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Research Article

Energy Consumption in IEEE 802.16E through Mobility Model using Qualnet Simulator

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Abstract

IEEE802.16 is the standard defining the Worldwide Interoperability for Microwave Access (WiMAX) for Metropolitan Area Network (MAN). WiMAX has recently being considered by Internet Service Providers (ISPs) as an attractive alternative to leasing lines from current ISPs or the deployment of new fiber networks. This is mainly the case since WiMAX is more flexible and much cheaper than other possible solutions. Our focus in this paper is on mobile WiMAX i.e. IEEE802.16e designed to provide broadband wireless access for mobile users. This bring potential benefits in terms of coverage, power consumption, frequency reuse and bandwidth efficiency by addition of full mobility support. The main contribution of this paper is that we have used different users with different speed by using different mobility model such as random waypoint model and flag mobility model. All the simulation are carried out by scalable network simulator through QualNet simulator. The changes in various speed will bring result in the form of energy consumption in transmit mode, energy consumption in receive mode and energy consumption in idle mode in mobile WiMAX cell.

Keywords: *Performance Evaluation, WiMAX, Wireless Access Networks, QualNet simulator.*

1. Introduction

WIMAX stands for Worldwide Interoperability for Microwave Access, the stage of mobile communications that will enable things like IP-based voice, data, gaming services and high quality streamed multimedia on portable devices with cable modem-like transmission speeds (J. Baliga et al, 2006). WiMAX is to promote deployment of broadband wireless access networks by using a global standard and certifying interoperability of products and technologies and to provide a cost effective wireless connection with high data rate and coverage which will be the best alternative to DSL, Wi-Fi or cellular data services. Mobile WiMAX (802.16e) has allowed users to access high speed internet access anywhere and anytime, it also provides true mobility (D. Chen et al, 2005). Users that are moving at the speed of 75 mph can get data and other multimedia support without any problem. Subscribers who are accustomed to the cellular environment will be able to get data services with a speed comparable to that of wired communication (J. Baliga et al, 2006). Mobile WiMAX technology will be able to address the most users' needs, now-a-days wired high speed internet access provide high data rates but the problem is mobility and the same is the case with wireless internet access which has very limited range and very slow transfer rates. WiMAX provides high broadband internet access at high transfer rates and meeting the demands of various users. However, for communications that require non-line of sight (NLOS), frequency bands below the 10 GHz are utilized with those below 6 GHz being more suited for mobile applications i.e. IEEE802.16e (B. Fong et al, 2004). Regardless of the frequency band used, Time Division Duplexing (TDD) and Frequency Division Duplexing (FDD) are both supported. The initial implementation of WiMAX, IEEE802.16 was intended for the 10 66 GHz licensed band. Later modifications of the standards, IEEE802.16a and d made it possible to deploy WiMAX in the licensed and unlicensed frequency bands in the range of 2-11 GHz. To enable mobility the IEEE 802.16 working group came up with the IEEE802. 16e standards to support mobility. In general, using WiMAX Base Stations (BS) to provide wide coverage for an entire region can still be economically infeasible due to the high cost of setup and maintenance of infrastructure (K. Gonchigsumla et al, 2010) The IEEE 802.16j Working Group aims to solve these issues through the use of multihop relay stations in an attempt to extend the coverage area and improve throughput at a feasible economical level. Communication networks support a wide range of services, from voice over IP for consumers to critical life-saving telemedicine applications. It is vital to ensure that a given network is capable of providing adequate network resources for future growth in demand (K. Kim et al, 2005). The data rate can be effectively doubled by doubling the number of sectors while maintaining an omni-directional coverage. The network can be further expanded by another sectorization. With an increased number of hubs to cover the same geographical area, less bandwidth will be required for each hub, and hence equipment costs can be

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reduced. WiMAX Provides fixed, nomadic, portable, and soon, mobile wireless broadband connectivity without the need for a direct line-of-sight with a base station (P. Lu et al, 2010). The WiMAX forum developed requirement guidelines for the several applications that can be run over WiMAX. In (K. Santi et al, 2006) the authors proposed a performance evaluation study of a WiMAX system when using directional antennas to improve its general performance. The 802.16e standard has been developed for speeds of up to 120 km/h at 3.8 GHz. WiMAX 802.16e also examines the possibility of using directional antennas to reduce the impact of Doppler spread, and hence improve the performance of a mobile WiMAX communications link. The use of directional antennas improves performance without the need for increased digital signal processing at the receiver (V. Nee et al, 2000). There are several advantages of the systems with wireless broadband access such as fast start-up implementation of the system, dynamic allocation of radio resources, lower costs (when compared to 3G mobile networks), efficient use of radio spectrum, large throughput in uplink and downlink directions, wide range of QoS, etc.

This broadband access is standardized by the IEEE 802.16 Working Group and the WiMAX Forum. However, the IEEE 802.16 Working Group developed the standards for the physical and MAC level WiMAX is IP native (as all other standards from IEEE), the telephony is represented by Voice over IP (VoIP) (G. Zaggoulos et al, 2007). However, if one wants to provide real-time services over Mobile WiMAX, such as VoIP, then we need to provide whether the QoS requirements for these services are met or not. For that purpose in this paper we perform performance analysis of Mobile WiMAX regarding the VoIP service by using simulation technologies (A. Shukla (2014)).

This paper is organized as follows. Section 2 describes important aspects of the physical layer regarding our analysis. Simulation setup. Section 3 introduces the Scenario description and environment used and results are given in Section 4. Finally, Section 5 and section 6 concludes the paper and references respectively.

2 Simulation Setup

We have created the WiMAX scenario using Qualnet 6.1 network simulator to simulate the comparative analysis of mobile WiMAX performance through mobility model and focusing on energy consumption in transmit mode, energy consumption in receive mode and energy consumption in idle mode in mobile WiMAX cell.

2.1 Simulation Parameters

Table I shows the parameters for new simulation design of the scenario for the consumption of energy in mobile WiMAX through mobility model.

3 Scenario Descriptions

In this paper we have designed two scenario with two different mobility model, one is random waypoint mobility and other is flag mobility. For this, we have used Qualnet simulator 6.1 to design and analyses the scenario over an area of 1500m*1500m. For both the Scenarios simulation time is 600sec. The results analyzed are compared to each other and different performance metrics are evaluated like energy consumption.

Table 1 Simulation Parameters

Parameters	Values
Terrain-Dimensions (m)	1500*1500
Mobility Model	Random Waypoint, Flag mobility
Frequency Band (GHZ)	2.4,2.43
Channel Bandwidth (MHZ)	20
Frame Duration (ms)	16
FFT Size	2048
MS Velocity (MS^{-1})	20
BS Transmitted Power (dbm)	30
SS Transmitted Power (dbm)	20
Simulation Time (s)	600
Traffic	CBR
Antenna Type	Omni-directional
No. Of Packet Sent	500
Pause Time (s)	30
Radio Type	802.16e

3.1 Scenario 1

In this scenario, there are 2 base stations and 102 subscribers' stations in which 14 CBR application are used. Flag mobility model is considered for this scenarios which provide a constant speed with a time interval of 30 sec for each flag. The scenario designed is shown in figure1.

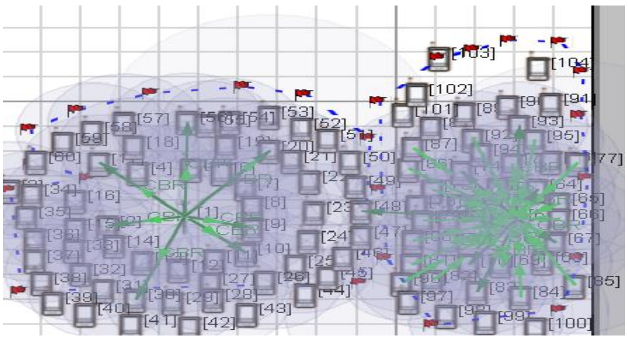

Fig. 1 Mobility with flag

3.2 Scenario 2

In this scenario, there are 2 base station and 102 subscribers' station in which 14 CBR application are used. Nodes are made mobile by using random waypoint mobility model. Minimum speed is 0 mps and maximum speed is 20 mps. Pause time is 30 sec. The scenario designed is shown in figure 2.

The comparative analysis is done to evaluate the different performance metrics so as to observe which mobility model gives the best network performance.

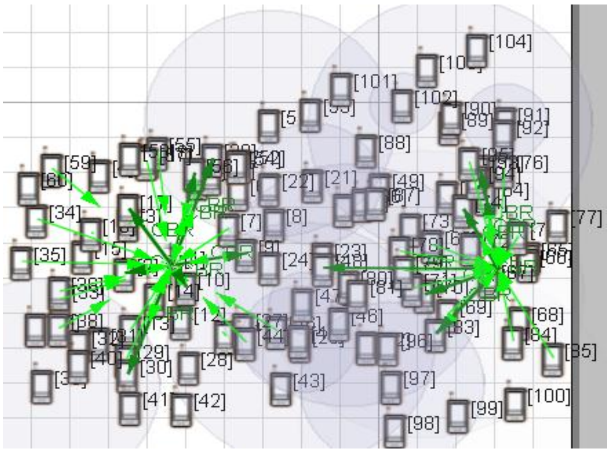

Fig. 2 Mobility with Random waypoint Model

4 Results And Discussion

4.1 Energy consumption in Transmit mode

Figure 3 shows that energy consumption in flag mobility model is more than energy consumption in random waypoint model. In case of flag mobility model, constant amount of power are always transmitted by mobile nodes because all the node requires a fix speed for moving in WiMAX cell. While in case of random waypoint model, various amount of power are transmitted by mobile nodes depending upon of its need because all the nodes requires minimum as well as maximum speed for moving in the WiMAX cell.

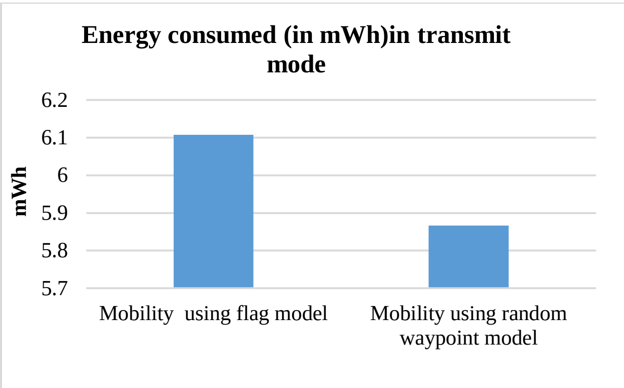

Fig. 3 Energy consumption in Transmit mode

4.2 Energy consumption in Receive mode

Figure 4 shows that energy consumption in flag mobility model is more than energy consumption in random waypoint model. But in receive mode, power receive is slightly less than transmit mode. In case of flag mobility model, constant amount of power are always received by mobile nodes because all the node requires a fix speed for moving in WiMAX cell. While in case of random waypoint model, various amount of power are received by mobile nodes depending upon of its need because all the nodes require minimum as well as maximum speed for moving in the WiMAX cell.

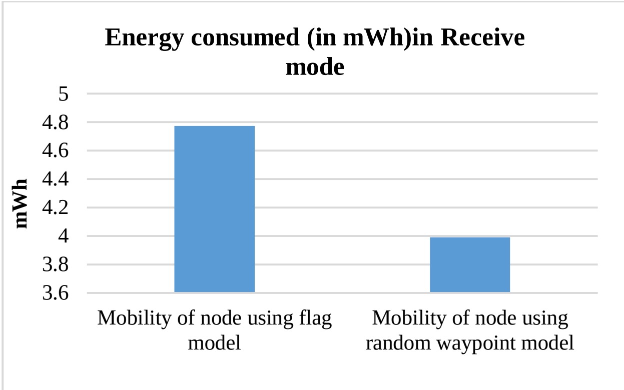

Fig. 4 Energy consumption in Receive mode

4.3 Energy consumption in idle mode

Figure 5 shows that energy consumption in random flag mobility model is less than energy consumption in random waypoint model.In case of flag mobility model, many of the nodes in WiMAX cell will stop receiving and transmiting power because all nodes comes in idle state after sometime. While in case of random waypoint all the nodes are moving with minimum and maximum speed therefore due to changing of speeds nodes will never come in idle position. So they will take more power during transmission and reception.

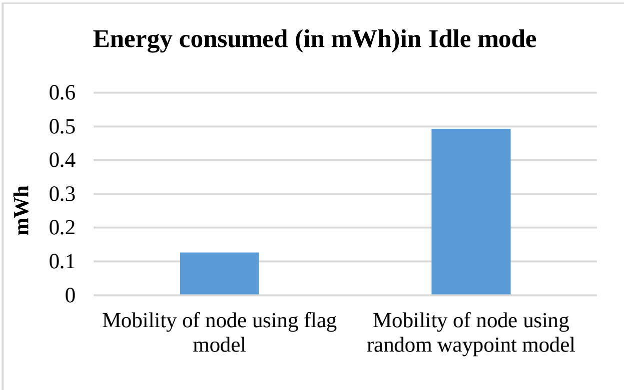

Fig. 5 Energy consumption in idle mode

Conclusions

It has been observed that the performance matrics such that energy consumption in transmit mode, energy consumption in receive mode and energy consumption in idle mode indicates that flag mobility model is more efficient than random waypoint model in case of energy consumption. It is concluded that in flag mobility model, a fixed trajectory path is established according to the user needs that takes constant energy from all the mobile nodes. Therefore flag mobility model will consume more energy. Whereas, in the case of random waypoint model, all the nodes in WiMAX cell moves with various speed from the circumference of the WiMAX cell. Therefore it will take minimum energy that depends upon the location of the mobile nodes.

References

J. Baliga, R. Ayre (2011) Energy Consumption in Wired and Wireless Access Networks, IEEE Communications Magazine.

D. Chen (2005) On the Simulation, Modeling, and Performance Analysis of an 802.16E Mobile Broadband Wireless Access System, Proceeding of CCN, October 24 – 26, 2005, Marinadel Rey, USA.

B. Fong (2004) On the Scalability of Fixed broadband Wireless Access Network Deployment, IEEE Communications, Vol. 42, No, 9.

K. Gonchigsumla (2010) The simulation model of Multicast and Broadcast Service in the Mobile WiMAX for Qualnet, in Proc.ICACT, vol. 1, pp.934-937.

IEEE802.16: IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems 2004.

IEEE802.16e: IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, 2005.

K. Kim (2005) A Seamless Handover Mechanism for IEEE 802.16e Broadband Wireless Access Networks 5, LNCS 3515, pp. 527-534.

P. Lu (2010) A Suburban Femtocell Model for Evaluating Signal Quality Improvement in WiMAX Networks with Femtocell Base Stations, in Proc. WCNC, pp.1-6.

V. Nee (2000) OFDM for Wireless Multimedia Communications, Artech House.

K. Santi (2006) Migration to 4G: Mobile IP based Solutions, Proceedings of the Advanced International Conference on Telecommunications and International Conference on Internet and Web Applications and Services, Guadeloupe, French Caribbean vol. 32, pp. 223.

The WiMAX Forum, Mobile WiMAX – Part I: A Technical Overview and Performance Evaluation, 2006.

WIMAX Forum, Fixed, nomadic, portable and mobile applications for 802.16-2004 and 802.16e WiMAX networks November 2005.

G. Zaggoulos (2007) WiMAX System Performance in Highly Mobile Scenarios with Directional Antennas, Proceedings of IEEE PIMRC, Athens, Greece.

Q. Zhang (2008) WiMAX network performance monitoring & optimization, Proceeding of IEEE NOMS, Bahia, Salvador.

A. Shukla (2014) Comparative Analysis of mobile WiMAX performance through mobility model using Qualnet simulator 6.1,IJCET,vol.4,No,2.

A. Shukla (2014) Performance Improvement of mobile WiMAX using Qualnet simulator 6.1, Proceeding of IEEE,I2CT Conference.