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RESEARCH ARTICLE

PERFORMANCE ANALYSIS OF WIMAX (802.16E) ON DIFFERENT SIZED NETWORKS USING OPNET

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ABSTRACT

The worldwide interoperability for microwave access (WiMAX) is one of the newest technologies developed for broadband wireless network which offers high data rates, long coverage area and several types of quality of services to the users. In this paper, a basic simulation and performance analysis of WiMAX network in three different scenarios, using different quality of services like BLER, throughput and load, is carried out using OPNET modeler (version 14.5) which is a powerful tool used for simulation of wireless networks.

INTRODUCTION

A wireless network is a type of computer network that uses wireless connections for transferring the data between different network nodes. Wireless networks generally make use of electromagnetic or radio waves for communication. Nowadays, we have got access to various types of wireless networks for example cellular networks, wireless local area network (WLAN), wireless metropolitan area network (WMAN), wireless personal area network (WPAN), wireless wide area network (WWAN) or even mobile ad-hoc networks (MANET) (Williamjeet Singh and Jyotsna Sengupta 2011). The bandwidth and coverage comparison of all available wireless technologies is shown in Figure1. WiMAX is the new revolution in wireless world which is growing faster than ever. It is the latest fourth generation wireless technology which has given an edge over all previous generations technologies. In this paper our focus is to simulate and evaluate the performance of WiMAX in terms of different quality of services which include WiMAX PHY uplink and downlink BLER, network load and the throughput.

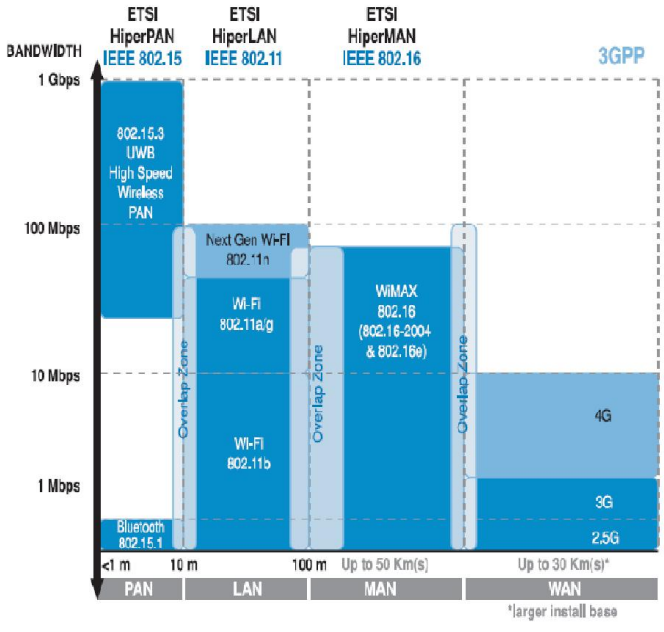

Fig.1. Bandwidth and coverage of wireless technologies

Wimax overview

In this Section, a brief overview of WiMAX technology is given. WiMAX which is abbreviated as "Worldwide Interoperability for Microwave Access" is currently one of the hottest technologies in wireless which provides broadband connectivity by connecting to the Internet Service Provider even when you are roaming outside home. The Institute of Electrical and Electronics Engineers (IEEE) 802 committee has published a set of standards that define WiMAX. IEEE standard Board in 1999 introduced and worked on Broadband Wireless Access Standards which aimed for global deployment of broadband Wireless Metropolitan Area Networks. The

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family of 802.16 is known as Wireless MAN which is also known as "WIMAX" or wireless broadband (Dr. Mayyada Hammoshi 2011). IEEE 802.16-2004 is known as 'fixed WiMAX' and IEEE 802.16-2005 or 802.16e is known as 'mobile WiMAX'.

Related Reserches

Iwan Adhicandra, April 2010, examined a case of QoS deployment over a cellular WiMAX network. He compared the performance obtained using two different QoS configurations differing from the delivery service class used to transport VoIP traffic, i.e. UGS or ertPS. Results indicated that for delay-sensitive traffic that fluctuates beyond its nominal rate, having the possibility to give back some of its reserved bandwidth, ertPS has the advantage to permit the transmission of BE traffic (Iwan Adhicandra 2010). Terminal mobility with Quality of Service (QoS) can be provided through efficient and seamless handoffs and handoff management procedures in 4G wireless access networks. Bhosale and Daruwala (2013) analyzed the handoff management procedures within a WiMAX access networks and to evaluate its impact on different QoS metrics such as Packet Loss, Throughput and End-to-End Delay (Sahana Bhosale and Daruwala 2013). Vinit Grewal and Sharma (2010) analyzed various QoS provisions for different application traffics. The effect of Adaptive Modulation Coding (AMC) mechanism on the QoS performance of WiMAX network was also determined. The results obtained showed that these provisions and mechanisms enhance the QoS performance of the network in terms of throughput, packet loss and delay (Vinit Grewal and Ajay K Sharma 2010).

Simulation scenarios

A. Simulation Software

The software used in this study is OPNET Modeler. OPNET is a network and application management software designed and distributed by OPNET Technologies Inc. OPNET provides technologies, protocols, communication devices for academic research, assessment and improvement (Bapuji and Sharma 2011; OPNET Modeler 14.5 Documentation).

B. Simulation Model

In our proposed model, we have simulated WiMAX network on three different network models that vary in number of their base stations and total no. of nodes (Kalpana Chaudhari *et al.,* 2012). A large geographic location has been divided into various cells of hexagonal shape. WiMax performance measurements for the following three simulations were performed:

1) Scenario_1: In first scenario model, performance of WiMAX network on Small network model is observed with three BS each having 5 nodes as shown in Figure 2.

2) Scenario_2: In second scenario model, performance of WiMAX network on Medium network model is observed which consists of five BS each having 5 nodes as shown in Figure 3.

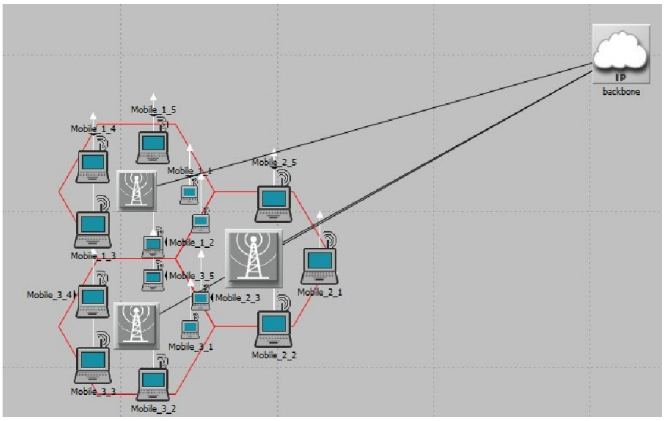

Fig 2. Scenario1 (Network with 3 BS having 15 clients)

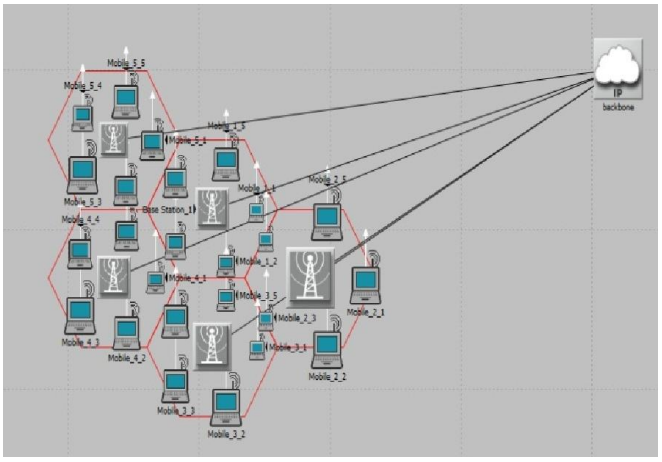

Fig. 3. Scenario2 (Network with 5 BS having 25 clients)

3) Scenario_3*:* In third scenario model, performance of WiMAX network on Large network model is observed which consists of eight BS each having 5 nodes as shown in Figure 4.

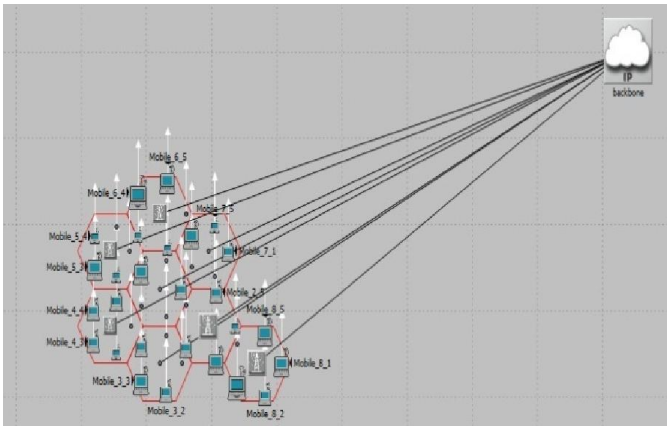

Fig. 4. Scenario3 (Network with 8 BS having 40 clients)

Parameter setup

The various parameters used during simulation are presented in Table 1 below.

Table 1. WiMAX Parameters

Parameters	Value
Average Simulation speed	182,370 event/sec
Memory used (MB)	45 , 60, 85
No. of cells	3,5,8
Cell radius (km)	1.00
Simulation Time	1000 sec
Update Interval	50,0000event
Multipath channel model	ITU vehicular A
Altitude (m)	0.10
PHY profile type	OFDM
Maximum handover retransmission	30
Request retries	16

SIMULATION RESULTS

A. BLER

BLER stands for block error ratio. A Block Error Ratio is defined as the ratio of the number of erroneous blocks received to the total number of blocks sent (http://en.wikipedia.org/wiki/Block_Error_Rate). The WiMAX PHY uplink and downlink BLER comparison of three scenarios are shown in Figure 5(a) and 5(b) respectively.

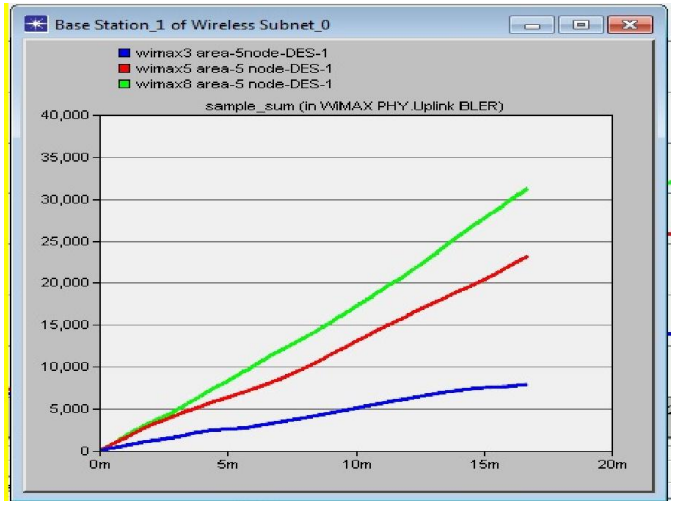

Fig 5(a). WiMAX PHY uplink BLER

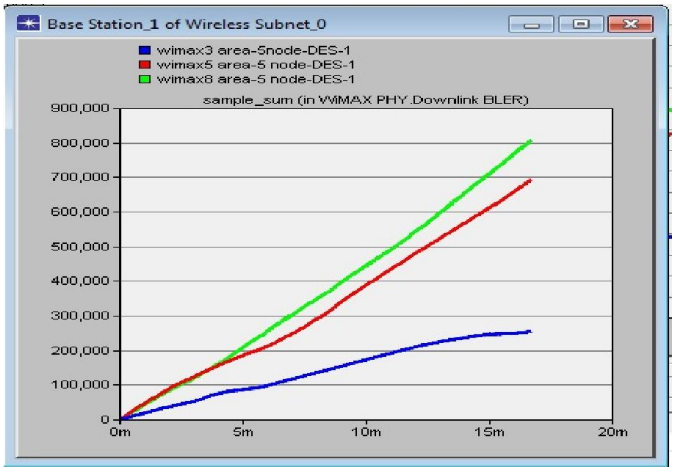

Fig 5(b). WiMAX PHY downlink BLER.

B. Throughput

Throughput is defined as the ratio of the total data reached to a receiver from the sender (Latif and Rashid 2004; Vats and Sachdeva 2012). The time receiver takes to receive the last message is known as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec). Throughput can be represented mathematically as in equation (ii);

$$Throughput = \frac{\text{Number of delivered packet} * \text{Packet size} * 8}{\text{total duration of simulation}} \quad \text{..... (ii)}$$

After simulation of 1000 sec. throughput values in three models with 802.16 are show in Figure 6.

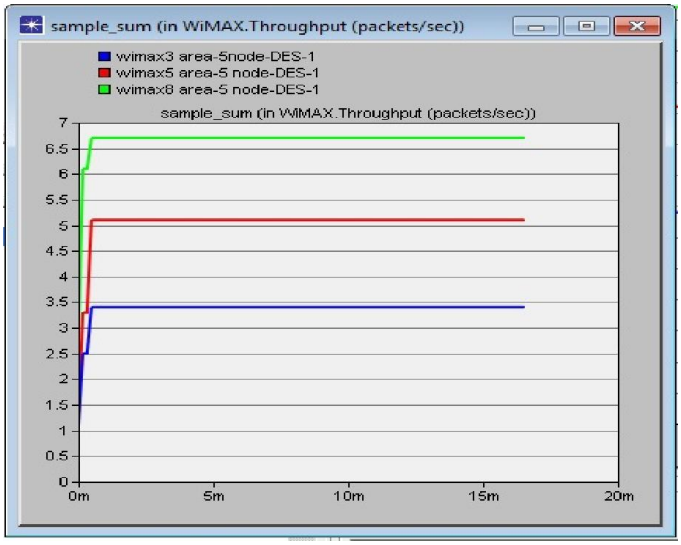

Fig 6. WiMAX throughput (packets/sec)

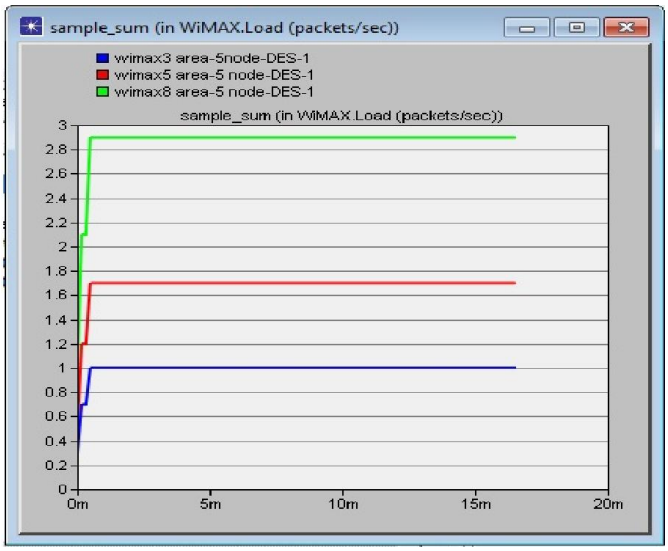

Fig 7. WiMAX network load (packets/sec)

C. Load

Network load represents the total load in bit/sec submitted to wireless LAN layers by all higher layers in all WLAN nodes of

the network. When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic then it is called the network load. After simulation of 1000 sec., network load values in three models with 802.16 are shown in Figure 7.

Conclusion

The simulation study of this work has been done for three WiMAX scenarios, consisting of different no. of mobile workstations, analyzing the behavior of WiMAX network for each scenario with respect to BLER, throughput and network load and the results performed on OPNET modeler using sample sum filter shows that both WiMAX PHY uplink and downlink BLERs are highest for the network having minimum no. of users and lowest for that having large no. of users. The throughput of WiMAX network is maximum in large networks and is minimum in small networks. The network load is also highest for large networks and lowest for small networks. Thus the motive of this study was to check the performance of WiMAX network over these three scenarios with different no. of connected nodes.

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