To Study the Impact of Varying Nodes Density and Traffic types of 802.16e based OPNET Model

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Abstract- As the technology is developing fast, communication and transmission is depending upon Wireless Networks. Even though Wireless networks are generally less efficient and irregular for some applications compared to Wired Networks, which make quality of service (QoS) a bigger challenge for Wireless Communications. In response to the increasing QoS challenges, researchers have made important modifications. The IEEE 802.16e standard, also known as Worldwide Interoperability for Microwave Access (WiMAX), has emerged as the strongest contender for Broadband Wireless Technology with promises to give guaranteed QoS to wireless application end users. The aims is to provide broadband wireless last mile access to Wide Range Area Network, offering easy deployment, high speed data rate and an expanded area of coverage. This technology supports real-time multimedia application services like broadcast of live events, voice-over internet protocols (VOIP), file transfer protocols and data services. The main aim of the paper is to analyze QoS deployment over a Mobile WiMAX network. It analyze WiMAX performance for small, medium and large network scenarios under FTP and VoIP traffic with varying node density through extensive simulation experiments using OPNET Modeler® Wireless Suite.

Keywords— WiMAX, FTP, VOIP, QoS, OPNET.

1. INTRODUCTION

Although the 802.16 family of standards is officially called Wireless MAN in IEEE, it has been commercialized under the name "WiMAX"("Worldwide Interoperability for Microwave Access") [1] by the WiMAX Forum industry alliance. The Forum promotes and certifies compatibility and interoperability of products based on the IEEE 802.16 standards.

IEEE 802.16 standard WiMAX gives freedom in several things compared to other technologies. The focus is not only on transmitting tens of megabits of data to many miles distances but also maintaining effective QoS (Quality of Services) and security.The 802.16e-2005 amendment version was announced as being deployed around the world in 2009. The version IEEE 802.16-2009 was amended by IEEE 802.16j-2009. WiMAX [2] main objectives are to cover those remote areas where cable connection is not feasible or expensive and for better coverage especially for mobile networks where users are always moving than the other broadband technologies like, Wi-Fi, UWB and DSL. This subsection describes the network architecture, mechanism and some technical issues of WiMAX mobile in brief with potential diagrams.

The recent versions of both broadband standards in 802.16 cover spectrum ranges from at least the 2 GHz range through the 66 GHz range. This is an enormous spectrum range. However, the practical market considerations of the Forum members dictated that the first product profiles focus on spectrum ranges that offered Forum vendors the most utility and sales potential.

The International standard of 3.5 GHz spectrum was the first to enjoy 802.16 products. The US license free spectrum at 5.8 GHz has a few WiMAX vendors building products. Licensed spectrum at 2.5 GHz used both domestically in the US and fairly widely abroad is the largest block in the US. Also, in the US and in Korea products are shipping for the 2.3 GHz spectrum range. Also in the US the 3.65 GHz band of frequencies now has WiMAX gear shipping to carriers.

The technology appears easily extensible to lower frequencies including the valuable 700 MHz spectrum range at which the nation's largest auction (in terms of money spent) concluded in 2008. More likely near term frequencies likely to be supported include the new 4.9 GHz public safety band (sometimes described as a Homeland security band).

The second largest block of frequencies ever auctioned (in terms of money spent) occurred in the summer of 2006 with the AWS auction from the FCC. This spectrum was split with the bulk being at 1.7 GHz and the rest at 2.1 GHz. At this point, the Forum is not expected to develop a product profile for this range as most licensees have announced support for LTE systems or plan to use it for existing GSM/UMTS networks.

This paper is organized as follows: Section 2 presents related work of WiMAX. Section 3 describes the Simulation Environment and Results studied. Section 4 concludes this paper.

2. RELATED WORK

In this section, we give a brief discussion of work related to Quality of Service (QoS) parameters in WiMAX.The IEEE 802.16 Working Group originally developed the broadband point-to-multipoint (PMP) standard as a wireless extension from a wired network infrastructure. The first approved air interface was based on a time division multiple access (TDMA) protocol. The interface supported time division

duplex (TDD) and frequency division duplex (FDD). The architecture was originally configured for fixed antenna terminals with line of sight (LOS) propagation across the 10 to 66 GHz frequency range. The standard was later expanded to include operation in the 2 to 11 GHz range with non line of sight (NLOS) capability using a robust OFDM technique. IEEE 802.11 supports real time multimedia application services like IPTV, broadcast of live events, voice over internet protocols, faster file services, data transfer. Support for this array of applications come from advanced antenna technologies like Multiple Input Multiple Output (MIMO), Orthogonal Frequency Division Multiplexing (OFDM), Adaptive Modulation and Coding (AMC). The goal of our thesis is to study the QoS parameters for FTP and HTTP traffic in a Wi-MAX network under different scenarios. Different Quality of Service parameters i.e. delay, jitter, packet loss, throughput, mean opinion score (MOS) are observed and evaluated to make a comparison of both FTP and HTTP.

Vinit Grewal, Ajay K Sharma "On Performance Evaluation of Different QoS Mechanisms and AMC scheme for an IEEE 802.16 based WiMAX Network" nternational Journal of Computer Applications, pp. 0975-8887, 2010 [1].

In this paper various QoS provisions are analyzed for different application traffics. The effect of Adaptive Modulation Coding (AMC) mechanism on the QoS performance of WiMAX network is also studied. The performance of various QoS mechanisms provided in IEEE802.16 standard is studied for both the fixed and mobile environments and their significance on QoS performance of the WiMAX network is realized.The results obtained show that these provisions and mechanisms enhance the QoS performance of the network in terms of throughput, packet loss and delay. Various service flows have been analyzed for different application traffic types and their QoS performance is found to be in accordance with the provisions in the standard. It can be concluded that FTP traffic is best served with nrtPS; Video traffic with rtPS; Email with BE and VOIP with UGS.

Chandra and Helen Prabha "Enhancement Of Quality Of Service Parameters In Wimax Mobile Networks" American Journal of Applied Sciences Volume 9 Issue 12, pp. 1906-1915, 2012 [2].

This study is based on the use of two scheduling algorithms to calculate the data in the MAC layer in order to provide maximum throughput. Moreover we propose a scheme to calculate the jitter between the various mobile users. The scheme performance is investigated through simulation. Priority Queuing gives better throughput compared to the Random Early Detection. Also jitter is minimized in priority queuing.

Vikram Mehta and Neena Gupta "Performance Analysis of QoS Parameters for Wimax Networks", International Journal of Engineering and Innovative Technology (IJEIT) Volume 1 Issue 5, pp 2277-3354, 2012 [3].

This paper focuses on analyzing essential QoS parameters for Wimax Network. Essential QoS parameters like delay, Jitter, Packet delivery Ratio (PLR), Packet Loss Ratio (PLR) and throughput have been calculated for 500 mobile nodes in a WiMax network. Ad Hoc on Demand Distance Vector Routing (AODV) protocol has been chosen as a routing protocol because of its ability to perform well under highly mobile and random conditions. MATLAB software version R2011 was used for creating WiMax network architecture and Regression analysis is done for each of the QoS parameter. Our results help in critically analyzing QoS parameters for WiMax Network and it has been found that an optimum value of QoS parameters is obtained with increasing number of mobile nodes for WiMax Network.

Wei Nie et al. "Packet Scheduling with QoS and Fairness for Downlink Traffic in WiMAX Networks", Journal of Information Processing Systems, Vol.7, No.2, June 2011 [4].In this paper, they studied the scheduling problem and propose a two level scheduling (TLS) scheme with support for quality of service and fairness guarantees for downlink traffic in a WiMAX network. A central controller Base Station has a number of users, and each mobile subscriber station has different channel conditions. The same mobile subscriber station may have different service requirements at different times in the WiMAX network. Based on OPNET simulation, the results show our scheduling algorithm can increase the network throughput, maintain relative fairness, and lower delay over the round robin and weighted round robin algorithms.Theycompared with the Round Robin algorithm and Weighted Round Robin algo-rithms, the QoS Priority and Fairness scheduling scheme for downlink traffic guarantees the delay requirement of UGS and ertps and rtps service flows and maximizes the throughput of BE service flows in the downlink.

3. Simulation Environment and Results

We begin the analysis of WiMAX network under FTP and VoIP traffic. We analysed scenarios at their internal level using specific parameters. The results obtained in the form of graphs, all the graphs are displayed as average. We used three scenarios for each FTP and VoIP traffic with varying load.

We carried out simulations on OPNET SIMULATOR [4]. OPNET is an object oriented, discrete event and general purpose network simulator. OPNET is chosen for this research because it carries the distinct features of a good simulator. OPNET provides a comprehensive modeling environment for unique specification, simulation and analysis of the performance of computer networks.

The simulation parameters are summarized in table 1. Modeler is commercial network simulation environment for network modelling and simulation. It allows the users to design and study communication networks, devices, protocols, and applications with flexibility and scalability.

Table 1: Network Parameters

Parameter	**Value**

Simulator	OPNET 14.5
Area	11×11 Km
Wireless MAC	802.16
Number Of Nodes	5,15
Traffic Type	FTP, VoIP
Data Rate	11 Mbps
Traffic Load	Light, Medium, Heavy
Simulation Time	60 minutes

3.1 Throughput

It is the time the total size of useful packets that received at all the destination nodes. It is the total number of packets (in packets/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

It is observed that:

It postulates about the load handling capabilities of WiMAX network when amount of data being downloaded and uploaded increases.Very interesting results are obtained for VoIP traffic. As we see for lesser number of nodes and low traffic number of packets received are less and reason being the large size of voice that is there is no pending transmissions in VoIP and only nodes which are transmitting voice contribute to throughput. Numbers indicate 81 packets/sec for light VoIP traffic and 180 packets/sec for medium and heavy VoIP traffic at 25 nodes

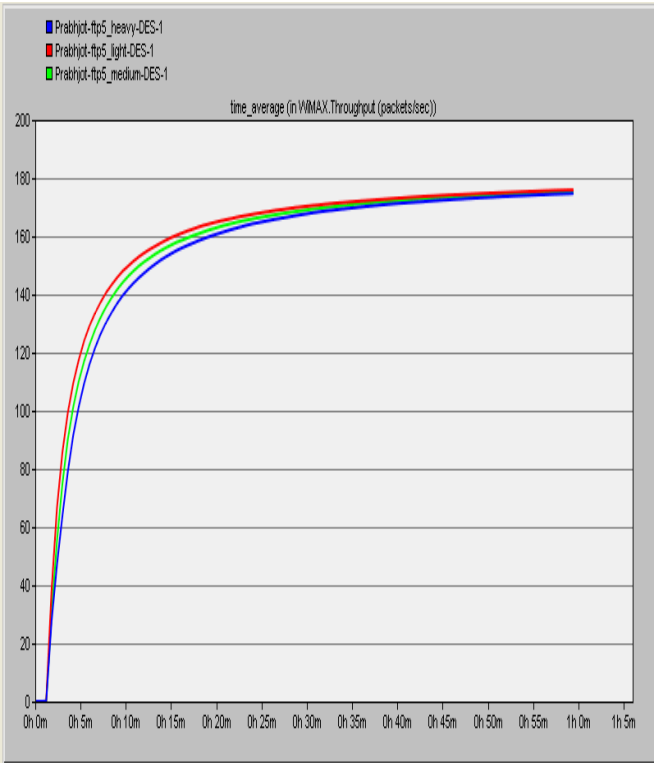

Fig. 1.1: Throughput (FTP_5)

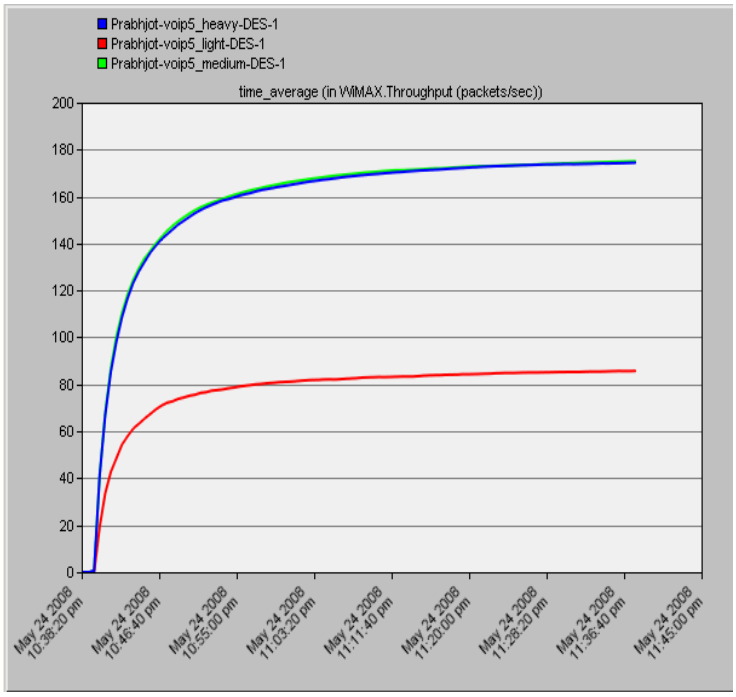

Fig. 1.2: Throughput (VoIP_5)

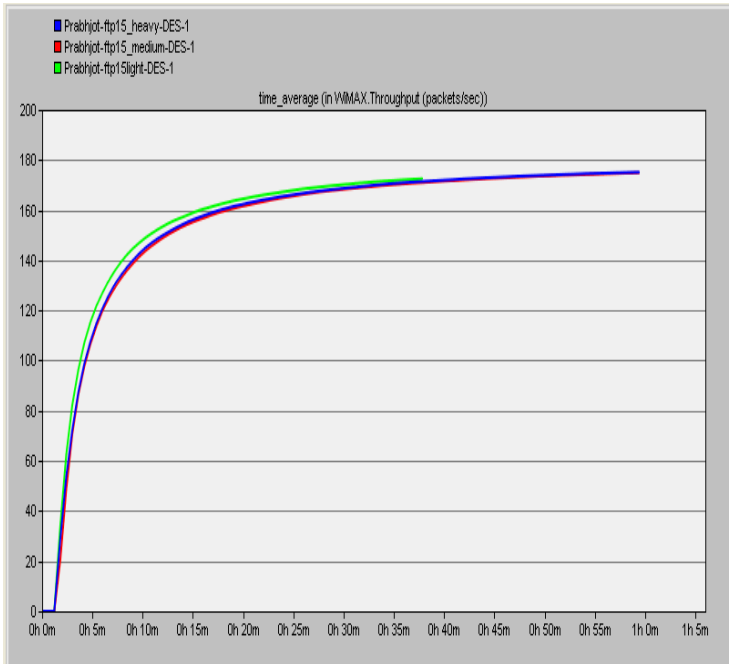

Fig. 1.3: Throughput (FTP_15)

Thus we see that VoIP traffic in WiMAX at higher node density and load makes optimum use of network capacity.Numbers indicate 81 packets/sec for light VoIP traffic and 180 packets/sec for medium and heavy VoIP traffic at 25 nodes.For 75 nodes it is seen as 525 packets/sec for

heavy VoIP, 520 packet/sec for medium traffic and 505 packets/sec for Light VoIP traffic. Thus we see that VoIP traffic in WiMAX at higher node density and load makes optimum use of network capacity.

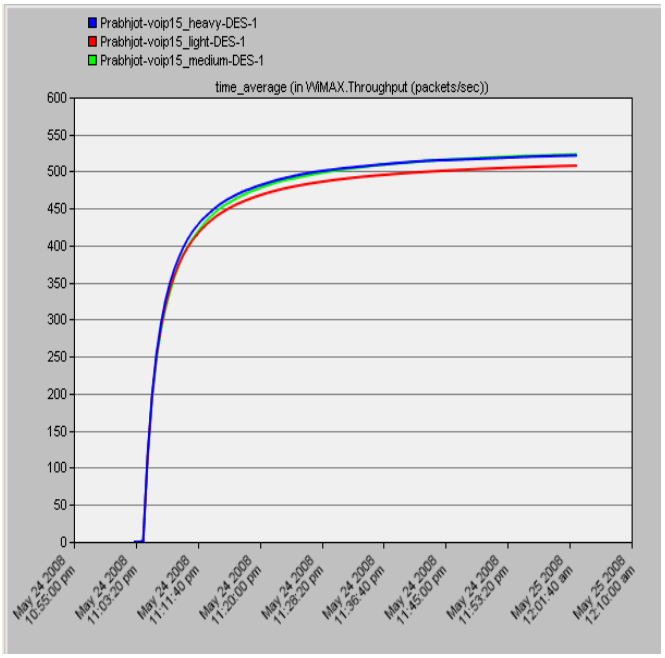

Fig. 1.4: Throughput (VoIP_15)

3.2 Jitter

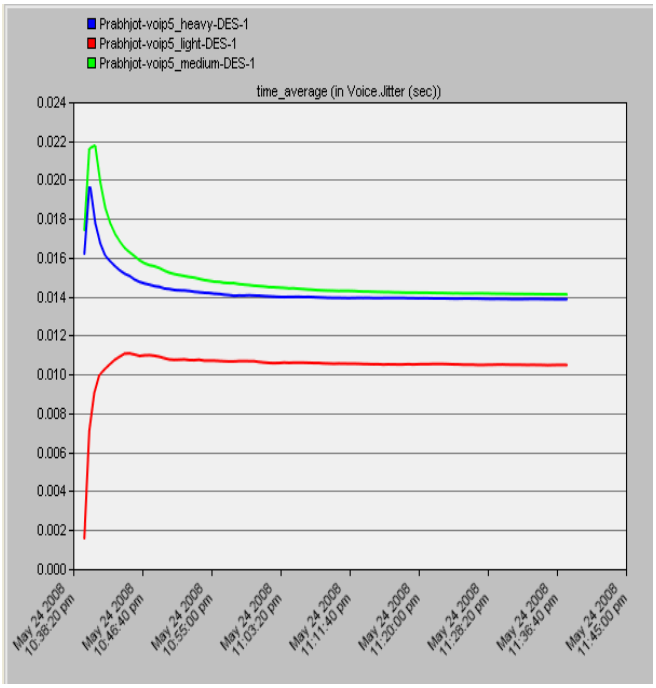

Fig. 1.5: Jitter (VoIP_5)

Jitter describes the degree of variability in packet arrivals, which can be caused by network congestion (bursts of data traffic), timing drift or because of route changes.

Fig. 1.5 and 1.6 show the results for jitter for light, medium and heavy VoIP traffic.

It is observed that:

> Jitter is low when amount of traffic load is less. It increases the quality of Voice from source to destination.

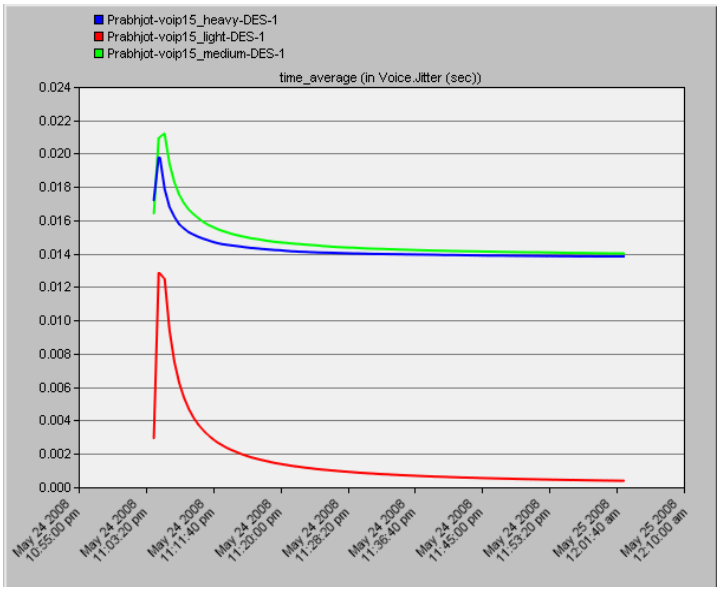

Fig. 1.6: Jitter (VoIP_15)

4. CONCLUSIONS

In this paper, WiMAX-based solution is set up and deployed like cellular systems using base stations that service a radius of several miles/kilometers. The most typical WiMAX-based architecture includes a base station mounted on a building and is responsible for communicating on a point to multi-point basis with subscriber stations located in business offices and homes. I have carried out simulation on WiMAX network for FTP and VoIP application traffic with same geographical area and network parameters to find out the best suitable applications for WiMAX networks. From the results it is quite clear that throughput of network is maximum when the number of nodes in VoIP is increased and traffic is peak. This is due to the cellular architecture of WiMAX network. For FTP applications substantial portion of the network capacity remains unutilized. Therefore, the overall conclusion of this thesis work postulates applicability of VoIP application in WiMAX IEEE 802.15.

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