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Research Article

Performance comparison of 802.16e using Qualnet Simulator 6.1

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Abstract

The IEEE 802.16 standard, including MAC layer and PHY layer specifications which defines the air interface and associated functions of the broadband wireless access system supporting multimedia services.IEEE802.16 (i.e. WIMAX) is designed basically for high range and high bandwidth wireless access, or wireless metropolitan area network (WMAN). The WIMAX having high bandwidth of 70 Mbps and radio range can access up to 50 km (31 miles). WIMAX provides multiple services with guaranteed different QOS. It is cost effective and as well as alternative idea to replace other network such as Wi-Fi & 3G/4G and easy to deploy for large miles (distance) access to public network. In this paper, we compared the performance of mobile WImax between the wireless networks with different scenario properties such as packet received unicast fragment, end to end delay, delay jitter and throughput by using Qualnet simulator 6.1, and also compare the performance by covering maximum distance with less packet losses and less power consumption through WIMAX base station.

Keywords: *Wi-MAX, Quality of service,Wi-Fi,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. 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 prove to be the best alternative to DSL, Wi-Fi or cellular data services is to use WIMAX (IEEE 802.16). Mobile WIMAX (802.16e) has allowed users to access high speed internet anywhere at any time and it also provides true mobility. Users that are moving at the speed of 75 mph can get data and other multimedia support without any hindrance (Fong, *et al 2004)* Subscribers who are accustomed to the cellular environment will be able to get data services with a speed comparable to that of wired communication. Mobile WIMAX technology will be able to address the needs of most of the user's. Now-a-days wired high speed internet access provide high data rates but the problem is mobility and the same is the scenario with wireless internet access which has very limited range and very slow transfer rates. WiMAX provides high broadband internet access at high data transfer rates and meeting the demands of various users (Nee *et al 2000).*Mobile WiMAX can be applied to various fields other than mobile communications. Mobile WiMAX can be applied to the areas where wired infrastructure cannot reach. WIMAX provides high speed internet regardless of the location of the user. Mobile WIMAX (IEEE 802.11e) operates at a frequency range of 2 to 6 GHz which is mainly licensed band. Mobile WIMAX ought to be the most famous technology in the coming years. Here, we are considering a network of WIMAX. This network is having two applications of WIMAX, One is Fixed WIMAX connection while another is Mobile WIMAX (Chen, *et al 2005)* Mobile WIMAX services are more cost effective solution than 3G technologies. To reduce multipath-fading with low complexity and to achieve WBMCS, OFDM is one of the applications of a parallel-data-transmission scheme, which reduces the influence of multipath fading and frequency selective fading or narrow interference in mobile WIMAX (Zaggoulos, *et al 2007*) WIMAX may be used as small network operator as well as large network operator[8], for many demanding issues that we have to deal with, such as limited available frequency resource, tight frequency reuse, capacity planning, proper network dimensioning, multi-class data services and so on. IEEE 802.16e provides the multimedia stream service to multiple subscribers by using multicast IP addresses in the Mobile WIMAX standard to offer high speed Internet service. Mobile WIMAX has been used to avoid the limitations of the existing wireless communication system such as bandwidth problem. Energy consumption has become a crucial factor in terms of decreasing the operational cost for the network operators. IEEE802.16e can also operate in unlicensed band for many applications which makes the network more attractive.

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The rest of the paper is organized as follows: Section 2 briefly discusses the related work. Section 3 introduces the simulation tool and environment used. Simulation scenarios and the Obtained results are presented in section 4 and the paper is concluded in section 5 along with intended future work.

2. Simulation Setup

We have used the Qualnet simulator 6.1 for our work. We have tried to improve the performance by covering maximum distance with less packet losses through WIMAX base station. Several Performance Metrics are used to analyze the Scenario which are- Throughput, average end to end delay, average jitter and total packets received. Table I shows the parameters for new simulation design of the scenario for performance improvement of WIMAX cell.

Table 1 Simulation Parameters

Parameters	Values
BS range radius (m)	500,1000
SS range radius (m)	500
Terrain-Dimensions (m)	1500*1500
Mobility Model	Random Waypoint
Frequency Band (GHZ)	2.4,11
Channel Bandwidth (MHZ)	20
FFT Size	1024
MS Velocity (MS-1)	10,20,25,30
BS Transmitted Power (dbm)	35,40
SS Transmitted Power (dbm)	20
Simulation Time (s)	600
Traffic	CBR
Antenna Type	Omni-directional
No. Of Packet Sent	200
Pause Time (s)	30
Radio Type	802.16e

3. Result and Discussions

The performance of Wi-max network can be compare on the basis different scenario which has different simulation parameter.

Scenario 1

In scenario1, we have designed a simple Wi-max network. Which has a single base station and 30 subscriber station placed in circular orientation? Five CBR applications are used in this scenario. Subscriber stations were varied from node 4 to node 30 as4, 5, 11, 13 and 22 that indicates the mobility around the base station. On the basis of throughput, end to end delay and average jitter in fig. 1, fig. 2 and fig. 3 respectively .performance of simple WI-max can measure these graphs shows that the performance of WIMAX cell depends upon the mobility of subscriber station. If the SSs move towards the WIMAX base station then it receive more packets and if the SSs go away from the base station it receive less packet with more end to end delay and jitter.

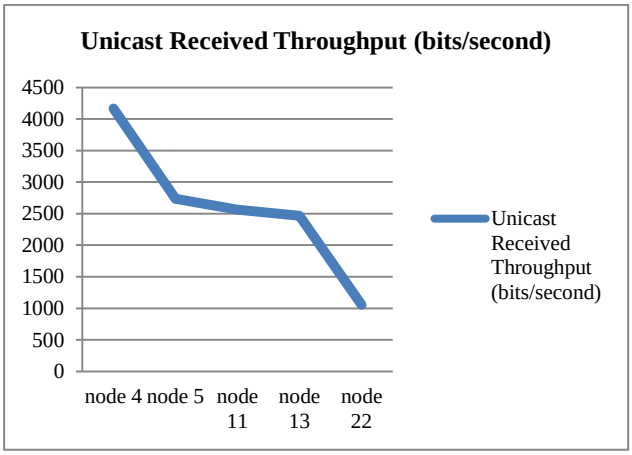

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Fig. 1 Average throughput in bit/sec per SS versus node of mobile subscribers with in the WIMAX cell

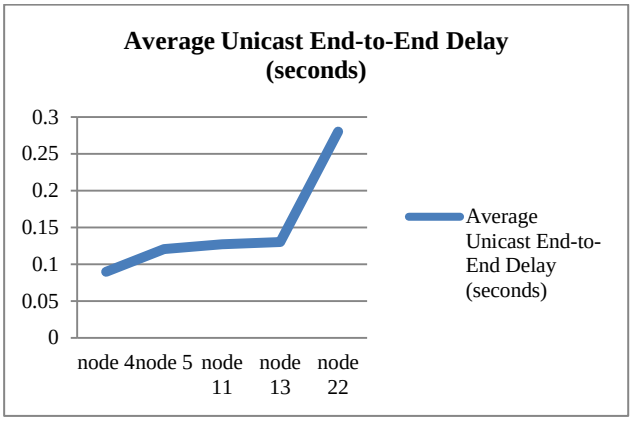

Fig. 2 Average end to end delay in seconds versus no. of mobile SSs within the WIMAX cell

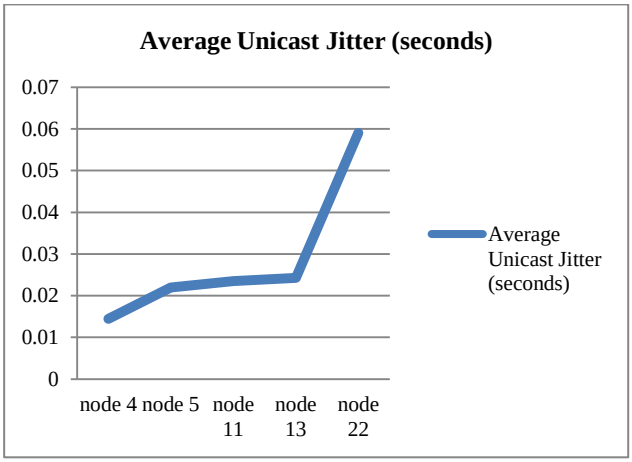

Fig. 3 Average delay jitter in seconds versus no. of mobile SSs within the WIMAX cell.

Scenario 2

In this scenario, we are using a single WIMAX cell which has a single base station and connected to the number of subscriber station with traffic generator (CBR). These subscriber stations (SSs) are placed in circular orientation

within the WIMAX mobile station. The coverage range of a single WIMAX cell is up to a 500 meter with a base station and 64 subscriber stations in which node 3, node 19, node 27 and node 56 are connected to a constant bit rate (CBR) in a circular format with a packet size of 1024 bytes, packet interval of 1 packet/second and simulation time of 3 minutes. These SSs move around the WIMAX cell by using a random waypoint model with speed of 10 mps and reaches to its destination. Each SSs pauses for 30 sec and then move towards or away from the base station depending upon the placement of the subscriber stations (SSs).For the performance evaluation, 200 packets are being sent to all nodes in WIMAX cell. The packet reception at the destination node will determine the performance of WIMAX Cell by the fallowing metrics such as throughput, average end to end delay and average jitter. The results of this experiment show that maximum packet is received in the WIMAX cell but there was a sharp drop that occurred at the edge of the cell. This occurred due to the large distance which was observed from the base station to the subscriber station. Hence Throughput shows a sharp drop with an increase in end to end delay and average jitter, as shown in Fig. 4, Fig.5 and Fig. 6.

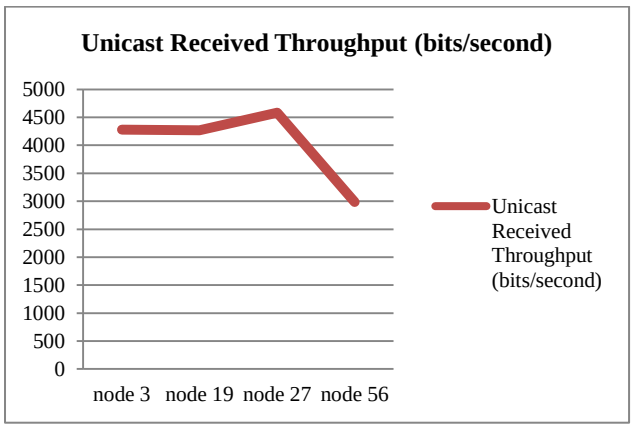

Fig. 4 Average throughput in bit/sec per SS versus no.of mobile SSs at different speed within the WIMAX cell

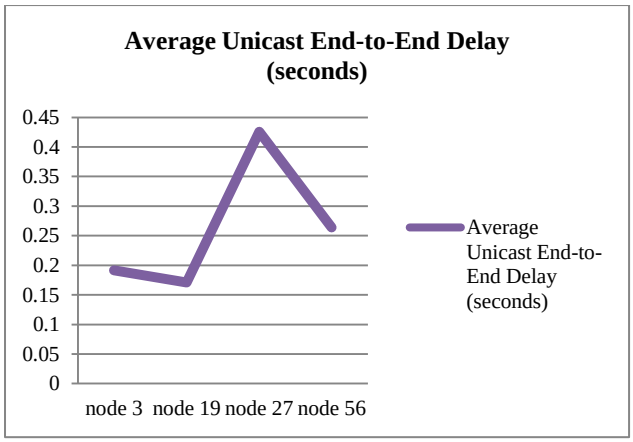

Fig. 5 average end to end delay in seconds versus no. of mobile SSs at different speed within the WIMAX cell

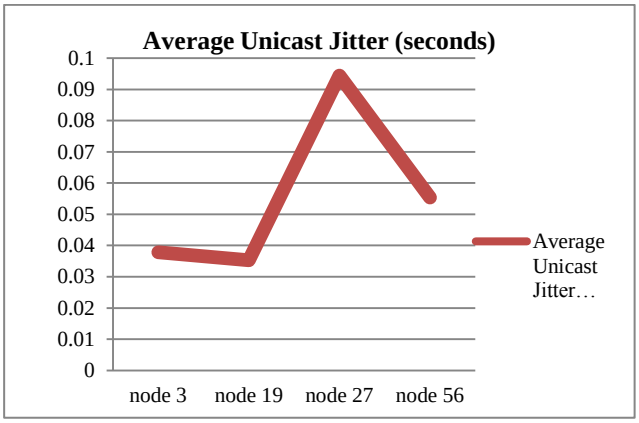

Fig. 6 Average delay jitter in seconds versus no. of mobile SSs at different speed within the WIMAX cell

Scenario 3

To overcome the problem of range coverage at end subscriber stations in WIMAX cell, we introduced two base station .In this scenario these two base stations are used to transmit power of 40 dbm (20 dbm each) with 85 subscriber station. Transmitted power of two base stations is slightly more than that of single base station. In single base station 35 dBm (tx power) is used to cover nearly 54 subscriber stations with better range coverage but in this scenario we have increased the coverage range and provide better signal strength to 84 subscriber stations in mobile WIMAX system. Each SSs moves around the two base station of 1000 m WIMAX cell by using a random waypoint model with a various speed (i.e. 10, 20, 25 and 30 mps) and pauses for 30 sec. After this, each subscriber stations move towards or away from the base station depending upon the placement of the SSs. The result shows the performance improvement of WIMAX cell with more SSs that is measured in the form of throughput, end to end delay and average jitter at the SSs in Fig.7. Fig. 8, Fig. 9 respectively.

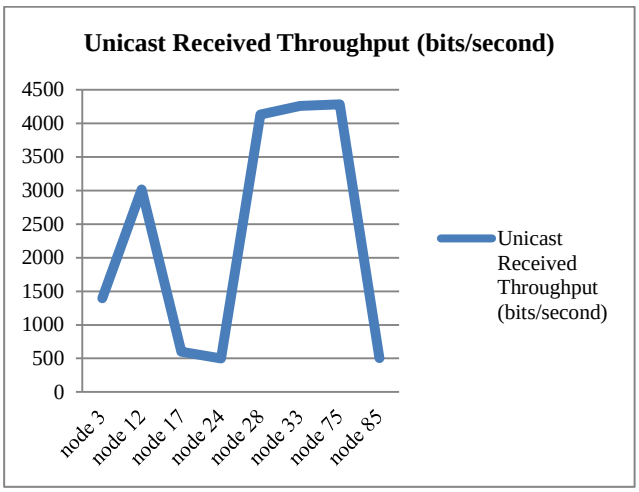

Fig. 7 Average throughput in bit/sec per SS versus no. of mobile SSs at different speed using two base station within the WIMAX cell.

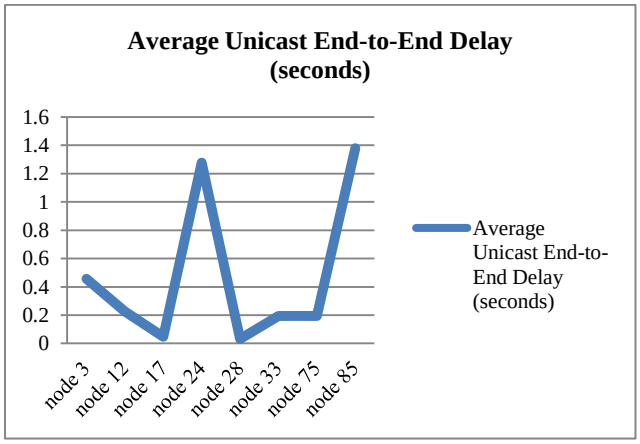

Fig. 8 Average End to end delay in seconds versus no. of mobile SSs at different speed using two base stations within the WIMAX cell

These figures show that more packets are received at last SSs as compared to scenario 1 and scenario 2. It also reduces the load exerted on the single base station

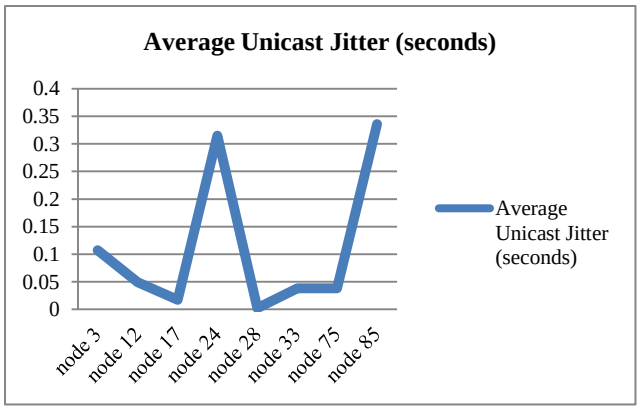

Fig. 9 Average delay jitter in seconds versus no. of mobile SSs at different speed using two base station within the WIMAX cell.

4. Conclusion

After observing the result it is concluded that, throughput, end to end delay and jitter performance of scenario 3 is good as compared to scenario 1 and scenario 2. While scenario3 overcome the problem of covering range by using two base stations with more transmitted power than single base station power. Hence, overall performance of Wi-max with two base stations is effective and reliable single base station network of Wi-max.

The future work will focus on heterogeneous networking and we can design the scenario by varying number of base station to observe the effect on handover, as well as mobile communication through mobility in mobile base station.

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