper. The results of some recent work on WiMAX networks are reported and an extensive survey of recent and relevant literature published in this field WiMAX networks is properly reviewed and given in chronological order.

References

[1] "Air interface for fixed broadband wireless access systems," IEEE STD 802.16 - 2004, Page(s): 0_1 - 857, October. 2004.
[2] H. Holma and A. Toskala, *WCDMA for UMTS — HSPA, Evolution and LTE*, Wiley, 2007.
[3] WiMAX Forum Network Architecture, rel. 1, vol. 4, Feb. 3, 2009.
[4] Mark C. Wood, "An Analysis of the Design and Implementation of QoS over IEEE 802.16".April 2006. Available online at http://cec.wustl.edu/~mcw2/QoS_over_802_16/QoS_over_802_16.html.
[5] Mobile WiMAX – Part I: A Technical Overview and Performance Evaluation, August 2006.
[6] Qiang Ni, A. Vinel, Yang Xiao, A. Turlikov, Tao Jiang, "Wireless broadband access: WiMax and beyond-investigation of bandwidth request mechanisms under point-to-multipoint mode of WiMax networks", *IEEE Communications Magazine*, vol.45, pp. 132-138, 2007.
[7] Bo Li, Yang Qin, Chor Ping Low, Choon Lim Gwee, "A Survey on Mobile WiMAX", *IEEE Communications Magazine*, pp. 70-75, December 2007.
[8] V. Genc, S. Murphy, Yang Yu, J. Murphy, "IEEE 802.16J relay-based wireless access networks: an overview", *IEEE Wireless Communications Magazine*, vol. 15, pp. 56-63, 2008.
[9] "A Performance Evaluation Study of WiMAX Using Qualnet". Shuaib, Khaled A. London U.K: *Proceedings of the World Congress on Engineering* 2009, 2009, Vol. I. WCE.
[10] Wail Mardini, Yaser Khamayseh, Muneer Bani Yasin, and Ghadeer Obiedat. "Survey of Latest WiMAX Technologies and Techniques". s.l.: *Jordan University of Science and Technology*, 2011.
[11] "Comparative Study of Scheduling Algorithms in WiMAX". Arhaif, Mohammed Sabri. 2, s.l.: *International Journal of Scientific & Engineering Research*, 2011, Vol. 2. ISSN 2229-5518.
[12] "The WiMAX Forum." [Online].Available: http://www.wimaxforum.org/