Performance Analysis of WiMAX in Mobile Ad-hoc Networks

Sajjan Virak
Research Scholar(ECE)
SBSSTC, Ferozepur

Amit Grover
Assistant Professor (ECE)
SBSSTC, Ferozepur

ABSTRACT
In this paper the performance of WiMAX is analyzed In the presence of MANET nodes. This effect is further analyzed by increasing number of cells and number of user. Further the effect of MANET nodes on WiMAX is checked by mining nodes using different mobility patterns (Random walk and Random way point). The performance has been analyzed in terms of Load, packet delay variation and packet end to end delay. The results show that the performance of WiMAX decreases as MANET nodes come into existence in the network.

Keywords
WiMAX, MANET, OPNET.

1. INTRODUCTION
WiMAX stands for Worldwide Interoperability for Microwave Access. WiMAX refers to broadband wireless networks that are based on the IEEE 802.16 standard, which ensures compatibility and interoperability between broadband wireless access equipment [1,2]. WiMAX, which will have a range of up to 31 miles, is primarily aimed at making broadband network access widely available without the expense of stringing wires (as in cable- access broadband) or the distance limitations of Digital Subscriber Line. A WIMAX system consists of a WiMAX tower, similar in concept to a cell-phone tower - a single WiMAX tower can provide coverage to a very large area as big as 3,000 square miles (8,000 square km). A WiMAX receiver - The receiver and antenna could be a small box or Personal Computer Memory card, or they could be built into a laptop the way WiFi access is today [3,4,13].

2. WIMAX STANDARDS
WiMAX utilized the IEEE 802.16 standards. IEEE 802.16 gives one indicate numerous points utilizing 10 to 66 GHz frequency go for Line of Sight [3,11,15]. In 802.16a standard the capacity to show one indicate point to many point in the frequency run from 2 to 11 GHz. 802.16c standard utilize frequency extend 10 to 66 GHz. 802.16d standard support mandatory and optional parts close by TDD and FDD technologies. It's utilizing data rate is 40 to70 Mbps. 802.16e was an alteration of 802.16d standard which is all the more fast [4, 5, 6].

3. FUNDAMENTAL WIMAX CONCEPTS
Base Station (BS) The BS is the node that logically connects wireless subscriber devices to operator networks [7,8,14]. The BS maintains communications with subscriber devices and governs access to the operator networks. Subscriber Station (SS) is a stationary WiMAX- capable radio system that communicates with a base station, although it may also connect to a relay station in multi-hop relay network operations. Mobile Station (MS) is an SS that is intended to be used while in motion at up to vehicular speeds. Compared with fixed (stationary) SSs, MSs typically are battery operated and therefore employ enhanced power management. Relay Station (RS) are SS configured to forward traffic to other RSs or SSs in a multi-hop Security Zone The RS may be in a fixed location (e.g., attached to a building) or mobile (e.g., placed in an automobile). The air interface between an RS and an SS is identical to the air interface between a BS and an SS [9,10,12].

4. EXPERIMENTAL SETUP
In this paper the performance of WiMAX is analyzed by moving nodes of MANET at different mobility patterns (Random walk and Random way point) and WiMAX nodes are moving by using random waypoint only. This effect is further analyzed by increasing no. of cells and no. of nodes. Firstly 5 cells are used which have 5 nodes in each cell then 6 cells are used and 10 nodes are used in each cell and then no: of cells are increased to 7 cells having 15 nodes in each cell. In each scenario maximum retransmission is 4. In each scenario the no. of nodes of MANET remains the same which is 5. In each scenario the nodes have application of voice and video both. For video SVC code is used. These scenarios are repeated by using maximum retransmission 2.

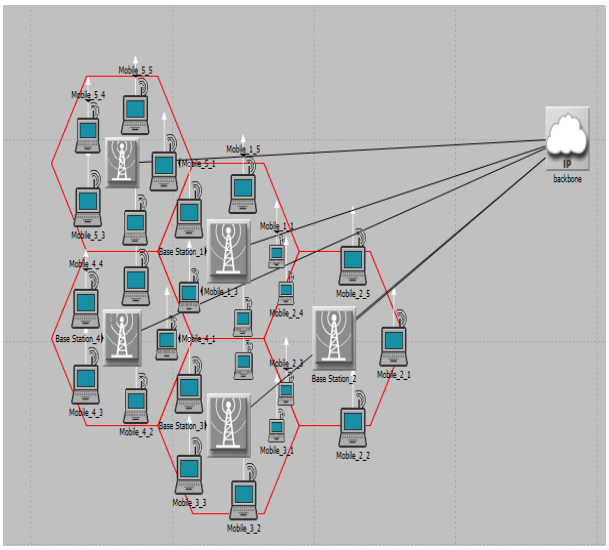

Fig 1: Cell 5

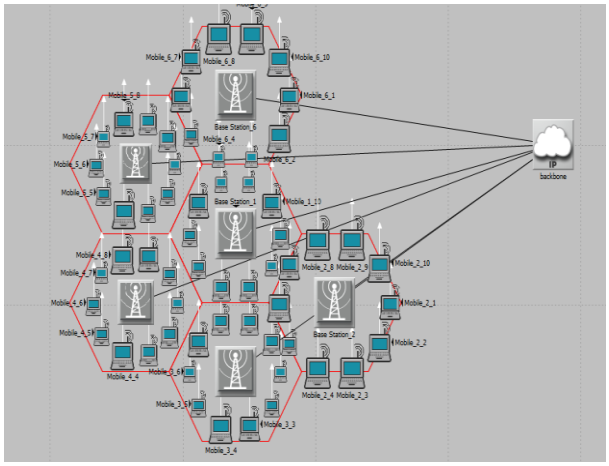

Fig 2: Cell 6

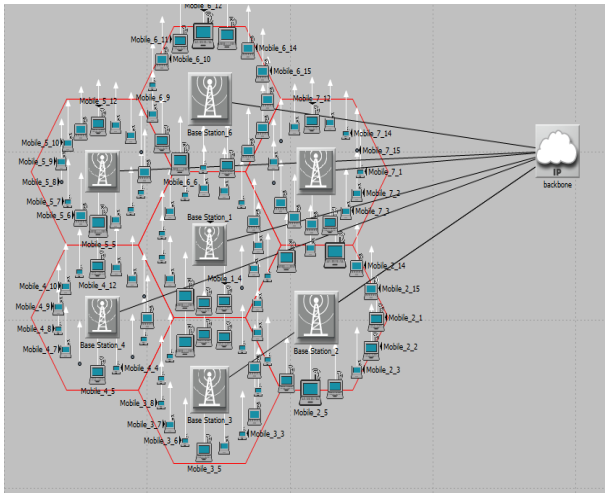

Fig 3: Cell 7

5. RESULTS AND DISCUSSIONS

In this research work the effect of MANET on WiMAX is analyzed in terms of Load, Packet delay variation, Packet end to end delay.

5.1 Load

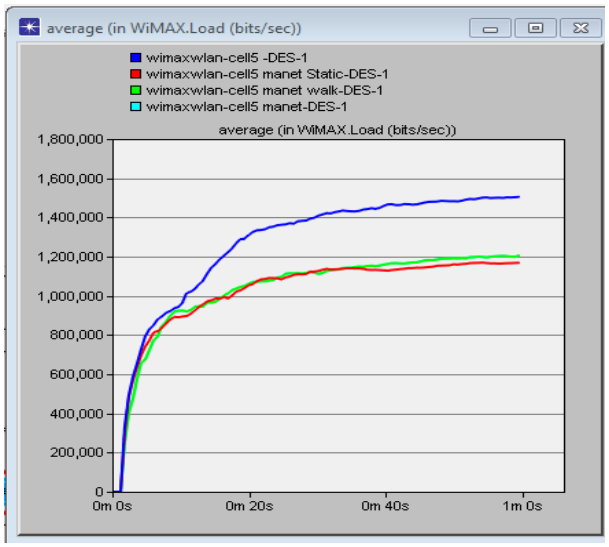

Fig 1: Load for cell 5

Fig 1 shows the result of Load for cell 5. Result shows that when there is no MANET node than Load is high which is 1500000 bits/sec and when MANET nodes come into existence then Load decreases to 1200000 bits/sec for every mobility patter.

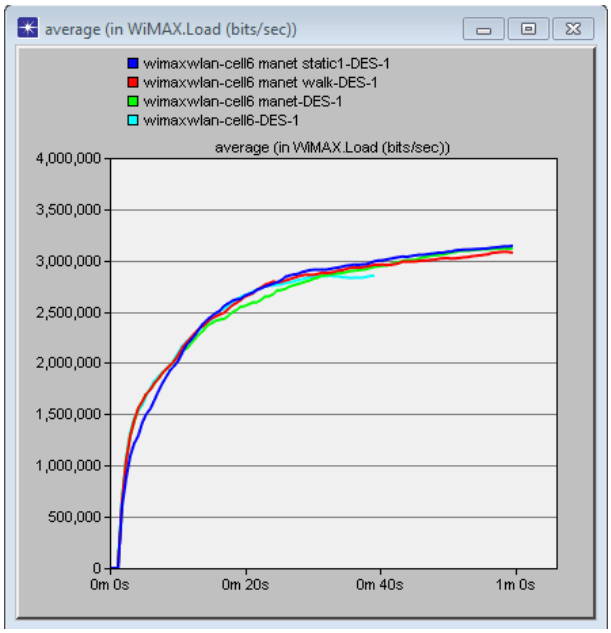

Fig 2: Load for cell 6

Fig 2 shows the result of Load for cell 6. Result shows that when there is no MANET node that Load is high which is 3200000 bits/sec and when MANET nodes come into existence then Load decreases. Further if nodes move with static mobility pattern and Random Way point and random walk then result is same which is 3100000 bits/sec .

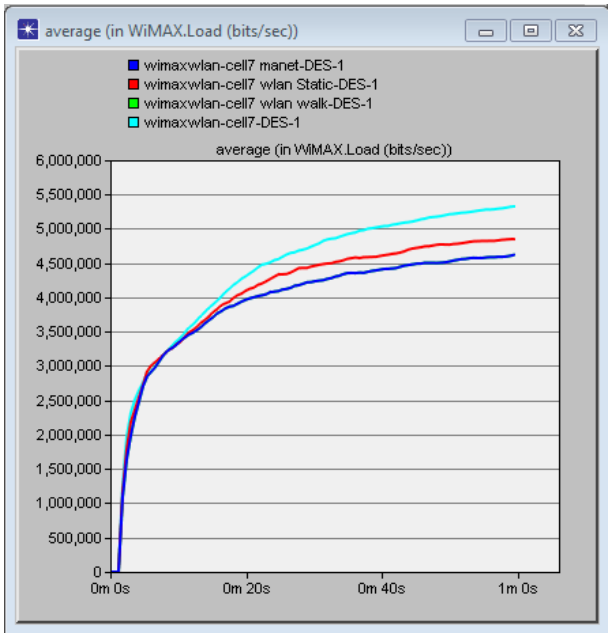

Fig 3: Load for cell 7

Fig 3 shows the result of Load for cell 7. Result shows that when there is no MANET node that Load is high which is 5300000 bits/sec and when MANET nodes come into existence then Load decreases. Further if nodes move with static mobility pattern then result is high which is 4900000

bits/sec and for random walk and Random Way point it same which is 4500000bits/sec.

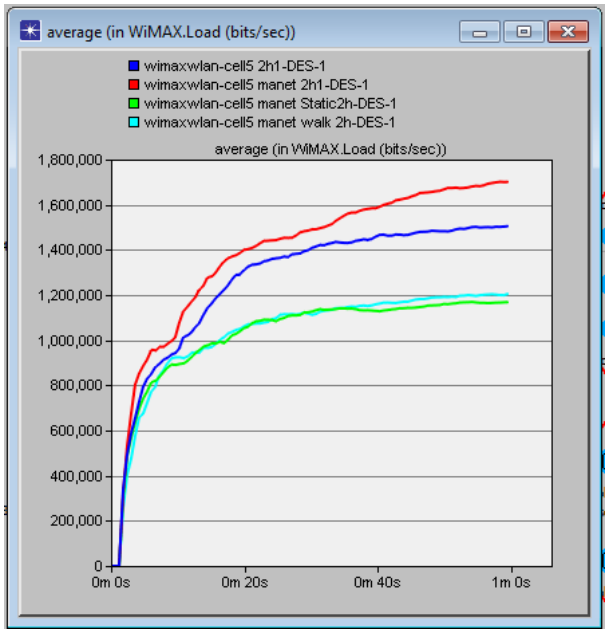

Fig 4: Load for cell 5 with maximum retransmission attempt 2

Fig 4 shows the result of Load for cell 5 with maximum retransmission attempt 2. Result shows that when there is no MANET node that Load is 1500000 bits/sec and when MANET nodes come into existence then Load decreases. Further if nodes move with static mobility pattern then result is 1700000 bits/sec for random walk bits/sec and for Random Way point it is 1200000bits/sec.

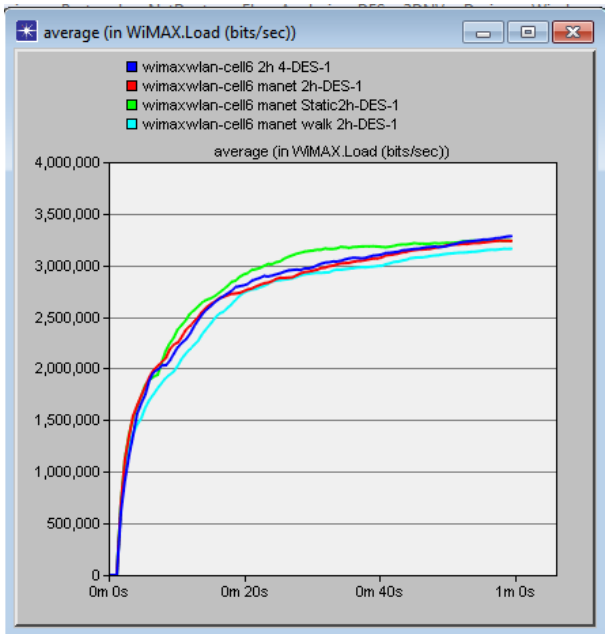

Fig 5: Load for cell 6 with maximum retransmission attempt 2

Fig 5 shows the result of Load for cell 6 with maximum retransmission attempt 2. Result shows that Load is same which is 3300000 bits/sec.

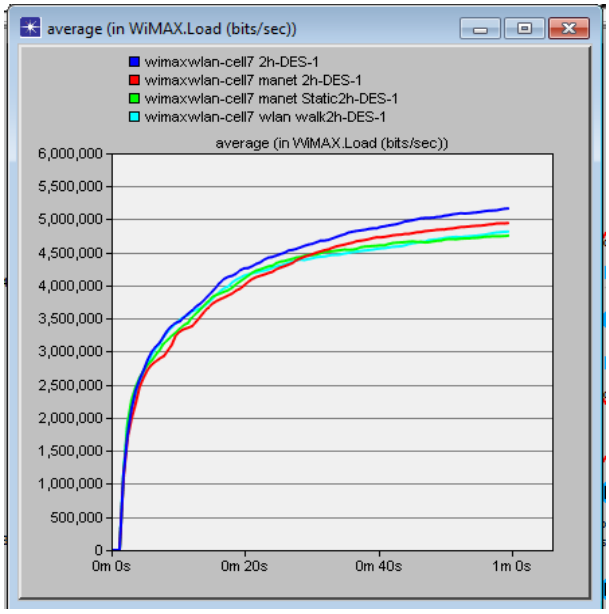

Fig 6: Load for cell 7 with maximum retransmission attempt 2

Fig 6 shows the result of Load for cell 7 maximum retransmission attempt 2. Result shows that when there is no MANET node that Load is high which is 5200000 bits/sec and when MANET nodes come into existence then Load decreases. Further if nodes move with random walk and Random Way point result is high which is 5500000 bits/sec and for static mobility pattern it is 4900000 bits/sec.

5.2 Packet delay variation

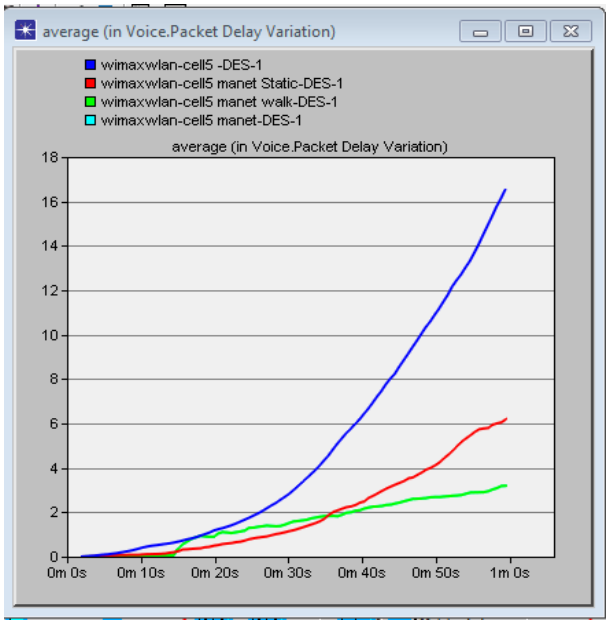

Fig 7: Packet delay variation for cell 5

Fig 7 shows the result of Packet delay variation for cell 5. Result shows that when there is no MANET node that Packet delay variation is more which is 15sec and when MANET nodes come into existence then Packet delay variation decreases. Further if nodes move with static mobility pattern then result is 6sec for random walk and Random Way point it is same which is 3 bits/sec.

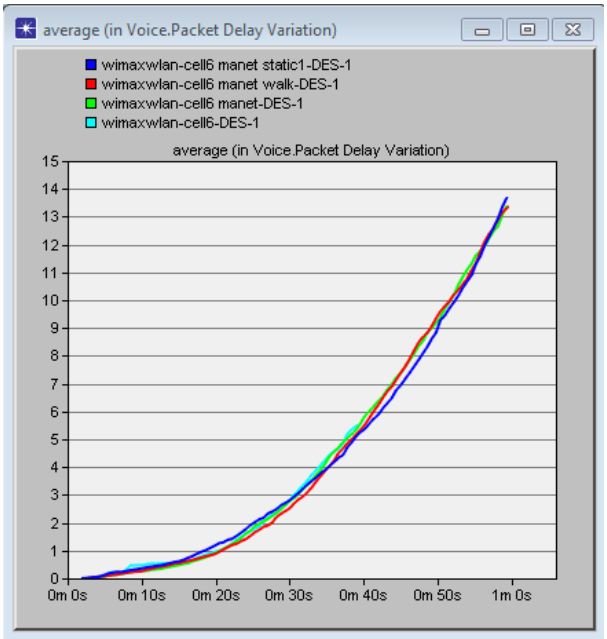

Fig 8: Packet delay variation for cell 6

Fig 8 shows the result of Packet delay variation for cell 6. Result shows that when there is no MANET node and when there is MANET nodes the that Packet delay variation is same which is 13.5sec

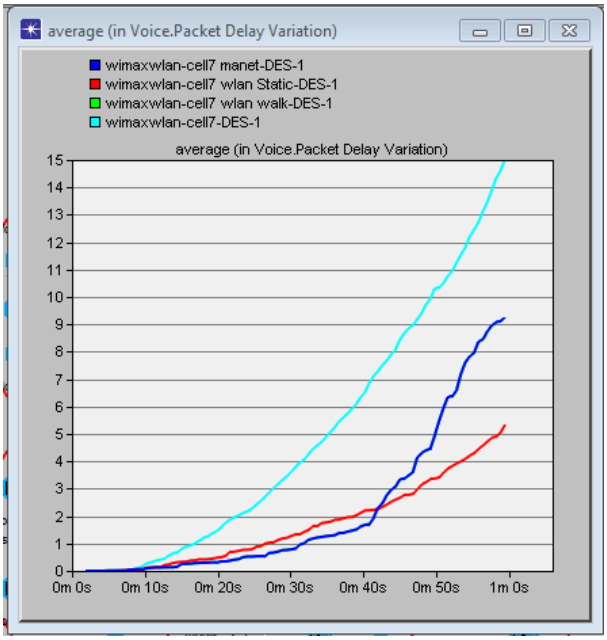

Fig 9: Packet delay variation for cell 7

Fig9 shows the result of Packet delay variation for cell 7. Result shows that when there is no MANET node that Packet delay variation is high which is 15sec and when MANET nodes come into existence than Packet delay variation decreases. Further if nodes move with static mobility pattern than result is 5sec for random walk and Random Way point it is same which is 9.

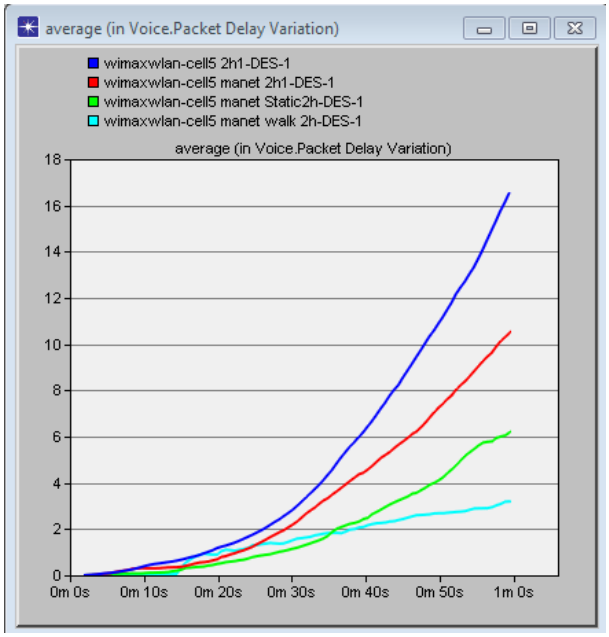

Fig 10: Packet delay variation for cell 5 for maximum retransmission attempt 2

Fig 10 shows the result of Packet delay variation for cell 5 for maximum retransmission attempt 2. Result shows that when there is no MANET node that Packet delay variation is more which is 17sec and when MANET nodes come into existence then Packet delay variation decreases. Further if nodes move with static mobility pattern it is 11sec and Random Way point it is 6sec and for random walk it is 3sec.

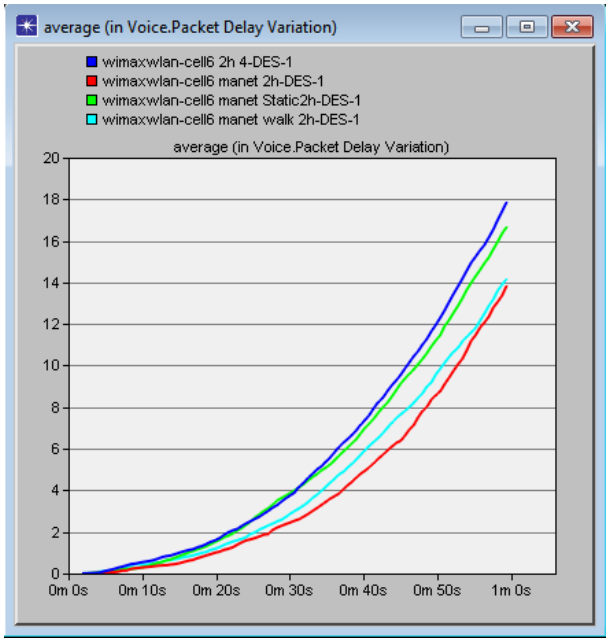

Fig 11: Packet delay variation for cell 6 for maximum retransmission attempt 2

Fig 11 shows the result of Packet delay variation for cell 6 for maximum retransmission attempt 2. Result shows that when there is no MANET node that Packet delay variation is more which is 18sec and when MANET nodes come into existence than Packet delay variation decreases. Further if nodes move with static mobility pattern then result is 17sec and for random walk and for Random Way point it is 14sec.

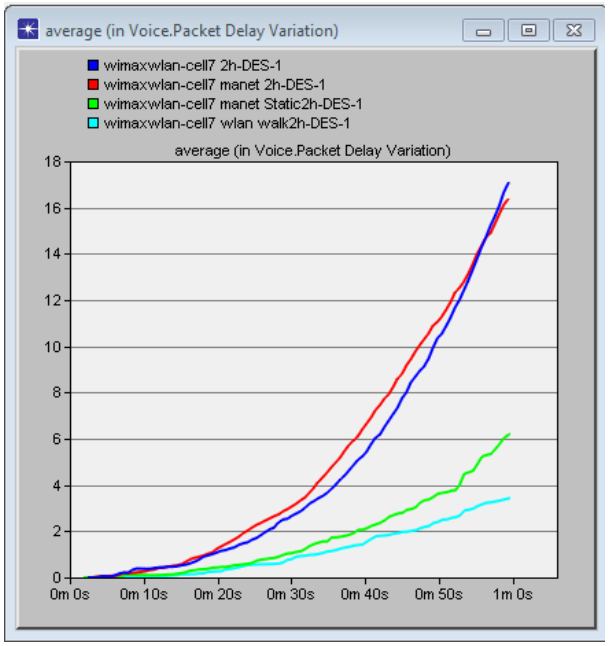

Fig 12: Packet delay variation for cell 7 for maximum retransmission attempt 2

Fig 12 shows the result of Packet delay variation for cell 7 maximum retransmission attempts 2. Result shows that when there is no MANET node that Packet delay variation is 17.5 sec and when MANET nodes come into existence then Packet delay variation decreases. Further if nodes move with static mobility pattern is 6sec and random walk it is 2 and Random Way point it is same which is 16sec

5.3 Packet end to end delay

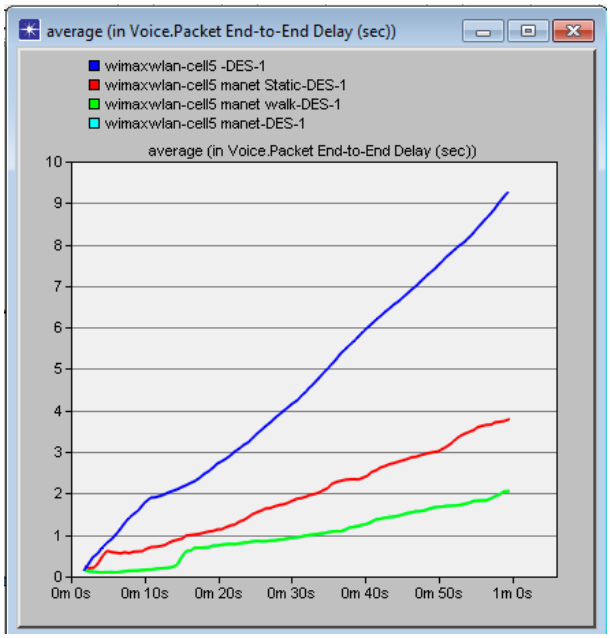

Fig 13: Packet end to end delay for cell 5

Fig 13 shows the result of Packet end to end delay for cell 5. Result shows that when there is no MANET node that Packet end to end delay is less which is 9sec and when MANET nodes come into existence than Packet end to end delay decreases. Further if nodes move with static mobility pattern than result is 4sec for random walk and for Random Way point it is same which is 2sec.

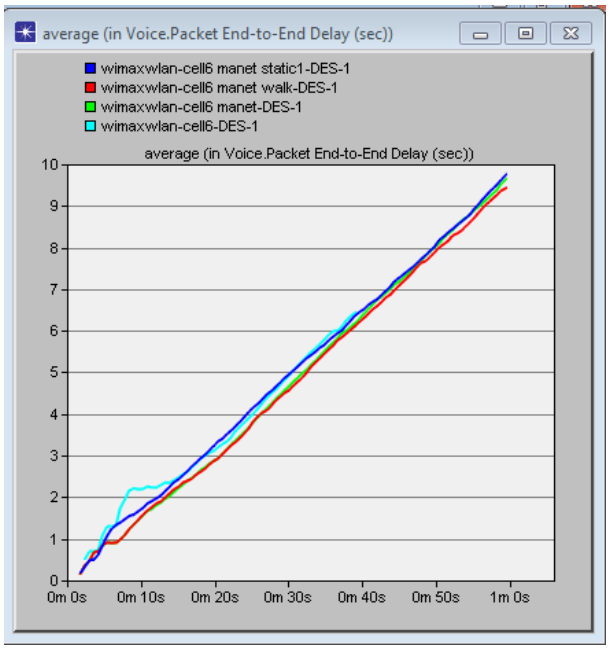

Fig 14: Packet end to end delay for cell 6

Fig 14 shows the result of Packet end to end delay for cell 6. Result shows that when there is no MANET node and when there is MANET nodes then Packet end to end delay is same which is 10sec

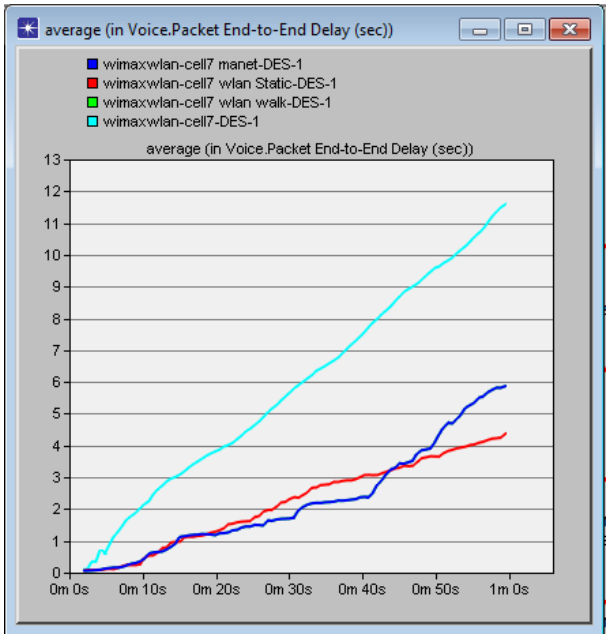

Fig 15: Packet end to end delay for cell 7

Fig 15 shows the result of Packet end to end delay for cell 7. Result shows that when there is no MANET node that Packet end to end delay is more which is 11.5 sec and when MANET nodes come into existence than Packet end to end delay decreases. Further if nodes move with static mobility pattern then result is 4sec for random walk and Random Way point it is same which is 5sec.

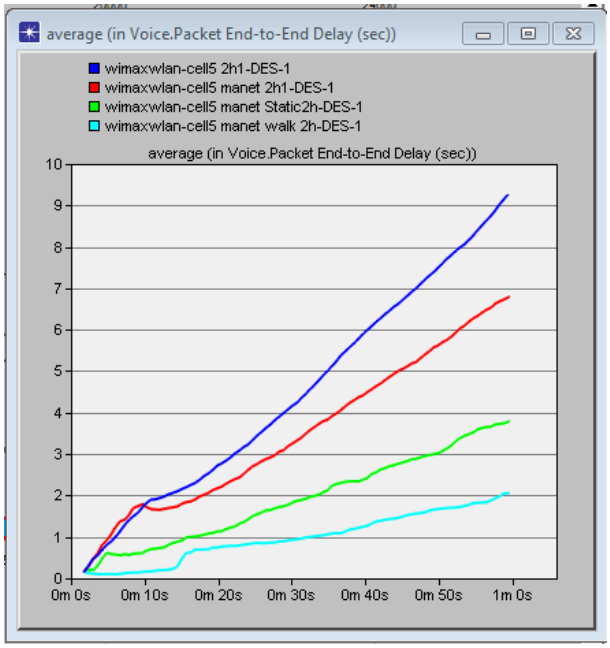

Fig 16: Packet end to end delay for cell 5 for maximum retransmission attempt 2

Fig 16 shows the result of Packet end to end delay for cell 5 for maximum retransmission attempt 2. Result shows that when there is no MANET node that Packet end to end delay is more which is 9sec and when MANET nodes come into existence than Packet end to end delay decreases. Further if nodes move with static mobility pattern it is 7sec and Random Way point is 4sec and for random walk it is 2sec

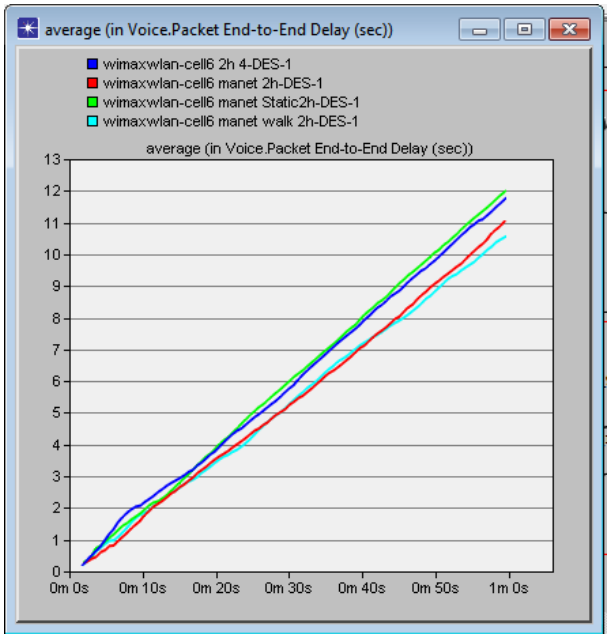

Fig 17: Packet end to end delay for cell 6 for maximum retransmission attempt 2

Fig 17 shows the result of Packet end to end delay for cell 6 for maximum retransmission attempt 2. Result shows that when there is no MANET node that Packet end to end delay is 12sec. Further if nodes move with static mobility pattern then result is 12sec and for random walk and Random Way point it is 11sec.

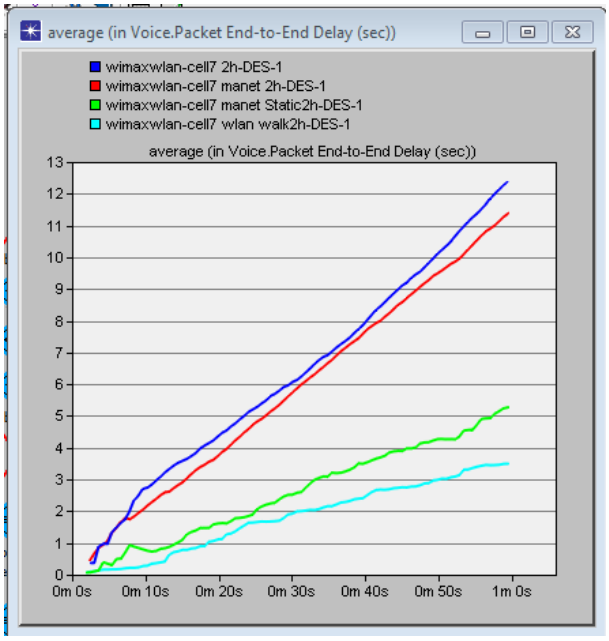

Fig 18: Packet end to end delay for cell 7 for maximum retransmission attempt 2

Fig 18 shows the result of Packet end to end delay for cell 7 for maximum retransmission attempt 2. Result shows that when there is no MANET node that Packet end to end delay is 12.5sec and when MANET nodes come into existence then Packet end to end delay is decreases. Further if nodes move with static mobility pattern then result is 5sec for random walk it is 2.5sec and Random Way point it is 11.5sec

6. CONCLUSIONS

In this paper the QOS of WiMAX is analyzed in presence of MANET. To analyze QOS MANET nodes are moved using different mobility patterns. The performance of WiMAX is further analyzed by increasing no. of cells and no. of nodes. This performance is analyzed in terms of Load, packet end to end delay and packet delay variation. The results show that the performance of WiMAX decreases as MANET nodes come into existence. Further if maximum retransmission attempt decreases then performance decreases.

7. REFERENCES

[1] Ghosh A. Wolter, D.R., "Broadband wireless access with WiMAX/802.16: current performance benchmarks and future potential", Communications Magazine, IEEE (Volume:43 , Issue: 2), 2005.

[2] Hung-Yu Wei, Ganguly S., "Interference-aware IEEE 802.16 WiMAX mesh networks**"** Vehicular Technology Conference. VTC-Spring. IEEE 61st (Volume:5),2005.

[3] Chakchai So-In, Jain, R., "Scheduling in IEEE 802.16e mobile WiMAX networks: key issues and a survey,**"** IEEE Journal on (Volume:27 , Issue: 2),2009.

[4] Deb, S. Bell Labs, "Real-Time Video Multicast in WiMAX Networks" , INFOCOM The 27th Conference on Computer Communications. IEEE ,2008.

[5] Schwarz, H.,Heinrich Hertz, "Overview of the Scalable Video Coding Extension of the H.264/AVC Standard" ,Circuits and Systems for Video Technology, IEEE Transactions on (Volume:17 , *Issue: 9 , 2007.*

[6] Pentikousis, K. Pinola, J., "An experimental investigation of VoIP and video streaming over fixed WiMAX**" ,** *M*odeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and Workshops, 2008.

[7] Will Hrudey, "Streaming Video Content Over IEEE 802.16 / WiMAX Broadband Access", Spring 2008.

[8] S. Sharangi, R. Krishnamurti and M. Hefeeda, "Energy-Efficient Multicasting of Scalable Video Streams Over WiMAX Networks," in IEEE Transactions on Multimedia, vol. 13, no. 1, pp. 102-115, Feb. 2011. doi: 10.1109/TMM.2010.2076799.

[9] Yong Liu, Yang Guo, Chao Liang, "A survey on peer-to-peer video streaming systems**"** peer-to-Peer Networking and Applications, Volume 1, Issue 1, pp 18-28, 2008.

[10] Y. Wang, " Survey of Objective Video Quality Measurements, Tech report," Worcester Polytechnic Institute, June 2006.

[11] C. Cicconetti, C. Eklund, L. Lenzini, E. Mingozzi, " Quality of service support in IEEE 802.16 Networks" , IEEE Network 20 (2006).

[12] J. Casasempere, P. Sanchez, ''Performance evaluation of H.264/MPEG-4 Scalable Video Coding over IEEE 802.16e networks"IEEE International Symposium on, 13–15 May 2009.

[13] Mengke Hu, Hongguang Zhang, ''Performance evaluation of video streaming over mobile WiMAX networks", GLOBECOM Workshops (GC Wkshps), 2010 IEEE, vol., no., pp.898–902, 6–10 Dec. 2010.

[14] S. Winkler, P. Mohandas, "The evolution of video quality measurement: from PSNR to hybrid metrics", IEEE Transactions on Broadcasting 54 (2008).

[15] T. Wiegand, G.J. Sullivan, G. Bjontegaard, "Overview of the h.264/avc video coding standard", IEEE Transactions on Circuits and Systems for Video Technology (2003).