To Investigate the Effect of Mobility on the Air Interface Parameter Selection in WIMAX Networks

Priyanka
Department of Electronics & Communication
Guru Nanak Dev University, Regional Campus
Jalandhar, India

Jyoteesh Malhotra, Ph.D
Department of Electronics & Communication
Guru Nanak Dev University, Regional Campus
Jalandhar, India

ABSTRACT
Mobility is an important factor in wireless networks because internet connectivity can be effective only if it is available during the movement of node. WiMAX standard IEEE 802.16e supports full mobility. This paper mainly focuses on the mobility i.e. when mobile node moves from one cellular BS (base station) to another cellular BS during this handover process is carried out for the movement. So in this paper simulative analysis is done for the performance of mobility in WiMAX network implemented by using OPNET 14.5. Three different scenarios having different number of BS'S are compared for the performance of network and also HARQ and scanning parameter effect is also observed. Performance is measured in QoS like jitter, end-to-end delay, load, Throughput, traffic received, Network Delay, etc.

Keywords
WiMAX, QoS, Mobility, MAC, OPNET,

.1. INTRODUCTION
The world is moving to the age of velocity in every field especially in the wireless networks field. It becomes needful to have mobility facilities in the wireless networks. The need is to provide mobile wireless network with high data rates, Quality of Service (QoS) and adaptability within one network or among networks of different technologies and service providers. Area of communication is rapidly growing that generates the need of mobility during communication. [4] The mobility of a terminal is supported by a procedure known as handover. Handover is an important procedure in maintaining links to base station even when mobile node is moving with high velocity and changes its geographical position. The handover is due to the movement of mobile node within different cellular cells or due to change in radio channel condition or due to cell capacity constraints. The users should be able to get its potential whatever they are using (PC, cell phone, etc.) and where ever they are sitting; at home, walking and even driving [1].Worldwide Interoperability for Microwave Access (WiMAX) is one of the future generations (4G) promising networks to fulfill consumer's needs. It is an emerging technology that is designed to deliver fixed and mobile broadband connectivity [2]. The WiMAX trade name is used to group a number of wireless technologies that have emerged from the Institute of Electrical and Electronics Engineers (IEEE) 802.16 Wireless Metropolitan Area Network (MAN) standards [3]. The main standards introduce mobility and currently receive a great deal of interest in the telecoms world [2]. Figure 1 show environments that can be employed in WiMAX [1]. The IEEE community has defined the IEEE 802.16e amendment (i.e. mobile WiMAX) to support mobility implemented with Orthogonal Frequency-Division Multiple Access (OFDMA) as its physical layer scheme [4]. Handover mechanism should be efficient to ensure high level of mobility.

The purpose of this study was to analyze QoS performance over a cellular WiMAX network and to examine the capability of a WiMAX network to deliver adequate QoS to video conferencing and voice applications. Need of mobility in this growing technological world motivates to deploy WiMAX network by using OPNET 14.5 simulator. This paper discusses about the performance of the MAC Layer by comparing different scenarios using OPNET Modeler Simulation Tool.

The paper is organized as follows. Section II describes methodology. Section III provides Model for implementation. Section IV evaluates results and analysis. Section V concludes the paper. References are given in section VI.

2. SIMULATION METHODOLOGY
OPNET 14.5 simulation tool is used for the simulative study. WiMAX network is deployed by using this simulation tool. The methodologies taken include creating the WiMAX network, deploying the required applications and QoS configurations. Then adjusting the QoS configurations within the WiMAX cells to meet application requirements.

HARQ and scanning are important air interface parameters. During scanning interval MS measures signal power and SINR for neighboring BSs and may optionally associate with them using initial ranging. In scanning process it scans all the BS's and decides which is best suitable. Hybrid ARQ (automatic repeat request) is defined as the joint use of ARQ and forward error coding (FEC) at the transmitter and/or receiver. When HARQ is used, instead of discarding each erroneously received packet, these are stored at the receiver side and later combined with their respective retransmitted copies, increasing the reliability of the transmitted information. Various air interface parameters are used while creating WiMAX network shown in fig 1.

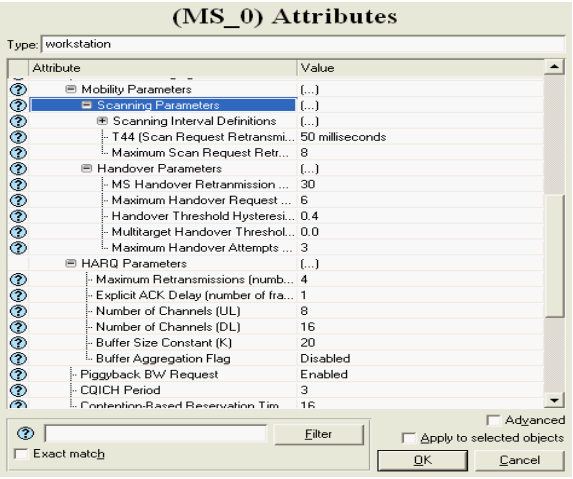

Fig 1: Mobility Parameters

There are various other simulation parameters shown in table 1.

Simulation parameters	
Parameter	**Value**
Modulation and coding	64 QAM ¾
Buffer size(bytes)	64KB
Multipath channel model	ITU vehicular B
Pathloss model	vehicular
Terrain type	terrain type A
Average SDU size(bytes)	1500
Profile type	OFDMA 5MHz
Max. transmit power(W)	2
Simulation time(min)	5
Efficiency mode	Mobility and Ranging Enabled

Table1. Simulation Parameters

2.1 Performance Metrics

2.1.1 Throughput:

It refers to the amount of data transferred from source to destination in a given amount of time. So it is represented by the ratio of total amount of data that reaches its destination to the time taken for the data to transfer from the source to the destination. Throughput is usually described by bytes or bits per second (Bps or bps).

2.1.2 End-to-End (E-2-E) Delay

It refers to the time taken for a packet to be transmitted across a network from source to destination. It is represented by the ratio of total E-2-E delay to the no. of packets received.

2.1.3 Jitter

The Jitter is the deviation in the time among packets arriving at the destination side. It signifies the Packets from the source till they reach their destination with different delays. Jitter is random in nature.

2.1.4 Load

Amount of incoming data. It is represented by the ratio of amount of data to the time taken. It is packets in bits per sec or packets per sec.

2.1.5 Delay

The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is measured in sec.

3. ENVIRONMENT SIMULATION MODEL

In this experiment, we used OPNET Modeler version 14.5 with WiMAX Module capability [9]. We designed three scenarios. All the three scenarios have one mobile node with different number of base stations. Each BS placed in different hexagonal cellular cell. This mobile node moves from one BS to another BS so the mobile node moving from one BS to another BS is known as mobility. All these BS's are connected to server through IP backbone.

Scenario 1: It is shown in figure 1. In this scenario 4 BS's are placed in different hexagonal cellular cell and mobile node moving from BS to BS.

Scenario 2: It is shown in figure 2. In this scenario 6 BS's are placed in different hexagonal cellular cell and mobile node moving from BS to BS.

Scenario 3: It is shown in figure 3. In this scenario 8 BS's are placed in different hexagonal cellular cell and mobile node moving from BS to BS.

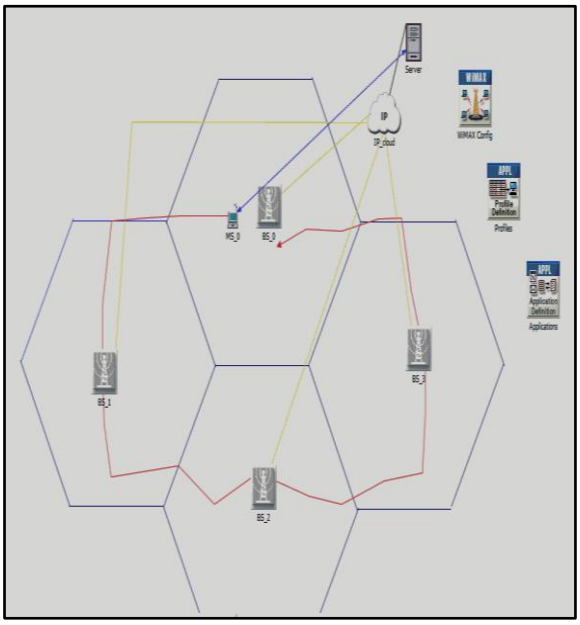

Fig 2: Model First

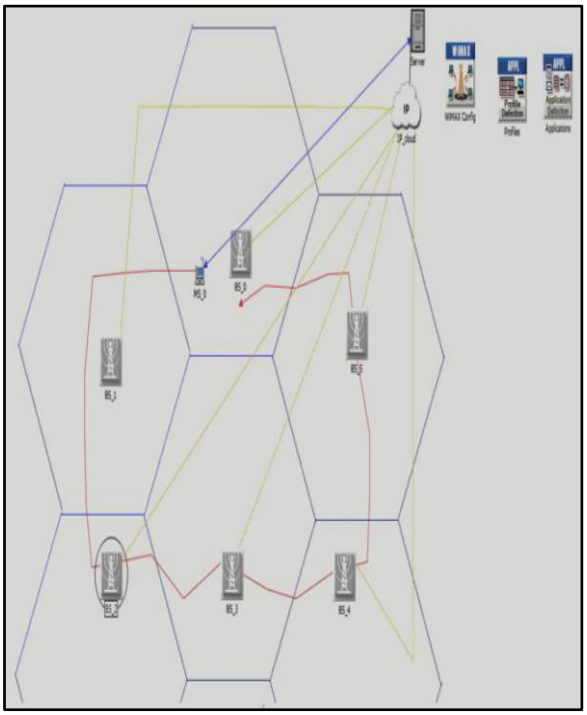

Fig 3: Model second

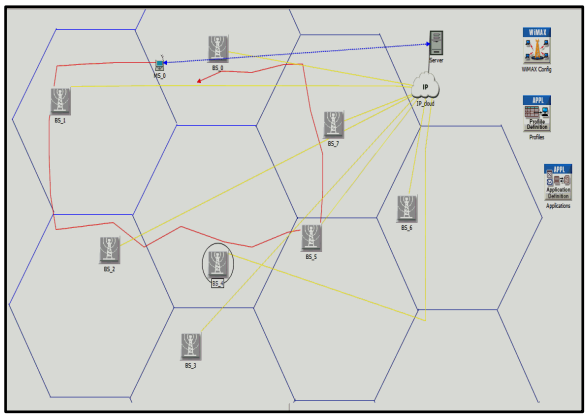

Figure 4: Model third

4. RESULTS AND DISCUSSION

Each scenario`s experimental result is summarized in a separate graph. Therefore, the graphs will clearly indicate how system performance has been influenced by increasing BS's in single Network. Scenarios with different number of BS's performance are compared in terms QoS parameters for 5 min simulation by using OPNET modeler.

Figure 5 compares delay shows that network with 4 BS have less delay than 6 BS and 8 BS network. It expresses that as the number of BS's increases delay also increases.

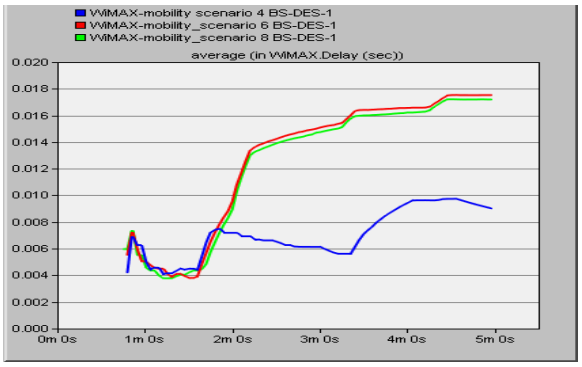

Fig 5: Delay

Figure 6 compares load shows that load for network with 4 BS is more than 6 BS and 8 BS network. It expresses that load decreases as number of BS's increases.

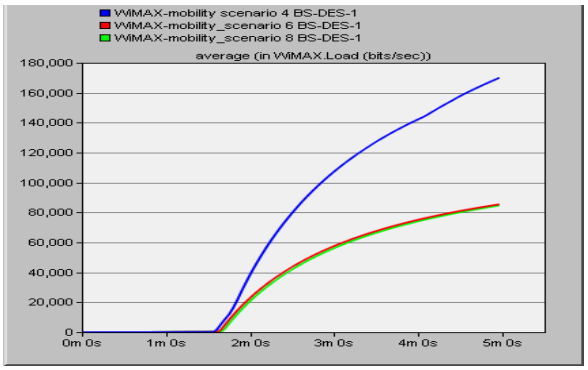

Fig 6: Load

Figure 7 compares ETE delay shows that delay is less for 4 BS network than 6 BS and 8 BS. It expresses that as the number of BS's increases ETE delay also increases.

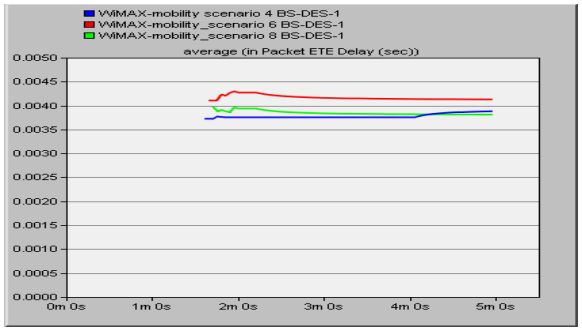

Fig 7: End to end Delay

Figure 8 compares jitter shows that jitter is more for 6 BS and 8 BS network than 4 BS network. It expresses that as the number of BS's increases jitter also increases. Jitter is random in nature so it eventually falls and modeled as Gaussian distribution.

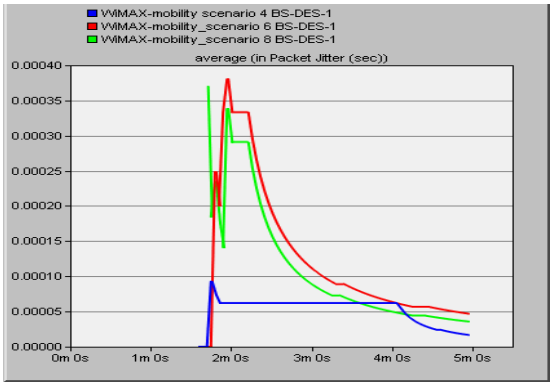

Figure 8 Jitter

Figure 9 compares Traffic Received shows that network with least number of BS's received least traffic. So network with 4 BS received less traffic than 6 BS and 8 BS.

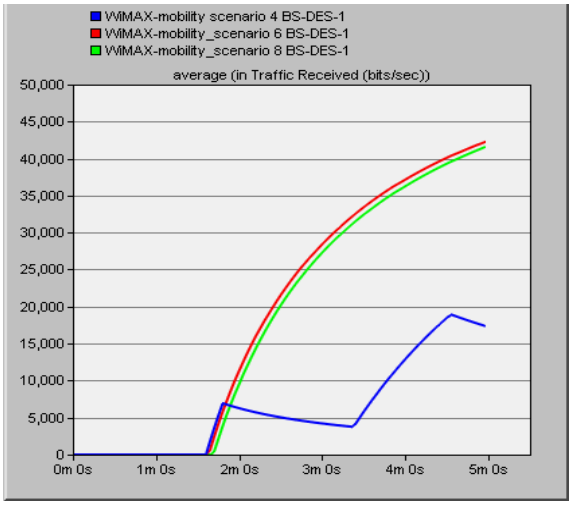

Fig 9: Traffic received

Figure 10 compares throughput shows that 6 BS and 8 BS network has more throughput than 4 BS. It expresses that as the number of BS's increases throughput also increases.

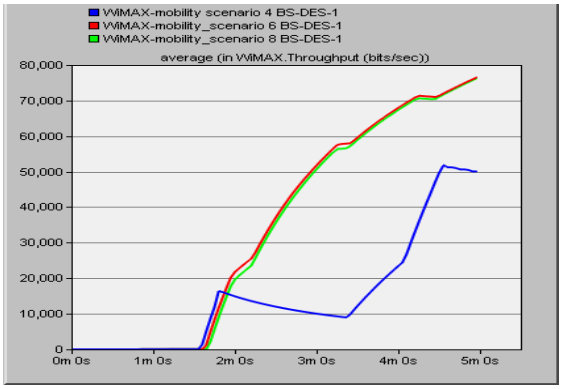

Fig 10: Throughput

All the results are shown in fig 5 to fig 10. According to all these results it concludes that WiMAX network performs best as the number of BS's increases even though delay, jitter and traffic received is more but gives best performance with very high throughput. These results assure that WiMAX standard gives best QoS performance under mobility conditions.

Now scenario with 6 BS also compared with HARQ and Scanning parameters. Firstly HARQ parameter is compared.

First scenario is with HARQ and second is with HARQ. Performance is compared with QoS parameter like jitter and Throughput. Results are shown in figure 10 and 11.

Figure 11 compares jitter shows that the scenario without HARQ has least jitter than scenario with HARQ. Jitter is random in nature and is modeled as Gaussian distribution. So it firstly increases then eventually falls.

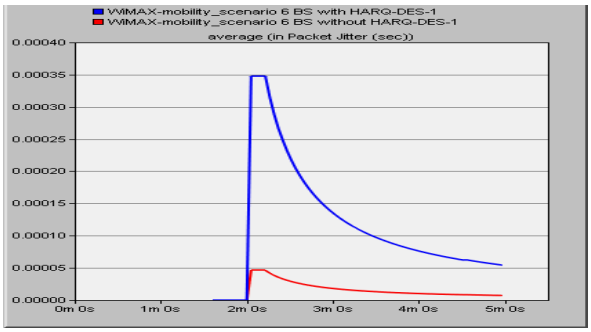

Fig 11: Jitter

Figure 12 compares throughput shows that that the scenario without HARQ has highest throughput than scenario with HARQ.

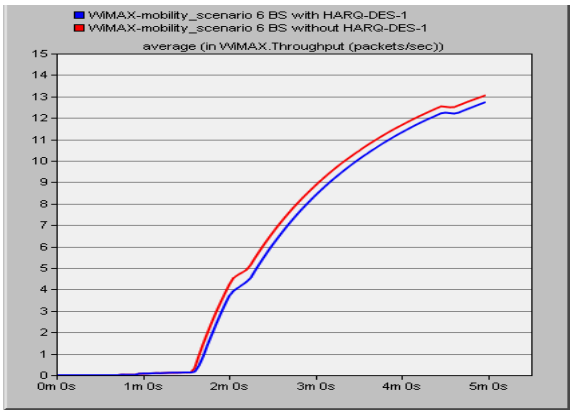

Fig 12: Throughput

Results from figure 11 and 12 shows that the scenario without HARQ performs better than the scenario with HARQ.

After this scenarios are compared with scanning parameters. In this also performance is compared with QoS parameters like jitter and throughput. Results are shown in figure 13 and 14.

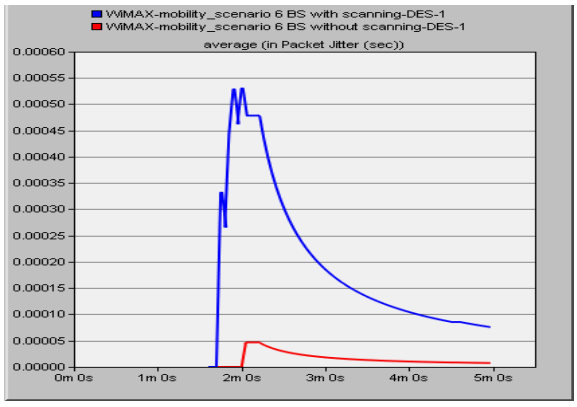

Fig 13: Jitter

Figure 13 compares jitter shows that jitter is least for the scenario without scanning than the scenario with scanning. Jitter is random in nature so it goes up in starting then eventually decreases.

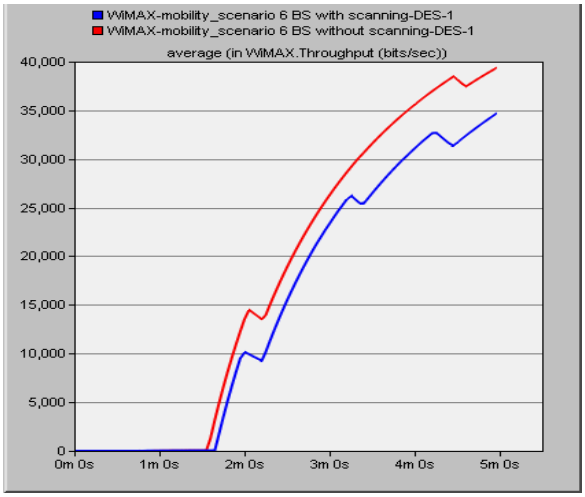

Fig 14: Throughput

Figure 14 compares throughput shows that the scenario without scanning has highest throughput than the scenario with scanning.

Performance analysis of WiMAX network with mobility parameters is shown in table 2.

Parameters	Jitter	Throughput
With HARQ	35 sec	12 pkts/sec
Without HARQ	5 sec	13 pkts/sec
With Scanning	54 sec	35000 bps
Without Scanning	5 sec	40000 bps

Table 2 Mobility Parameters Performance

5. CONCLUSION

This paper presents three different scenarios with different number of BS's and one mobile node. Mobile node is moved from one BS to another BS, so the performance is analyzed for mobility in terms of QoS parameters. In above results it has been shown that performance of node mobility during handover is higher in the network with more number of BS's and also the network without HARQ and Scanning parameter performs better. Above results has been analyzed using OPNET simulator and to measure the performance we took parameters Average Throughput, Average Delay, Average Jitter and End to End delay and after examining the simulation in mobile environment.

6. REFERENCES

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