WIMAX NETWORK PERFORMANCE ANALYSIS USING QUALNET NETWORK SIMULATOR

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ABSTRACT

WIMAX (World Wide Interoperability for Microwave Access) is used to provide a wireless solution in the metropolitan area networks. WIMAX network is capable of wide range coverage, high data rates, secured transmission and mobility supported at vehicular speed. Mobile WIMAX is one of the best concepts for system designed in fixed wireless access to provide good performance and cost effective solution. In this paper, performance of the WIMAX network is analyzed in terms of throughput, end to end delay, and jitter and packet reception. Simulation is carried out using QUALNET simulator. In this paper AODV, DYMO, ZRP routing protocols are applied to the created mobility scenario. DYMO shows best packet reception, highest throughput, low jitter and low end to end delay. We can say DYMO showed best performance out of AODV, ZRP. Later we have compared WIMAX scenario having mobility and having no mobility by applying DYMO Protocol which we have got under experimentation in terms of best performance. WIMAX scenario having no mobility shows the highest packet reception, high through put, low jitter and low end to end delay compared to the WIMAX scenario having mobility. Later we have applied fading condition to the mobility scenario and it is compared with the WIMAX mobility scenario under no fading condition. We have got the result of high throughput and high packet reception in WIMAX Mobility scenario under no fading condition. To improve the Packet Reception in WIMAX mobility scenario under fading condition, we will going to Apply ARQ. As a result we have got the improved packet reception after applying ARQ to the WIMAX mobility Scenario under fading condition. WIMAX Scenario having Mobility Under fading and WIMAX Scenario having no Mobility under fading is compared. We have got high throughput and high packet reception in WIMAX Scenario having Mobility Under fading condition.

Keywords : *WIMAX, AODV, HRQ, Tangbility*

I. Introduction

802.16 is designed to provide a cost effective last mile broadband access. WIMAX is the newest example of broadband wireless networks that has been used lately to provide multimedia applications over large areas, but it is still in its fancy and requires more research on evaluating its performance while processing multimedia and other application. Performance is related to quality of service and it is defined as the ability of the network to provide different services for different users with high performance level. Quality of Service includes Bandwidth, Latency (Delay), Throughput, Jitter. Delay is time taken by packets to reach from source to destination. Jitter is defined as variation of delay. Packets from different destination will reach to their destination with different delays. A packet delay

varies with position in the ques of the routers along the path between source and destination. Throughput is defined as measure of number of packets successfully delivered in a network. For high quality of service, network should show low jitter, low delay and high throughput and high packet reception at destination. Routing is the process of selecting a path for traffic. It is necessary to select optimized path in a network. It will going to play major role in studying the performance of wireless networks. When coming to protocol no protocols perform well in all kind of scenario. The Rayleigh fading model is normally viewed as a suitable approach to take when analyzing and prediction radio wave propagation performance for areas such as cellular communication in a well built up urban environment where there are many reflections from buildings. Rayleigh fading model is particularly useful in scenarios where the signal may be considered to be scattered between the transmission and receiver. Automatic Repeat request is an error control method for data transmission that uses acknowledgement. In this paper we have applied AODV, ZRP, and DYMO for the WIMAX network to get the best performance of WIMAX. Later we will going to give mobility to the WIMAX scenario and analyzed the statistics by comparing WIMAX Scenario having mobility and WIMAX Scenario having no mobility. To represent the movement of a mobile node, we use mobility models that indicate how mobile station's position and its velocity change over time. It will going to play major role in studying the performance of wireless networks. We use random waypoint mobility in this paper.

II. LITERATURE SURVEY

WiMAX Network performance for CBR traffic in three different Mobility models and four different Energy Models have been analyzed [1]. This [2] paper analyses Bit Error Rate for WIMAX based COFDM system with BPSK under various channel conditions like AWGN, Rayleigh, Rician and Nakagami. Further, Rayleigh and Rician channels are investigated in detail. It has been observed that performance of Nakagami fading channel is better than other fading channels.

The book [3] brings to the field a comprehensive study on up-to-date BWA standardization, including 3G networks and WiMAX. It also provides an updated, detailed, and thorough analysis of WiMAX architectures, security, development scenarios, and business issues. A variety of case studies are also addressed. Very special attention is given to the technology contemporary to WiMAX, the WiBro. This technology is being developed by the Korean telecom industry, and it is expected that WiMAX and WiBro will be compatible. Mobile WiMAX [5] is based on orthogonal frequency division multiplexing/ orthogonal frequency division multiplexing Access (OFDM/OFDMA) technology. It supports Adaptive Modulation and Coding in both downlink and uplink with variable packet size. This paper presents a new form of Adaptive Modulation (AM), which has the ability to improve the data rate of Mobile WiMAX OFDMA system especially at low SNR values, this new form of AM will combine together with the simplest Peak to Average Power ratio (PAPR) reduction technique, which is the clipping to produce a novel algorithm called Modulation adaptation and Clipping algorithm (MC) has the ability to improve the performance of Mobile WiMAX system through reducing the PAPR, improving the SER performance, and increasing the data rate.

III. OVERVIEW OF ROUTING PROTOCOL

The process of selecting a path to send and receive the data from origin to terminal node is called routing. The Ad hoc on demand distance vector (AODV), Source tree adaptive routing protocol (STAR) routing as well as Zone routing

Protocol (ZRP) protocols have been explained in this section.

A. Adhoc On Demand Distance Vector (AODV)

This is a complete on demand approach acquisition algorithm and uses destination sequence numbers to recognize the current paths. All routing packets must have sequence numbers. This protocol is contains four messages. Route Request (RREQ) and Route Reply (RREP) messages are used for route discovery. Route Error (RERR) messages and HELLO messages are used for route maintenance. AODV takes minimum delay for connection and increases speed and accuracy.

B. Zone Routing Protocol (ZRP)

ZRP combines the best features of both Table driven and on-demand routing protocol. The Zone Routing Protocol (ZRP) divides the network into zones. A zone of a node has all the nodes lying within a certain zone radius which is defined in hops. ZRP consists of two sub-protocols [3], a proactive routing i.e., the intra zone routing protocol (IARP) is used inside the zone; while the reactive routing protocol i.e., inter-zone routing protocol (IERP) is used outside the zone.

C. Dynamic MANET On Demand (DYMO)

DYMO can work as both a pro-active and as a reactive routing protocol, i.e. routes can be discovered just when they are needed. In any way, to discover new routes the following two steps take place: A special "Route Request" (RREQ) messages is broadcast through the MANET. Each RREQ keeps an ordered list of all nodes it passed through, so every host receiving an RREQ message can immediately record a route back to the origin of this message. When an RREQ message arrives at its destination, a "Routing Reply" (RREP) message will immediately be passed back to the origin, indicating that a route to the destination was found. On its way back to the source, an RREP message can simply back trace the way the RREQ message took and simultaneously allow all hosts it passes to record a complementary route back to where it came from. So as soon as the RREP message reaches its destination, a two-way route was successfully recorded by all intermediate hosts, and exchange of data packets can commence.

IV. SIMULATION SETUP

We have taken QUALNET network simulator to simulate the network why because it supports real time speed. And it has got more scalability, can model thousands of nodes. And it has got portability. QUALNET Network simulator is user friendly. It's a drag and drop operation provider for usage. GUI support is excellent in QUALNET. GUI is an interface through which user interacts with electronic devices. This interface uses icons, menus, and other visual display information and related user controls. Fast simulation is only supported by QUALNET. We created WiMAX scenario using Qualnet 7.1 Network Simulator. All scenarios share the same CBR applications parameters. In the scenario of figure 1 ,its having 4 cells, each cell consists of 1 base station and 10 subscriber station. Totally scenario consists of 40 subscriber station and 4 Base stations. Node 11, Node 22, Node 33, Node 44 are the Base stations.2.4, 2.5, 2.6, 2.7 GHz frequency band and CBR traffic have been used. In fig 2 we can see, have given mobility to the WIMAX scenario. Minimum speed of 0 m/s and maximum speed of 20 m/s and having pause time 30 sec. We use random waypoint mobility in this paper. We won't give mobility to 4 Base stations. Simulation parameter is given in the Table I. We will going to apply Raleigh fading to the WIMAX scenario and performance under the fading condition is analyzed. To improve

packet reception in the fading condition we will going to apply ARQ error control method and performance is analyzed. We can see the analyzed results in the results and discussion section.

Table I. Simulation Parameter

Tabel	Parameter
Terrain size	1600X1600 m2
Number of Packets	100
Number nodes	44
Antenna	Omni-directional
Radio Type	802.16
Routing Protocol	AODV, DYMO, ZRP
MAC Protocol	IEEE 802.16
Simulation Time	300
Traffic Type	CBR
Minimum Speed	0 m/s
Maximum Speed	20m/s
Pause Time	30 sec

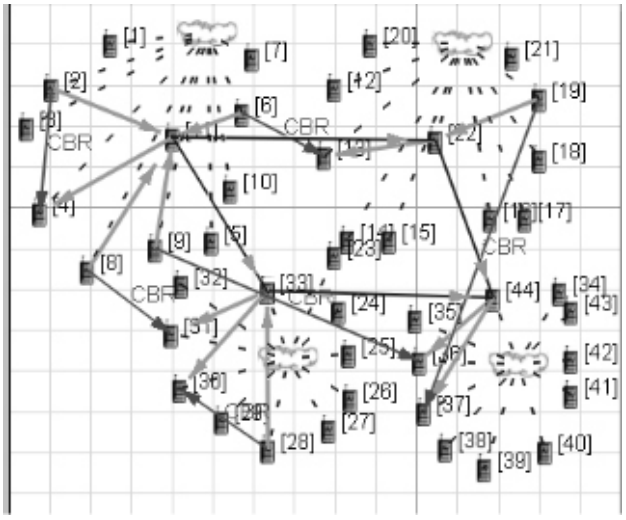

Fig 1. WIMAX scenario having no Mobility

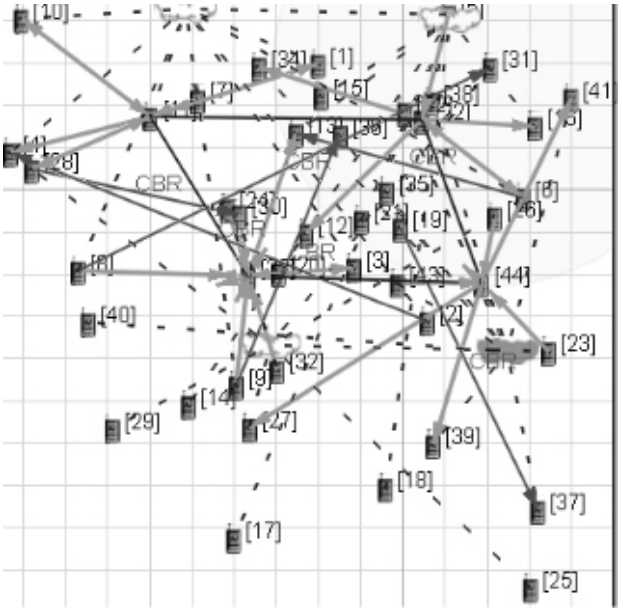

Fig 2. WIMAX scenario having Mobility

V. RESULTS AND DISCUSSION

A. Throughput

Throughput refers to the rate of information arriving at or passing a particular point in the network. It is the total amount of data at that point divided by the time it takes to get the last packet. It is measured in bits per second (bit/s or bps).

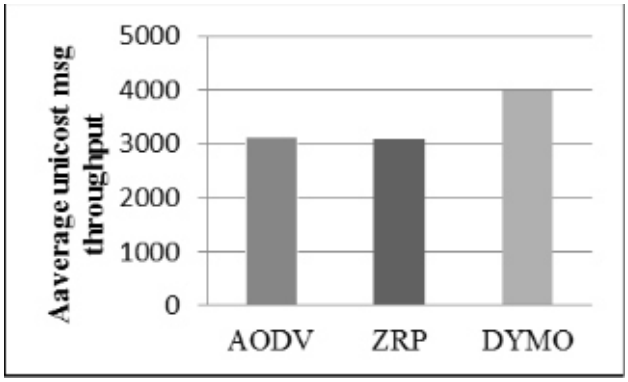

Fig 3. Throughput

Througput of the DYMO shows the highest.so we can say DYMO gives the best performance over ZRP and AODV protocol.

B. End to End Delay

End-to-end delay indicates how long or how

much time units it takes for a packet to travel from the source to the destination. “It is the average data delay an application experiences while transmitting data.

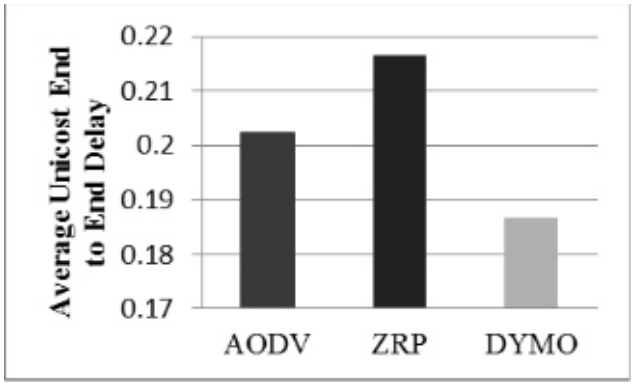

Fig 4. End to End Delay

End to End delay of DYMO shows less compare to AODV and ZRP . so we can say DYMO gives the best performance over ZRP and AODV protocol.

C. Averaagae Unicost Jitter

Jitter can seriously affect the quality of services. “It is the variation in delay of different data packets that reach the destination. Jitter should be minimum to get the best performance from the network.

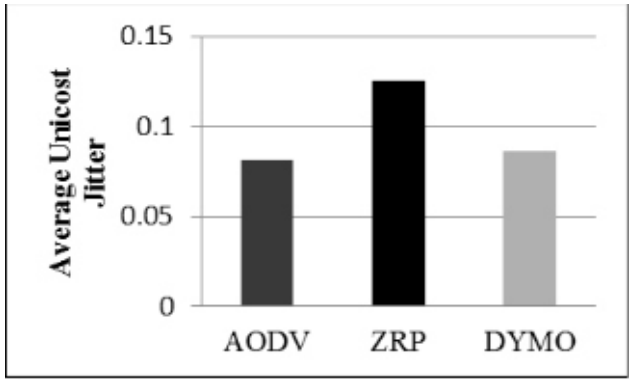

Fig 5 Average Jitter

JItter of DYMO shows less compare to AODV and ZRP . so we can say DYMO gives the best performance over ZRP and AODV protocol.

D. Packet Reception

It shows how many packets succesfully received in destination.

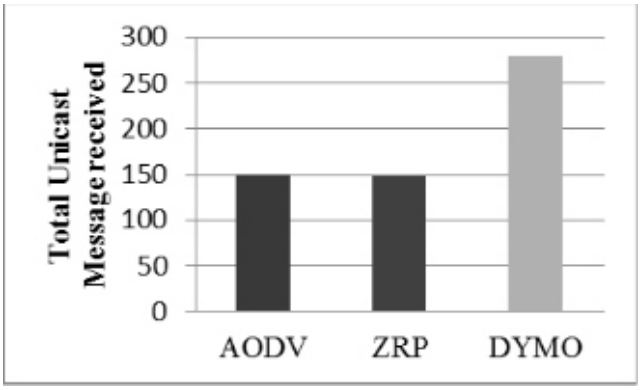

Fig 6 Average Message Received

DYMO high packet packet reception compare to AODV and ZRP . so we can say DYMO gives the best performance over ZRP and AODV protocol.

E. Comparision of WIMAX Scenario having mobility and not having mobility in terms of Throughput, End to End Delay, Jitter, and Packet Reception respectively

Below graphs are plotted according to the metric values taken in QUALNET for the Scenarios shown in fig 1 and fig 2.

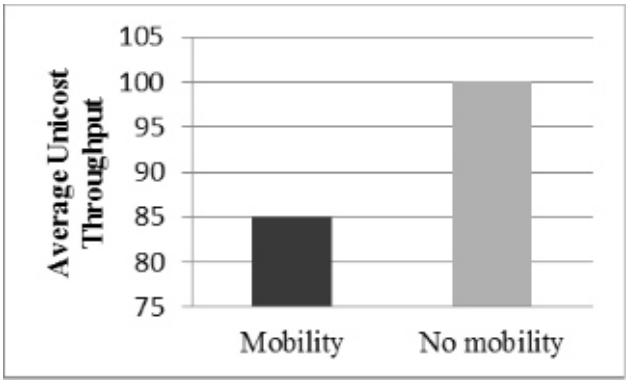

Fig 7 Throughput

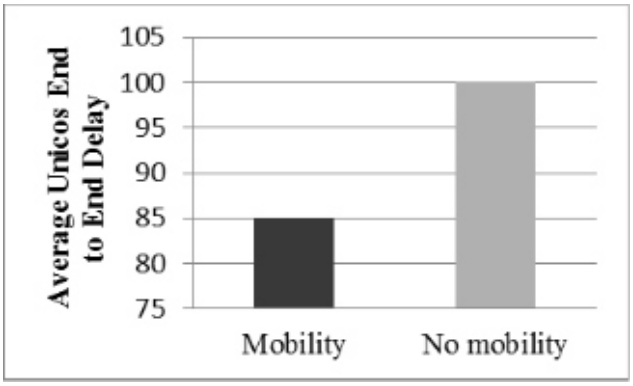

Fig 8 End to End Delay

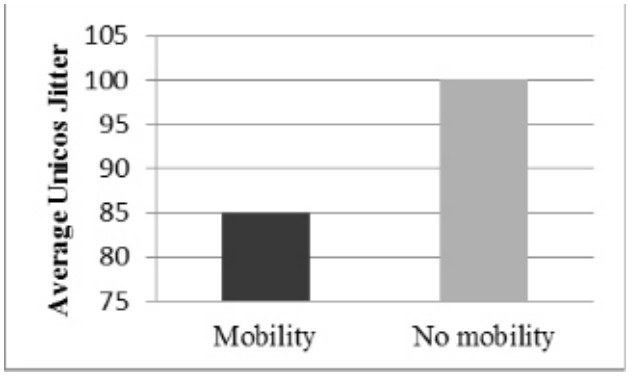

Fig 9 Jitter

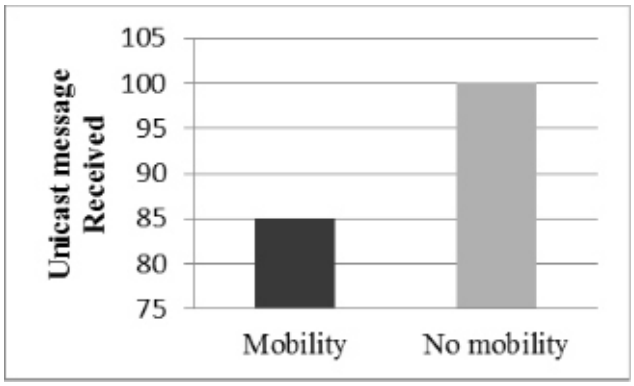

Fig 10 Packet Reception

WIMAX Scenario having no mobiity gives high throughput, high packet reception,low jitter and low end to end dealy. This shows WIMAX Scenario having no mobility gives best performance over WIMAX Scenario having mobility in terms of Throughput.

F. Comparision of WIMAX mobility Scenario and WIMAX mobility with fading model in terms of Throughput, End to End Delay, Jitter, and Packet Reception respectively

Below graphs are plotted according to the metric values taken in QUALNET for the Scenarios shown in fig 1 and fig 2.

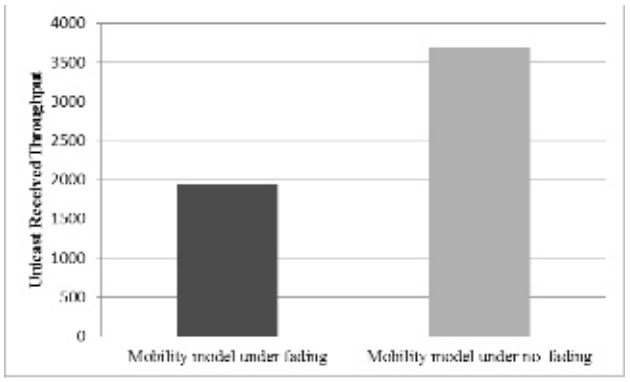

Fig 11. Throughput

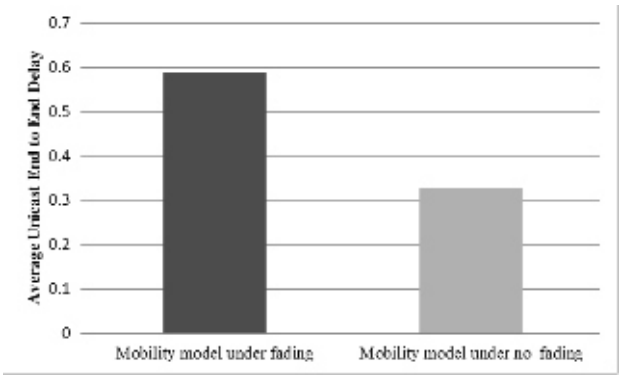

Fig 12. End to End Delay

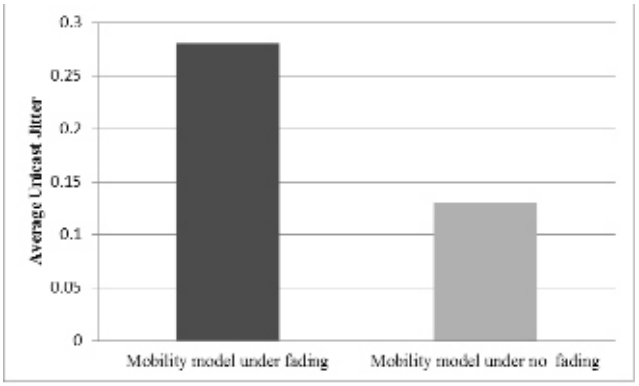

Fig 13. Jitter

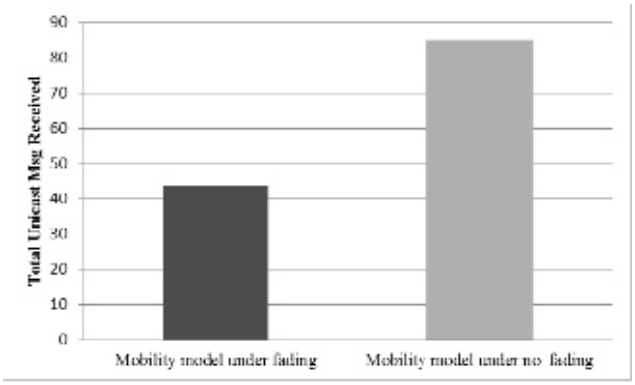

Fig 14. Total Packet Received

From the above graphs we can say that WIMAX mobility Scenario showing high throughput ,high packet reception , low jitter and low end to end delay over WIMAX mobility with fading model.

G. Comparision of WIMAX mobility Scenario under fading condition and WIMAX mobility Scenario under fading and ARQ condition in terms of Throughput, End to End Delay, Jitter, and Packet Reception respectively

Below graphs are plotted according to the metric values taken in QUALNET for the Scenarios shown in fig 1 and fig 2. To improve the packet reception under fading condition, we will going to apply ARQ for scenario under fading

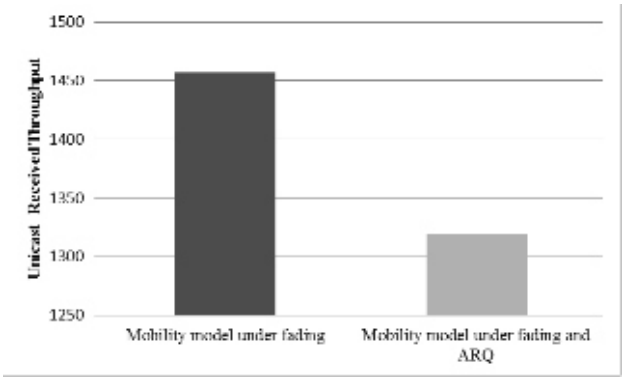

Fig 15. Throughput

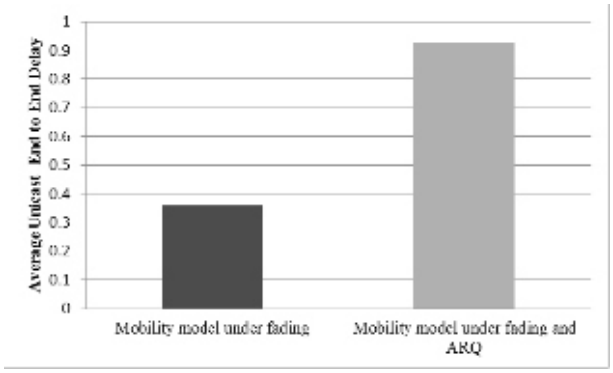

Fig 16. End to End Delay

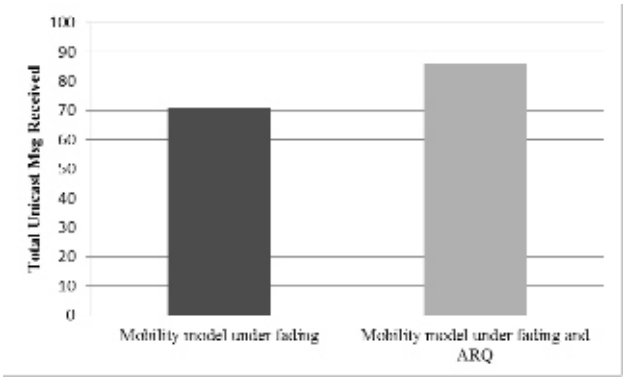

Fig 17. Total Packet Reception

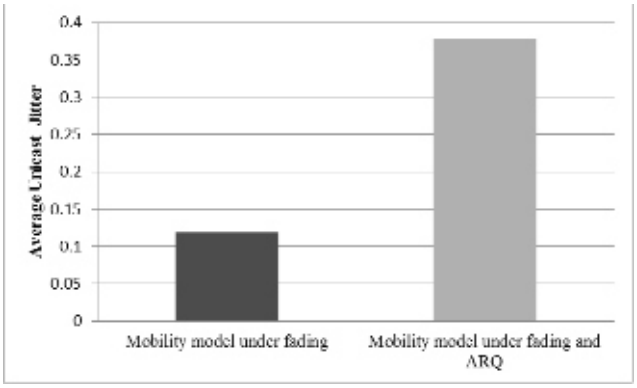

Fig 18. Jitter

From the above graphs its clearly shows that we have got improved packet rception after applying ARQ to the WIMAX scenario under fading conditon.we have got less throughput after applying ARQ. Througput is dependent on Scenario and simulation time. For this scenario we have got less throughput does not mean that for all type of scenrio we will going to get less throughput.

H. Comparision of WIMAX Scenario having Mobility Under fading and WIMAX Scenario having no Mobility under fading in terms of Throughput, End to End Delay, Jitter, and Packet Reception respectively.

Below graphs are plotted according to the metric values taken in QUALNET for the Scenarios shown in fig 1 and fig 2.

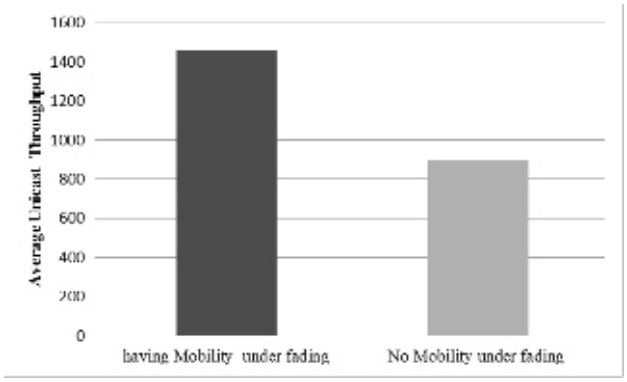

Fig 19. Throughput

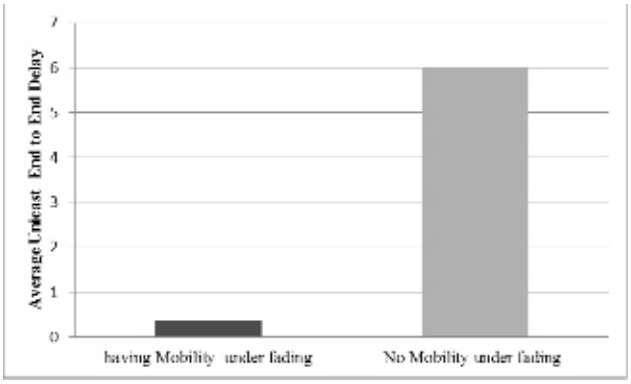

Fig 20. End to End Delay

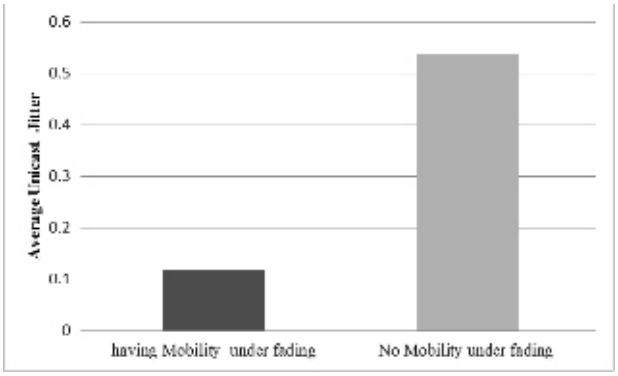

Fig 21. Jitter

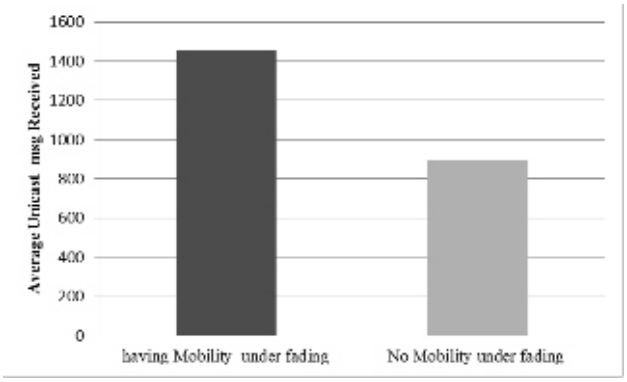

Fig 22. Total Packet Receiption

From the above graphs its clearly shows that WIMAX mobility Scenario under fading condition has got high throughput, high packet reception and low jitter, low end to end delay over WIMAX Scenario having no Mobility under fading.

VI. CONCLUSION

Result of performance evaluation in terms of througput, end to end delay, and jitter, show that DYMO gives the best performance over ZRP, AODV protocols. . WIMAX scenario having no mobility shows the highest packet reception, high through put, low jitter and low end to end delay compared to the WIMAX scenario having mobility. WIMAX scenario having no mobilitly gives the best performance .We have used Random waypoint mobility. WIMAX Scenario having mobility is compared with the scenario having mobility under fading condition, the model under no fading condition gives low jitter ,low end to end Delay and high throughput and high Packet reception. This shows mobility scenario under no fading conditon gives the best performance over WIMAX under fading condition Scenario. To improve packet reception under fading conditon we will going to apply ARQ error control method. We have compared WIMAX mobility Scenario under fading condition and WIMAX mobility Scenario under fading and ARQ condition , the model having mobility and under fading and under ARQ

shows low throughput and high packet reception and high jitter and high end to end delay over WIMAX scenario having mobility and under fading condition. By applying ARQ we have achieved better packet reception, we can see this in graph. Throughput is dependent on Scenario as well as simulation time. So we can see less throughput after applying ARQ but improved packet reception is achieved. We have compared WIMAX Scenario having Mobility Under fading and WIMAX Scenario having no Mobility under fading, the model WIMAX Scenario having Mobility Under fading gives high packet reception, high throughput, low jitter and end to end delay over WIMAX Scenario having no Mobility Under fading condition.

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