Scientific Journal of Impact Factor(SJIF): 3.134
e-ISSN(O): 2348-4470
p-ISSN(P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2,Issue 4, April -2015

Analysis of the Parameters Affecting Handover Performance in Mobile WiMAX Networks

Dr.R.Sindhu[1], Sruthi M.P[2], Sruthi P.M[3], Suvarna Parvathy K.V[4], Vidya K.V[5]

[1,2,3,4,5](Department of Electronics and Communication Engineering, N.S.S College of Engineering, Palakkad, Kerala, India)

Abstract — *Mobile WiMAX is the latest technology that promises broadband wireless access over long distances. This mobile WiMAX has proven to be more stable and applicable for fixed, portable, nomadic and mobile network. The main consideration of Mobile WiMAX is to achieve seamless handover such that there is no loss of data. Handover is an essential process in wireless networks to guarantee continuous and effective services. The basic meaning of handover process is to provide uninterrupted connectivity when a mobile station transfers from the air interface of one base station to the air interface of another base station. The handover performance in mobile network is the most important factor that can influence the Quality of Service (QoS). The parameters such as delay, packet delivery ratio, throughput etc. are some factors which affect the WiMAX network performance. This paper aims to analyze the effect of such parameters on handover performance.*

Keywords- *Handover, Mobile WiMAX, Parameters, QoS*

I. INTRODUCTION

WiMAX has been increasingly called the technology of the future. In early 2001, the WiMAX Forum developed the most modern wireless technology named WiMAX, which is a telecommunications protocol that provides fixed and fully mobile Internet access. There are many positive aspects of this technology; one of the most important is the support of a large coverage area. Belonging to the IEEE 802.16 series, WiMAX will support data transfer rates up to 70 Mbps over link distances up to 30 miles. WiMAX has the ability to provide a service even in areas that are difficult for wired infrastructure to reach and with the ability to overcome the physical limitations of a traditional wired infrastructure [1].

The WiMAX Forum gradually improves the functionality and approves different generations for this standard. Usually these standards differ in two different forms generally known as 802.16d or Fixed WiMAX and 802.16e or Mobile WiMAX. The 802.16d-2004 standard has no support for mobility. To overcome this IEEE 802.16e was proposed and had full support for mobility [2].

The major issue that arises in Mobile WiMAX is to provide proper handover when the user is in motion. The system should provide a method for seamlessly handing over an ongoing session from one base station to another as the user moves across them. Many studies have been conducted to improve the handover techniques. Many new algorithms are being introduced to improve the quality of service during handover [4]. But before going for further improvements it is necessary to analyze the present condition of performance of the network during handover. There are various parameters of the WiMAX module that affect the handover performance. Some of these parameters are lgd factor, scan duration, scan iteration etc. This paper aims to analyze the effect of such parameters on handover performance based on the Quality of Service (QoS) metrics.

Section 2 gives an overview of handover. Section 3 describes about the QoS metrics analyzed in the project. Section 4 discusses the simulations and results. The results are summarized and conclusion is given in section 5.

II. HANDOVER

A special requirement for a mobile device is the ability to change the serving BS if there exists another BS with, for example, better link quality in the reach of the MS. The handover is a procedure with an intention to switch the network connection access point of the MS without data loss or disturbing the existing connection(s).

The handover usually is understood as a change of serving BS, but it does not necessarily mean that the BS must be changed. In some cases the handover can occur also within the same BS, though within different channels. This handover type is called intra-cell handover, while the other option is called inter-cell handover. Besides handover can be within a single network technology, where it is called horizontal handover or between two different technologies in which case it is referred to as vertical handover.

III. QoS PARAMETERS

There are various metrics based on which the network performance can be analyzed and assess the quality of the network. Some of them are briefed below.

3.1 Throughput

In any communication network, such as Ethernet or packet radio or mobile WiMAX network, throughput or network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second or data packets per time slot. So this means more messages delivered over channel will make network more reliable and fast. Equations (1) and (2) can be used to calculate the throughput.

Throughput = File Size / Transmission Time (bps) (1)
TP = ∑ Packet Size / (Packet Arrival - Packet Start) (2)

3.2 PDR

PDR is defined as the ratio between the received packets by the destination and the generated packets by the source. It is the measure of the successful delivery of packets. Equation (3) shows how to calculate the PDR in percentage (It is referred to as PDR itself throughout this paper).

PDR = (∑ packets delivered / ∑ Packets sent) * 100 (3)

3.3 Delay

Delay or latency would be time taken by the packets to transverse from the source to the destination. The main sources of delay can be further categorized into: source- processing delay, propagation delay, network delay and destination processing delay. Equation (4) shows the calculation for Average Delay, where Packet Arrival is the time when packet "i" reaches the destination and Packet Start is the time when packet "i" leaves the source and "n" is the total number of packets.

Average delay = (Packet Arrival - Packet Start) / n (4)

3.4 Handoff Delay

Handoff delay is the latency incurred in the network during the handover process from one base station to another base station.

IV. SIMULATION AND RESULTS

The main objectives of the simulations were to analyse the impact of different parameters of the WiMAX module during handover. A simple and basic scheme was designed in order to keep the simulation process simple. Network Simulator tool (NS-2 version) was used due to its ease of implementing handover in mobile WiMAX. Additionally, in order to support mobile WiMAX two other particular modules known as WiMAX and mobility modules were used from a NIST project.

4.1 Simulation Scenario

For performing handover, at least two base stations (BS) and one mobile station (MS) are required. The analysis was carried out in an environment which consists of two base stations and ten mobile stations. The influence of the different handover parameters such as Lgd factor, scan iteration, scan duration and frame duration were analysed against different QoS parameters like throughput, PDR, average delay and handoff delay. The influence of speed of mobile stations on these QoS parameters was also analysed.

4.2 Handover Parameters

Some of the parameters of the WiMAX module that affect handover performance are given below.

1. Lgd factor: Lad factor is one of the important parameters that affect the handover. It determines the sensitivity of detecting a falling link. When the received power of a signal is less than factor RXThresh, a trigger is generated to initiate scanning for neighbour BSs. It determines how sooner the trigger is generated.
2. Scan duration: Scan duration defines the length of the scanning period in frames. In order to make a successful scan, long duration time is desirable. On the other hand, short duration time for scanning also produces moderate elapsed time.
3. Scan iteration: Scan iteration defines the requested number of iterating scanning interval by an MS, which means how many times the MS will complete the scanning procedure.

4. Frame duration: Frame duration defines the length or the size of a frame.

These parameters were varied one at a time, keeping others constant and the effect on the different QoS metrics were analysed.

4.3 Analysis of throughput with various handover parameters

This section consists of the analysis of throughput with variations in different handover parameters such as Lgd factor, frame duration, scan iteration and scan duration. The observations and inferences obtained from the analysis are also mentioned in this section.

4.3.1 Lgd factor vs. Throughput

The plot of Lgd factor against throughput is as shown in Figure 4.1. The variation in throughput is analyzed for different values of Lgd factor ranging from 1.1 to 1.4. From the figure, it is clear that the Lgd factor significantly affects the throughput and a maximum throughput is obtained at an Lgd factor of 1.2.

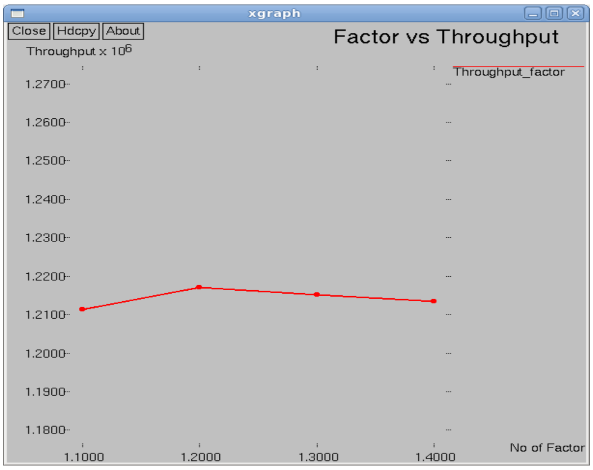


Figure 4.1 Lgd factor vs. Throughput

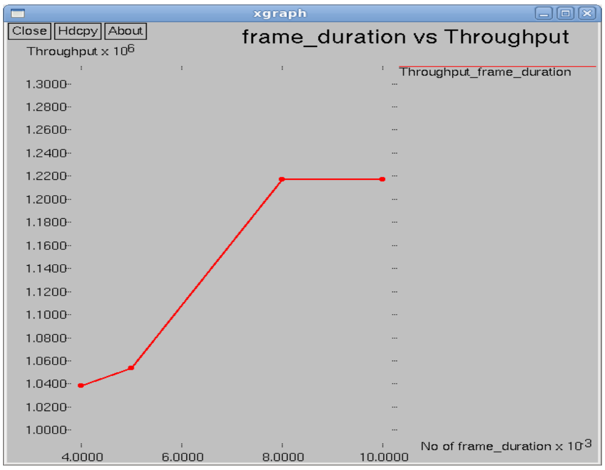


Figure 4.2 Frame duration vs. Throughput

4.3.2 Frame duration vs. Throughput

The plot of Frame duration against throughput is as shown in Figure 4.2. The variation in throughput is analyzed for different values of Frame duration ranging from 4ms to 10ms . The plot is in such a way that it increases first and then becomes constant. Hence it is clear that the frame duration seriously affects the throughput and a maximum throughput is obtained at frame duration of 8 ms.

4.3.3 Scan iteration vs. Throughput

The plot of scan iteration against throughput is as shown in Figure 4.3. The variation in throughput is analyzed for different values of scan iteration ranging from 1 to 10 and is found to be varying. Since there are fluctuations, it is clear that the scan iteration seriously affects the throughput and a maximum throughput is obtained at a scan iteration of 7.

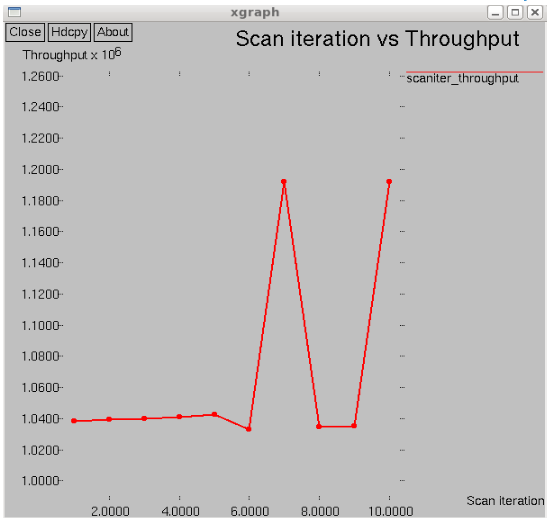


Figure 4.3 Scan iteration vs. Throughput

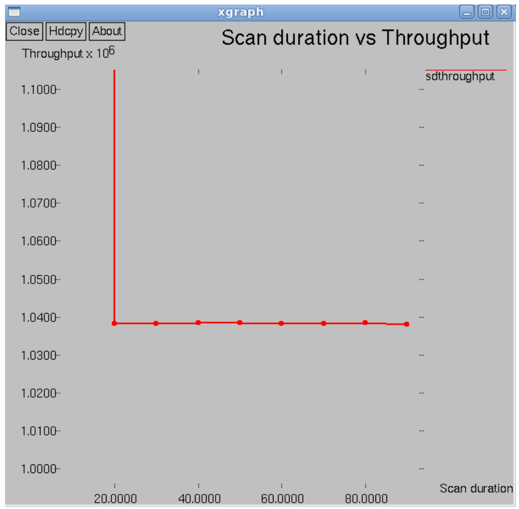


Figure 4.4 Scan duration vs. Throughput

4.3.4 Scan duration vs. Throughput

The plot of scan duration against throughput is as shown in Figure 4.4. The variation in throughput is analyzed for different values of scan duration ranging from 20ms to 80ms. The plot is found to be a constant and hence it is clear that scan duration does not affect the throughput much.

4.3.5 Observations and results

Analyzing the different plots of throughput with different handover parameters, it can be inferred that Lgd factor, frame duration and scan iteration seriously affects the throughput since there are many fluctuations. Scan duration does not affect the throughput performance appreciably. Maximum throughput obtained for the different handover parameters is shown in Table 4.1

Table 4.1 Parameter values to obtain maximum throughput in ten MS network

PARAMETER	OPTIMUM VALUE
Lgd factor	1.2
Frame duration	8 ms
Scan iteration	7

4.4 Analysis of PDR with various handover parameters

This section consists of the analysis of PDR with variations in different handover parameters such as Lgd factor, frame duration, scan iteration and scan duration. The observations and inferences obtained from the analysis are also mentioned in this section.

4.4.1 Lgd factor vs. PDR

The plot of Lgd factor against PDR is as shown in Figure 4.5. The variation in PDR is analyzed for different values of Lgd factor ranging from 1.1 to 1.4 and the plot is found to be varying subsuming a peak point. A maximum PDR value of 96.9% is obtained at an Lgd factor of 1.2. Hence it is clear that the variation in Lgd factor affects the PDR much.

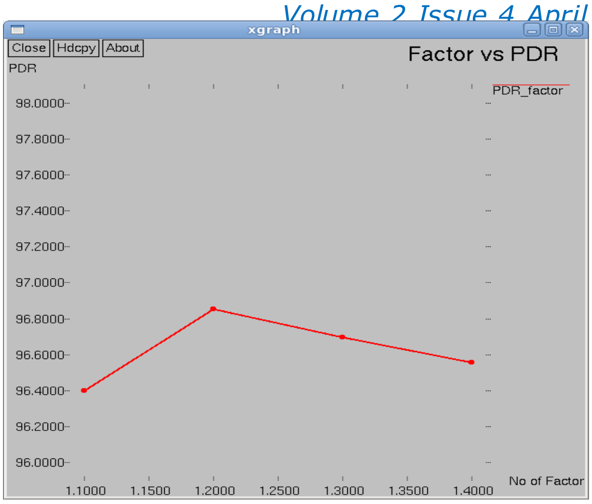


Figure 4.5 Lgd factor vs. PDR

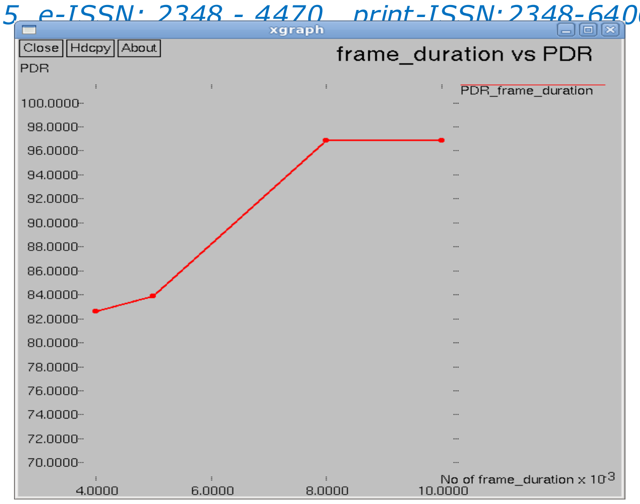


Figure 4.6 Frame duration vs. PDR

4.4.2 Frame duration vs. PDR

The plot of frame duration against PDR is as shown in Figure 4.6. The variation in PDR is analyzed for different values of frame duration ranging from 4ms to 10ms and the plot is found to be increasing first and then becomes constant. A maximum PDR value of 97% is obtained at frame duration of 8ms. Hence it is clear that the variation in frame duration significantly affects the PDR.

4.4.3 Scan iteration vs. PDR

The plot of scan iteration against PDR is as shown in Figure 4.7. The variation in PDR is analyzed for different values of scan iteration ranging from 1 to 10 and the plot is found to be varying. A maximum PDR value of 95% is obtained at a scan iteration of 7. Hence it is clear that the variation in scan iteration also significantly affects the PDR.

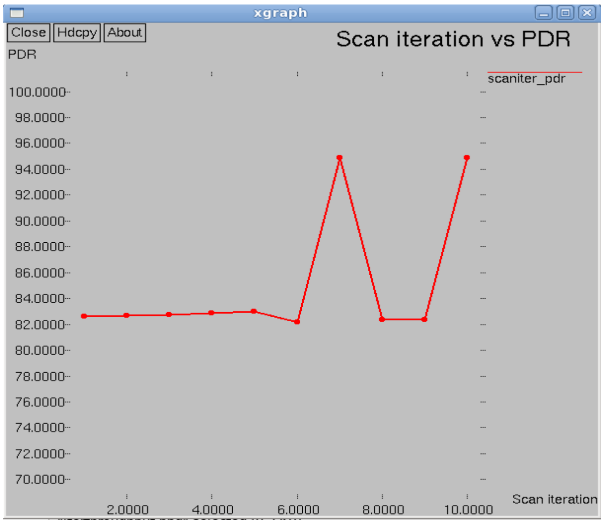


Figure 4.7 Scan iteration vs. PDR

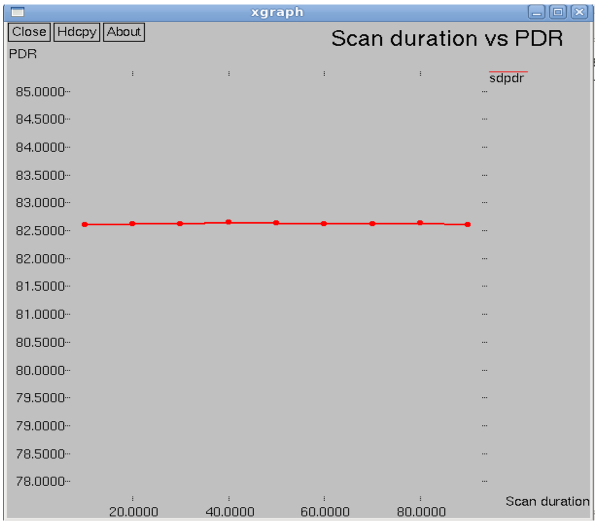


Figure 4.8 Scan duration vs. PDR

4.4.4 Scan duration vs. PDR

The plot of scan duration against PDR is as shown in Figure 4.8. The variation in PDR is analyzed for different values of scan duration ranging from 10ms to 80ms and the plot is found to be constant. A constant PDR value of 82.6% is obtained. Since the graph is a straight line, it is clearly seen that the variation in scan duration does not affect the PDR much.

.

4.4.5 Observations and results

Analyzing the different plots of PDR with different handover parameters, it can be inferred that Lgd factor, frame duration and scan iteration seriously affects the PDR, whereas scan duration does not significantly affects the PDR much. Maximum PDR obtained for the different handover parameters is shown in Table 4.2.

Table 4.2 Parameter values to obtain maximum PDR in ten MS network

PARAMETER	OPTIMUM VALUE
Lgd factor	1.2
Frame duration	8 ms
Scan iteration	7

4.5. Analysis of delay with various handover parameters

This section consists of the analysis of delay with variations in different handover parameters such as Lgd factor, frame duration, scan iteration and scan duration. The observations and inferences obtained from the analysis are also mentioned in this section.

4.5.1. Lgd factor vs. Delay

The plot of Lgd factor against delay is as shown in Figure 4.9. The variation in delay is analyzed for different values of Lgd factor ranging from 1.1 to 1.4 and the plot is found to be a varying. Since the plot is fluctuating, it is clearly seen that the variations in Lgd factor significantly affects the delay. Minimum delay of 27.4 ms is obtained at an Lgd factor of 1.4.

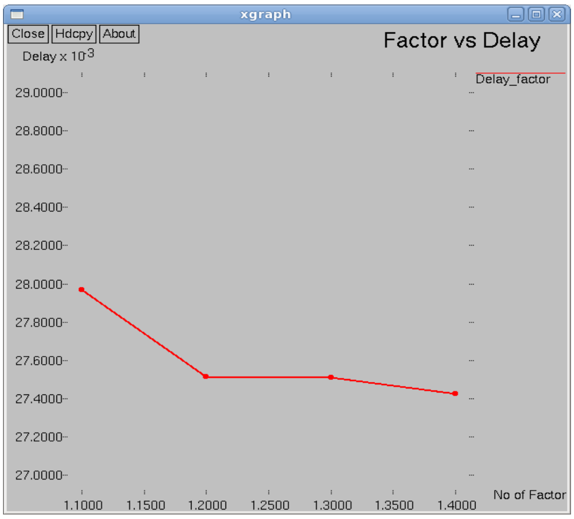


Figure 4.9 Lgd factor vs. Delay

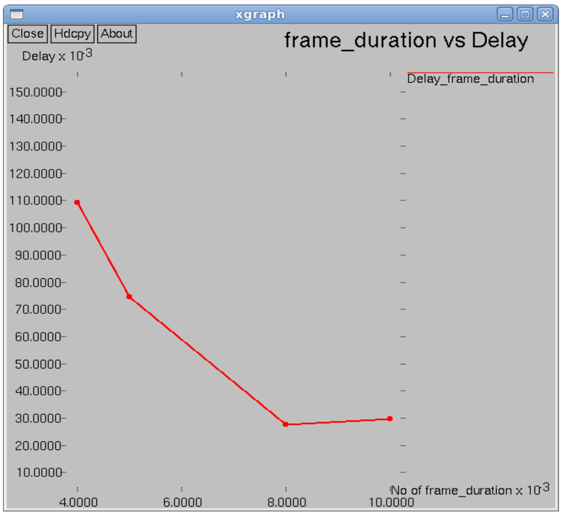


Figure 4.10 Frame duration vs. Delay

.

4.5.2 Frame duration vs. Delay

The plot of frame duration against delay is as shown in Figure 4.10. The variation in delay is analyzed for different values of frame duration ranging from 4ms to 10ms and the plot is found to be varying. Hence it is clearly seen that the variations in frame duration significantly affects the delay and lower values of delay is obtained for higher frame duration. Minimum delay of 30 ms is obtained at frame duration of 8ms.

4.5.3 Scan iteration vs. Delay

The plot of scan iteration against delay is as shown in Figure 4.11. The variation in Delay is analyzed for different values of scan iteration ranging from 1 to 10 and the plot is found to be a varying. There are many fluctuations in the plot and hence it is clearly seen that the variations in scan iteration significantly affects the delay. Minimum delay of 110 ms is obtained at a scan iteration of 1.

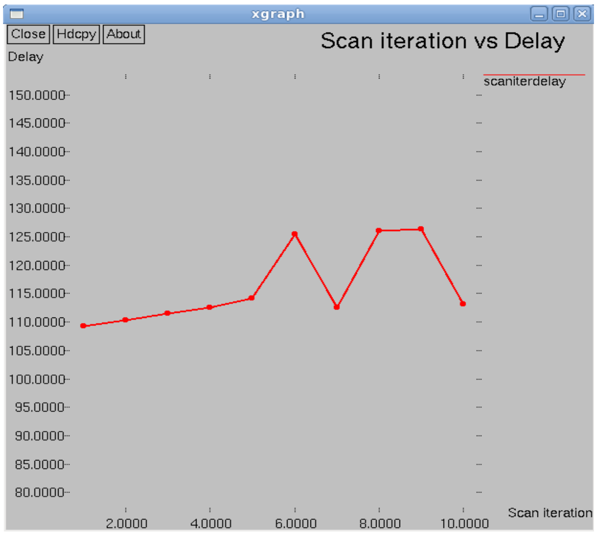


Figure 4.11 Scan iteration vs. Delay

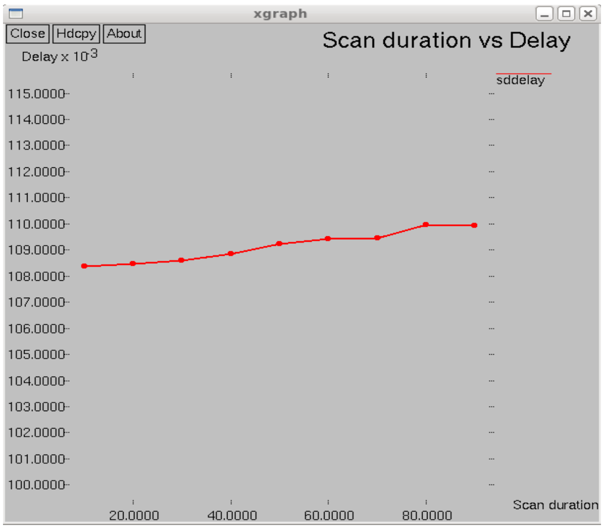


Figure 4.12 Scan duration vs. Delay

4.5.4 Scan duration vs. Delay

The plot of scan duration against delay is as shown in Figure 4.12. The variation in delay is analyzed for different values of scan duration ranging from 10 ms to 80 ms and the plot is found to be somewhat varying. From the plot it is clear that the variation in scan duration affects the delay. Minimum delay of 108.5 ms is obtained at scan duration of 10ms.

4.5.5 Observations and results

Analyzing the different plots of delay with different handover parameters, it can be inferred that Lgd factor, frame duration, scan iteration and scan duration seriously affects delay since there are fluctuations in the plots. Optimum values obtained for the different handover parameters to achieve minimum delay are shown in Table 4.3.

Table 4.3 Parameter values to obtain minimum delay in ten MS network

PARAMETER	OPTIMUM VALUE
Lgd factor	1.4
Frame duration	8 ms
Scan iteration	1
Scan duration	10 ms

4.6. Analysis of handoff delay with various handover parameters

Handoff delay is the latency incurred in the network during the handover process from one base station to the another base station.This section consists of the analysis of handoff delay with variations in different handover parameters such as Lgd factor, frame duration, scan iteration and scan duration. The observations and inferences obtained from the analysis are also mentioned in this section.

4.6.1 Lgd factor vs. Handoff delay

The plot of Lgd factor against handoff delay is as shown in Figure 4.13. The variation in handoff delay is analyzed for different values of Lgd factor ranging from 1.1 to 1.8.The Lgd factor vs. delay plot shown in figure is highly fluctuating due to network traffic. Here a very low delay value of 28 ms is obtained at an Lgd factor of 1.1. Hence it is clear that Lgd factor materially affects the handoff delay.

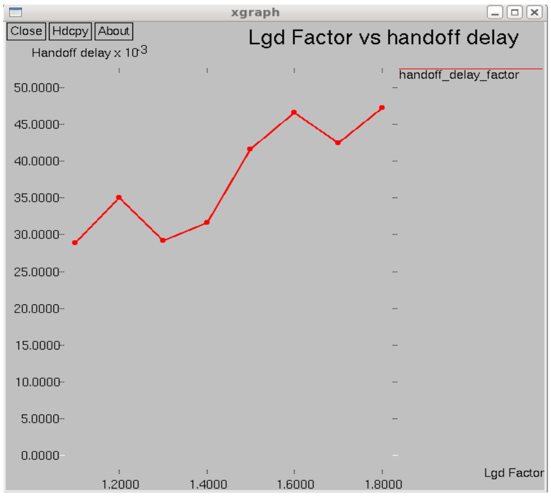


Figure 6.13 Lgd factor vs. Handoff delay

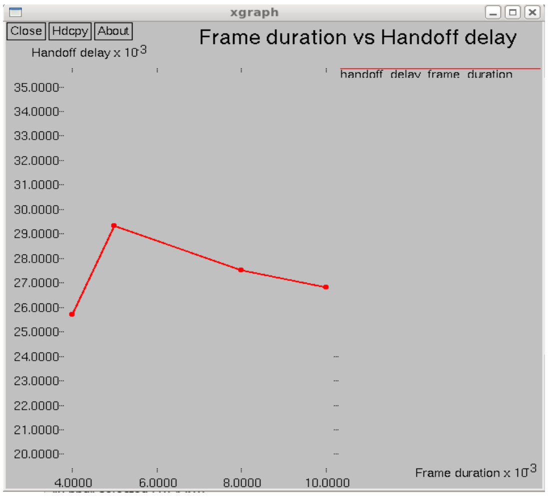


Figure 6.14 Frame duration vs. Handoff delay

4.6.2 Frame duration vs. Handoff delay

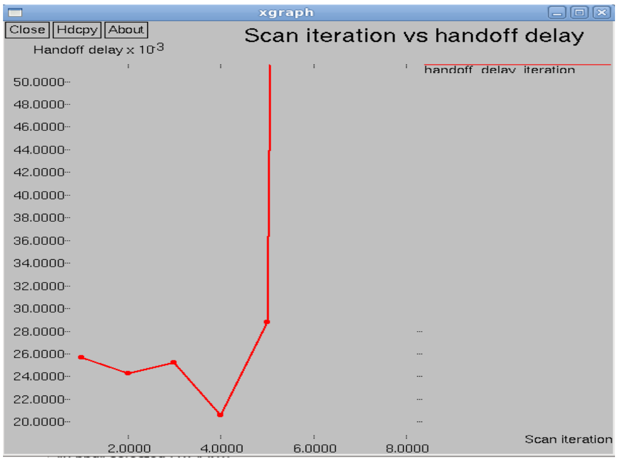
The plot of Lgd factor against handoff delay is as shown in Figure 4.14. The variation in handoff delay is analyzed for different values of frame duration ranging from 4ms to 10ms.From the grid a peak point can be seen. A minimum handoff delay of 25.5 ms is obtained at frame duration of 4.

4.6.3 Scan iteration vs. Handoff delay

The plot of Lgd factor against handoff delay is as shown in Figure 4.15. The variation in handoff delay is analyzed for different values of scan iteration ranging from 1 to 8 and the plot is found to be varying. A minimum handoff delay of 20 ms is obtained at a scan iteration of 4. Hence it is clear that scan iteration significantly affects the handoff delay.

4.6.4 Scan duration vs. Handoff delay

The plot of scan duration against handoff delay is as shown in Figure 4.16. The variation in handoff delay is analyzed for different values of scan duration ranging from 20ms to 80ms and the plot is found to be varying. A minimum handoff delay of 20 ms is obtained at scan duration of 30ms. Hence it is clear that scan duration significantly affects the handoff delay.



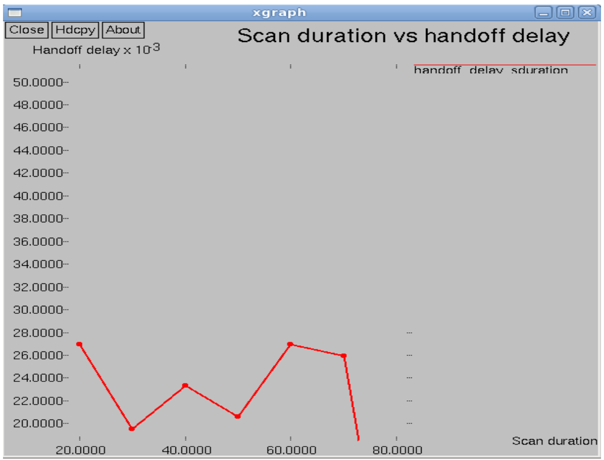


Figure 4.15 Scan iteration vs. Handoff delay ***Figure 6.16 Scan duration vs. Handoff delay***

4.6.5 Interleaving interval

It is the time of normal operation between scanning periods in the MS. The plot of interleaving interval against handoff delay is as shown in Figure 4.17. The variation in handoff delay is analyzed for different values of interleaving interval ranging from 20ms to 70ms and the plot is found to be constant and hence the variations in interleaving interval does not affect the handoff delay much. A constant handoff delay of 25 ms is obtained.

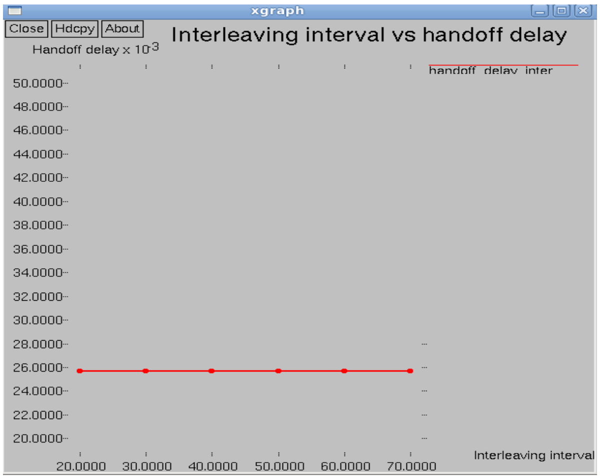


Figure 6.17 Interleaving interval vs. Handoff delay

4.6.6 Observations and results

Analyzing the plots of handoff delay with different handover parameters, it can be inferred that Lgd factor, frame duration, scan iteration and scan duration seriously affects the handoff delay since the plots are fluctuating. Interleaving interval does not affect the handoff delay much, since the plot is a constant. Minimum value of handoff delay is obtained for the following values which are shown in Table 4.4.

Table 4.4 Parameter values to obtain minimum handoff delay in ten MS network

PARAMETER	OPTIMUM VALUE
Lgd factor	1.1
Frame duration	4 ms
Scan iteration	4
Scan duration	30 ms

4.7 Influence of the velocity of MS

The impact of the different velocities of the MS on handoff delay is given in Figure 6.18. It is found that from the MS speed of 0 m/s to 5 m/s, the handoff delay is constant which is minimum. It can be clearly seen that for the MS speed of 10m/s to 25m/s, the handoff delay varied consistently by a few milliseconds. A minimum handoff delay is obtained at speed of about 22m/s. Therefore speed also remarkably affects the handoff delay.

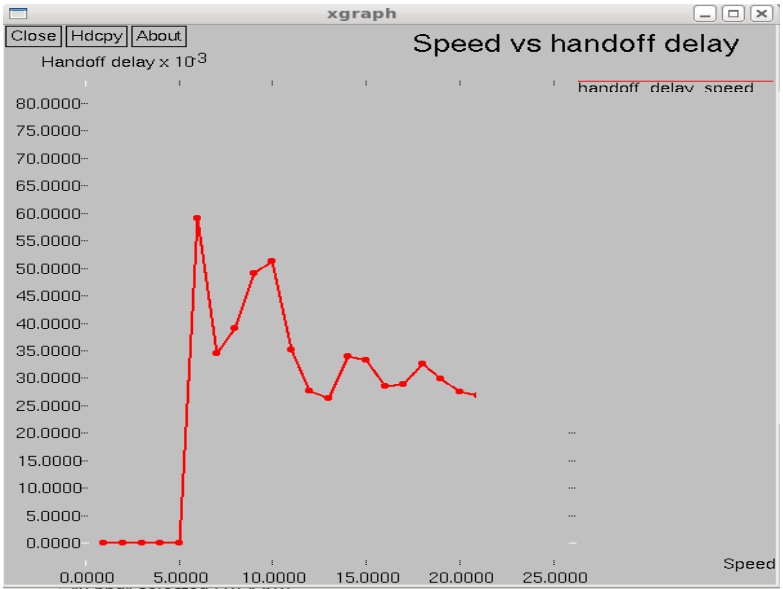


Figure 6.18 Speed vs. Handoff delay

V. CONCLUSION

In this paper, the effect of different parameters of WiMAX module on handover performance was analyzed based on the Quality of Service (QoS) metrics. The analysis was carried out in a simulation scenario consisting of two base stations and ten mobile stations. The simulation results show that the parameters like lgd factor, frame duration, scan iteration and scan duration affect the QoS metrics differently. The optimum values of these parameters giving say maximum throughput differ from that values which give minimum delay. Hence a trade off is required in choosing the parameter values which may depend on the application as well. Apart from the handover parameters the velocity of mobile station also influences the handover latency. It is clear from the analysis that appropriate parameter values help to achieve good network performance.

REFERENCES

[1] Seok-Yee Tang , Peter Muller , Hamid Sharif, *WiMAX Security and Quality of Service:* An End-to-End Perspective, Wiley Publishing, 2010.
[2] WiMAX Forum: Feb 2006. *"Mobile WiMAX – Part I: A Technical Overview and Performance Evaluation"* url:<http://www.wimaxforum.org/technology/downloads/Mobile_WiMAX_Part1_Overview_and_Performance.pdf
[3] Rambir Joon, Sandeep, Manveen Singh Chadha, *Analysis of WIMAX Handover*, International Journal of Soft Computing and Engineering (IJSCE), Volume-2, Issue-3, July 2012
[4] Jeffry G. Andrews, Arunabha Ghosh, Rias Muhamed, *Fundamentals of WIMAX*, Pearson Education, February 2007
[5] Mohd Sidek Pardi, Mohd Dani Baba, Muhammad Ibrahim, *Analysis of Handover Performance in Mobile WiMAX Networks* IEEE Control and System Graduate Research Colloquium (ICSGRC) June 2011 .
[6] Vikram Mehta, Dr. Neena Gupta, *Performance Analysis of QoS Parameters for WiMAX Networks*, International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 5, May 2012
[7] Pooja bhat, Bijender mehandia, *Analysis of Handover in WiMAX for Ubiquitous connectivity*, International Journal Of Computational Engineering Re- search , Volume-2, Issue-4, July 2012.

