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Performance analysis of IPTV (VOD) over WiMAX for SC and OFDMA for Different Modulation Techniques

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Abstract— In this paper the effect of misbehavior node on IPTV over WiMAX by varying the buffer size of misbehavior nodes is analyzed. This effect is analyzed by using different services (be and rtps) and different modulation techniques (16qam3/4,64qam3/4 and qpsk3/4) and physical Characteristics(Single carrier and OFDMA). The effect is analyzed in terms of Packet Delay Variation, End To End Delay, and Load. The result shows that for best effort the performance of qpsk is better and for rtps the performance of 64qam3/4 is better. The result also shows that the performance of single carrier is better than OFDMA.

Keywords— WiMAX, OPNET, IPTV, VoD, OFDMA;

I. INTRODUCTION

Communication is the most important to interchange information in between the whole world, there are many way to make possible this communication. The first WiMAX (Worldwide Interoperability for Microwave Access) system (IEEE 802.16-2004) offered fixed broadband wireless communications using rooftop mounted Customer Premises Equipment (CPE) [5]. IEEE 802.16 is a alternative to 3G or wireless LAN for providing last mile connectivity by radio link because of its more coverage area, low cost and high speed of data rates. In December, 2005 the IEEE completed the 802.16e-2005 amendment, which added new features to support mobile applications. The resulting standard is commonly known as mobile WiMAX [3]. WiMAX is Wireless Interoperability for Microwave Access, it is the latest technology for Wireless Communication which is based on the IEEE 802.16-2004 and IEEE 802.16e-2005 standards and was designed with much influence from Wi-Fi [10]. IEEE 802.16 Originally, four different service types were supported in the 802.16 standard: UGS, rtPS, nrtPS and BE. The UGS (Unsolicited Grant Service) is similar to the CBR (Constant Bit Rate) service in ATM, which generates a fixed size burst periodically. The original WiMAX physical layer (PHY) used orthogonal frequency division multiplexing (OFDM). This provides strong performance in multipath and non-line-of-sight (NLOS) environments. Mobile WiMAX extends the OFDM PHY layer to support terminal mobility and multiple-access. The resulting technology is known as scalable orthogonal frequency division multiplexing (OFDMA) [13].

The IEEE 802.16 suite of standards (IEEE 802.16-2004/IEEE 802-16e-2005) [3], [4] defines within its scope four PHY layers, any of which can be used with the media access control (MAC) layer to develop a broadband wireless system [12, 15]. WiMAX makes communications in two way i.e. Management message and Data messages. Management messages are used to govern communications parameters necessary to maintain wireless links, and data messages carry the data to be transmitted over wireless links. WiMAX is able to support a wide range of bandwidths. The scalability is implemented by varying the FFT size from 128 to 512, 1024, and 2048 to support channel bandwidths of 1.25 MHz, 5 MHz, 10 MHz, and 20 MHz respectively.

The primary operation bands of WiMAX include frequencies 10–66 GHz, 2–11 GHz and license–exempt frequencies below 11GHz (primarily 5–6 GHz). According to these operation bands, WiMAX PHY defines five specifications for different operation scenarios. Among them, Wireless MAN–OFDM PHY is based on orthogonal frequency–division multiplexing (OFDM) technology and designed for NLOS operation in the frequency bands below 1GHz [12, 14].The PHY layers defined in IEEE 802.16 are[4, 6]: WirelessMAN SC: It is a single-carrier PHY layer intended for frequencies beyond 11GHz requiring a LOS condition. This PHY layer is part of the original 802.16 specifications.

WiMAX Components

WiMAX networks have five primary components i.e. [3, 5, 7] Base Station (BS): BS logically connected to wireless subscriber devices to operator networks. BS makes communications with subscriber devices and governs access to the operator networks. A BS consists of the infrastructure elements that enable wireless communications; these are antennas, transceivers, and other electromagnetic wave transmitting equipment. BSs are typically fixed nodes, but they may also be used as part of mobile solutions. Subscriber Station (SS): SS is a stationary WiMAX-capable radio system that communicates with a base station. Mobile Station (MS): MS is an SS that is intended to use 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): RS are SS which configure to forward traffic to other RS or SS in a multi-hop Security Zone. Operator Network: The operator network encompasses infrastructure network functions that provide radio access and IP connectivity services to WiMAX subscribers. These functions are defined in WiMAX Forum technical specifications as the access service network (radio access) and the connectivity service network (IP connectivity).

To make a communication IEEE 802.16 used a four primary topologies networks i.e. point-to-point, point-to-multipoint, multi-hop relay, and mobile. Now-a-days popularity of IPTV is increasing because it gives us promise to deliver data to the user when it needed. IPTV provides service of VoD(video on demand) with video acquisition, video processed and video secure distribution which is received by user by using setup box. This service is provided to user with the help of WiMAX technology. There are many problems related to the transmission of video. This can be solved by using MPEG codes. MPEG is used because it provides better coding efficiency with an increased degree of supported scalability relative to the scalable profiles of prior video coding standards [9, 11]. When any node do not operate properly in WiMAX that means it is effected by some kind of internal or external attack, which make the node as a malicious or misbehavior node. In this condition node can not accurately forward the data packet to next node, it may be destroyed in routing path or dropped by misbehavior nodes.

II. RELATED WORK

In 2013, Rakesh Kumar Jha *et al.* [16] have analyzed and observed the performance of the Black hole attacks in WiMAX-WLAN interface network. Black hole attack is very important for Next Generation Network (NGN) because this attack is very much possible in WiMAX-WLAN interface network. In our case study intruder node associated with less buffer size and it is moving with defined trajectory from router WiMAX-WLAN converter. In this observation there are three possibility of black hole attack has been studied i.e on the basis of less buffer size, medium buffer size and finally default buffer size. This attack is effected the performance of entire network like decrease the throughput and increase the packet dropped or delay. In last phase observed that the Access Point (AP). Access Point is highly sensitive for black hole attack with respect to buffer size . On the basis of simulation result observed that black hole attack is possible in WiMAX-WLAN interface network because buffer size has been played an important role in our proposed scenarios. This attack is highly sensitive attack as far as NGN network because enemy can destroy or degrade the network performance with minimum effort and very less expenditure. Our performance analysis has given proposal about the packet dropped, delay and throughput at mobile node (malicious node), AP and highly effected client in the presence of malicious node.

In 2014,Jamil Hamodi *et al.* [17], analyzed the performance of Mobile TV over mobile WiMAX is conducted with different types of adaptive modulation and coding taking into account key system and environment parameters which include the variation in the speed of the mobile, path-loss, scheduling service classes with the fixed type of modulations. Our simulation has been conducted using OPNET simulation. Simulation results show that dynamic adaptation of modulation and coding schemes based on channel conditions can offer considerably more enhanced QoS and at the same time reduce the overall bandwidth of the system.They had evaluated the performance in terms of average packet jitter, average packet E2E delay, average throughput, and average data dropped. It has been demonstrated, using OPNET simulation, that higher order modulation and coding schemes (namely, 16 QAM and 64 QAM) provide better performance. Also, it has been shown that AMC schemes (namely, AMC-1 and AMC-2) give relatively comparable performances to 64 QAM 3/4 scheme. In this work, simulation results show that the free space path loss is best for deploying A/V video application over different mobile node speeds, whereas “outdoor to indoor” is the worst case with the highest packet drop rate. Moreover, our simulation showed that rtPS scheduling service class is the most appropriate scheduling service for A/V video.

III. EXPERIMENTAL SETUP

In this experiment the Effect of Misbehavior Nodes on VOD over WiMAX is analyzed by using OPNET Simulator. OPNET Simulator 14.5 [18] was used to analyze the performance of WiMAX. We used OPNET modeler, as OPNET modeler provides a comprehensive development environment supporting the modeling of communication network and distributed systems. OPNET modeler provides better environment for simulation, data collection and data analysis [9]. In this experiment, seven Hexagonal cells are taken in each scenario. Each cell has a radius of 2 Km. In each cell there is one Base station and 15 mobile nodes are taken. These nodes are circularly placed. The BS connected to the IP backbone via a DS3 WAN link. The base stations are connected to backbone cloud through ppp_DS3 link. The Backbone Cloud is also connected to VOD server through Sonet os12 link. To analyze the performance of misbehavior nodes different experiment is carried out as follows:-

Experiment 1*:* In this experiment, we used scenarios simulation to study the effect of different VOD services (be and rtps) over WiMAX networks without misbehavior nodes .Here we make scenarios without misbehavior nodes. These scenarios is repeated by using different modulation techniques (16qam3/4,64qam3/4 and qpsk3/4) and physical Characteristics(Single carrier and OFDMA)

Experiment 2*:* here we used scenarios simulation to study the effect of different VOD services (be and rtps) over WiMAX networks with misbehavior nodes. Here we make scenario with Misbehavior nodes to study the effect of different Services on VoD over WiMAX networks by taking buffer size of Misbehavior nodes less than ss nodes and then equal to ss nodes. These scenarios are repeated by using different modulation techniques (16qam3/4,64qam3/4 and qpsk3/4) and physical Characteristics(Single carrier and OFDMA).

IV. RESULTS AND DISCUSSIONS

In this paper the effect of misbehavior nodes is analyzed in terms of Load, Packet delay variation and end to end delay.

Load: Fig 1,2.3,4 &5 shows comparision of load for best effort and rtps with misbehaviour and without misbehaviour nodes using OFDMA.

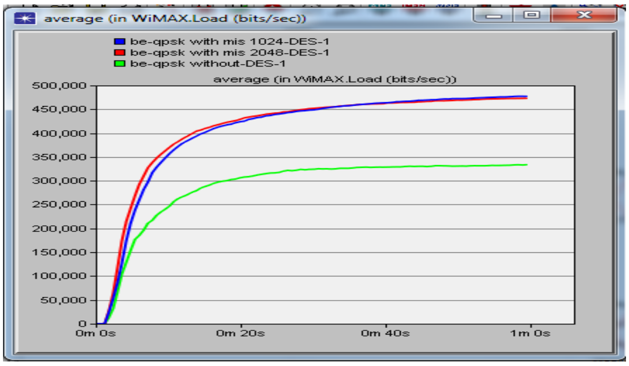

Fig 1: load for qpsk for be

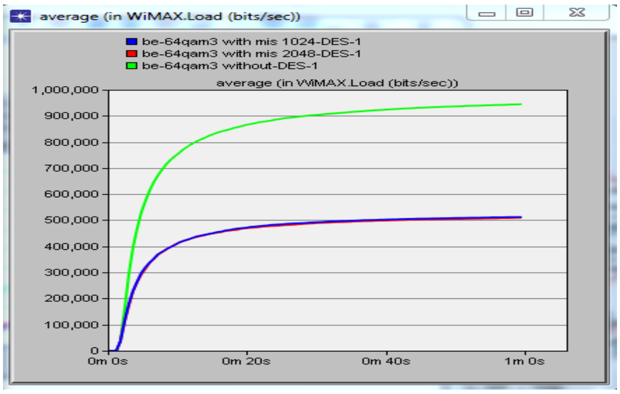

Fig 2: load for 64qam3/4 for be

Fig 1 & Fig 2 shows that for qpsk when there is no misbehavior node the load is less but when misbehavior nodes come than load increase. Fig also shows that when we increase the buffer size load increases. The fig also shows that for 64 qam3/4 when there are no misbehavior nodes than load is high. Fig also shows that when misbehavior nodes is added than load decrease. The fig also shows that when we increase the buffer size there is no effect on load.

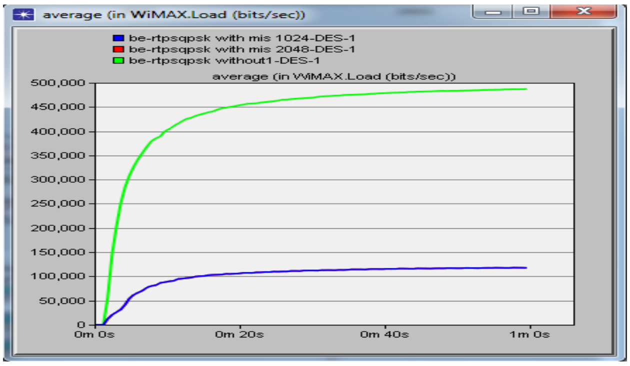

Fig 3: load for qpsk3/4 for rtps

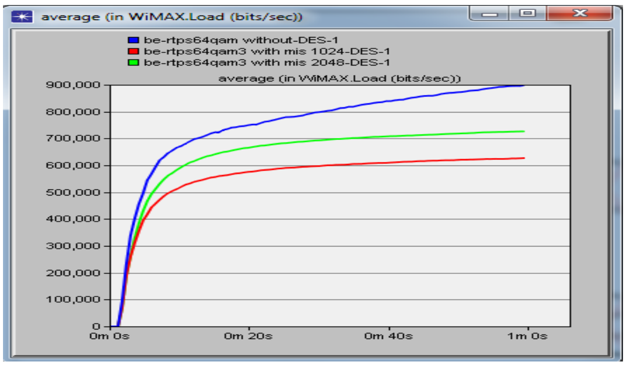

Fig 4: load for 64qam3/4 for rtps

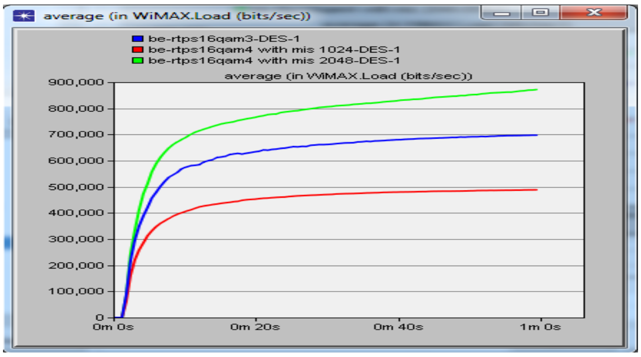

Fig 5: load for 16qam3/4 for rtps

Fig3, fig 4 & Fig 5 shows that for qpsk when there is no misbehavior node than load is high when misbehavior is introduced than load decrease, the fig also shows that when we increase the buffer size there is no effect on load. The figures also shows that for 64qam and 16 qam when there is no misbehavior nodes than load is high and when we introduce the misbehavior nodes than load decrease. The fig also shows that when we increase the buffer size load increases.

Fig 6,7,8,9 , 10 &11 shows comparision of load for best effort with misbehaviour and without misbehaviour nodes using SC.

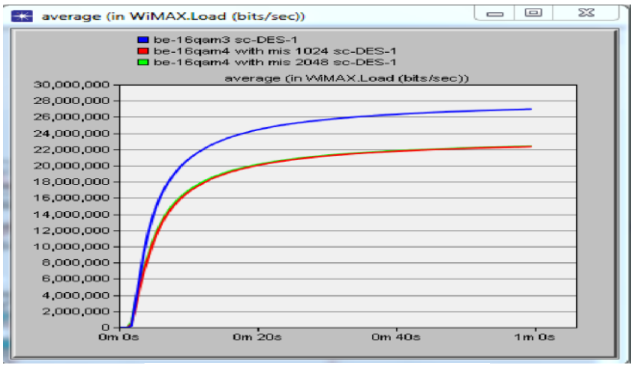

Fig 6: Load for 16qam3/4 for be

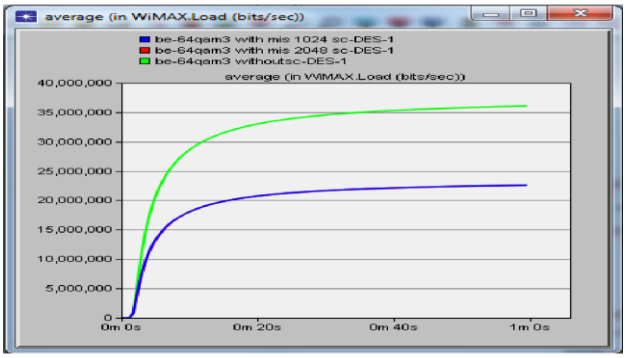

Fig 7:Load for 64qam3/4 for be

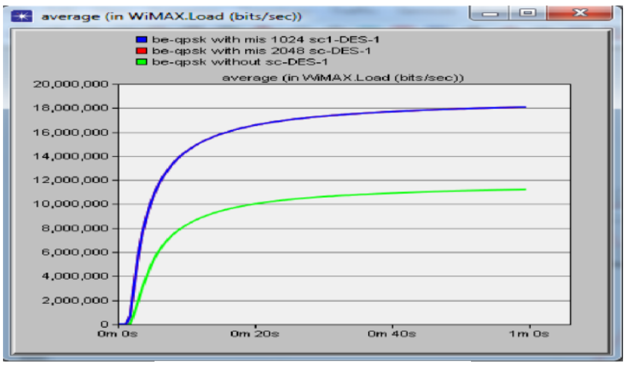

Fig 8:Load for qpsk3/4 for be

Fig 6, fig7 & fig 8 shows the result for best effort. fig shows that when there is misbehavior node load is high for 16qam and 64 qam and is less for qpsk. The fig also shows that when we increase the buffer size there is no effect on load.

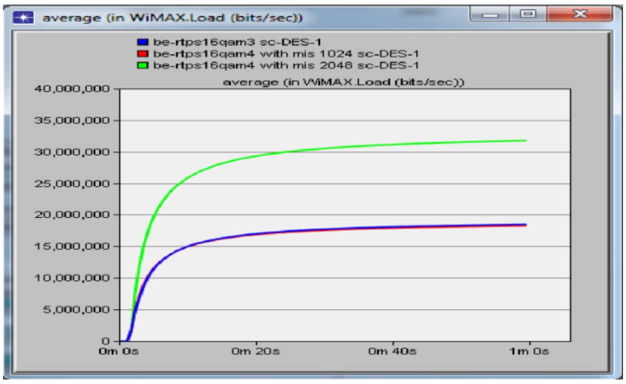

Fig 9: Load for 16qam3/4 for rtps

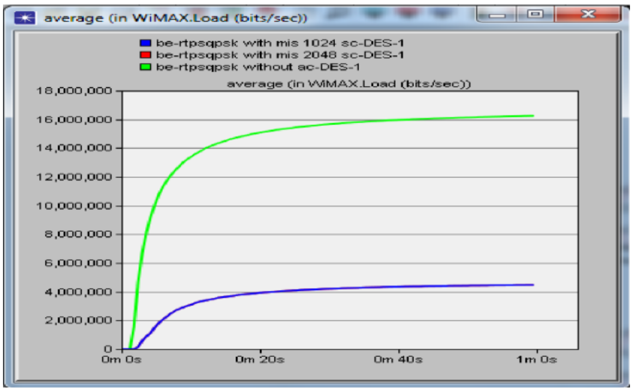

Fig 10: Load for qpsk3/4 for rtps

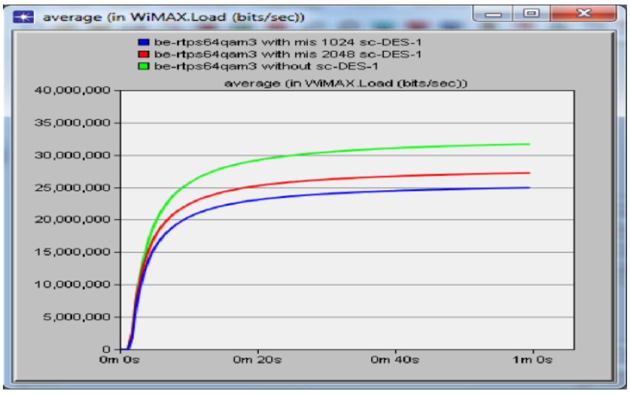

Fig 11: Load for 64qam3/4 for rtps

The fig 9, fig 10 & fig 11 shows the result for rtps. the fig shows that when we misbehavior nodes come across the network the laod decrease for 64qam and qpsk and for 16qam it increase. the fig also shows that when we increase the buffer size increase for 64qam and 16qam and there is no effect on qpsk.

Packet delay variation: Fig 12,13 ,14, 15,16 &17 shows comparision of packet delay variation for best effort and rtps with misbehaviour and without misbehaviour nodes using OFDMA.

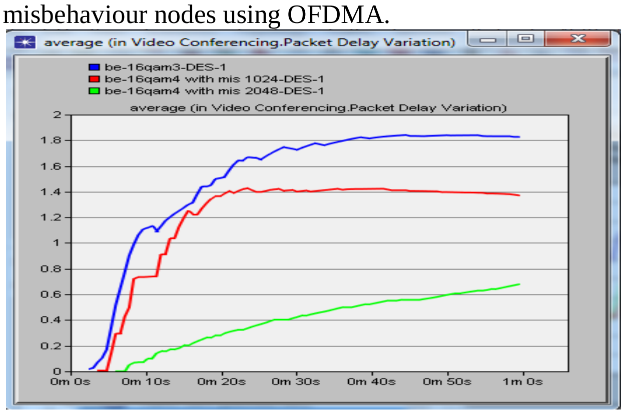

Fig 12: packet delay variation for 16qam for be

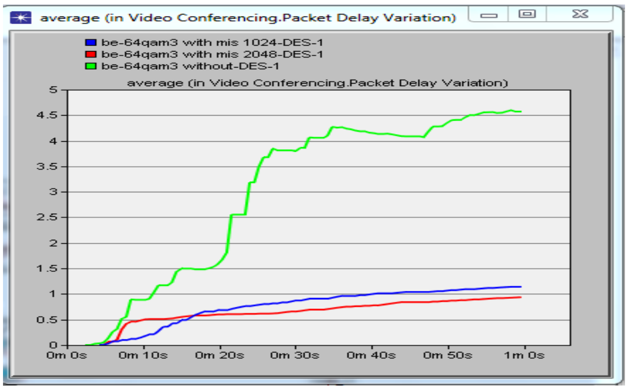

Fig 13: packet delay variation for 64qam for be

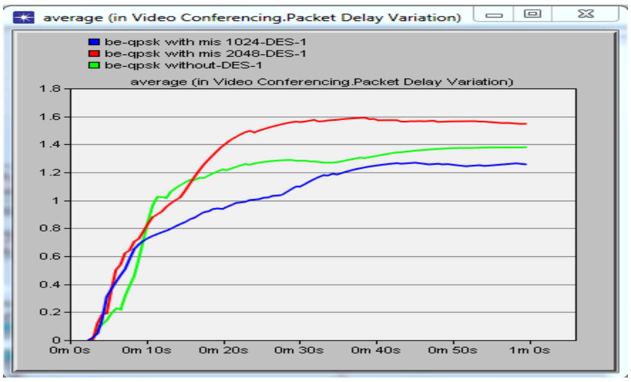

Fig 14: packet delay variation for qpsk for be

Fig 12,13 & 14 shows that for 16qam and 64qam when we add misbehavior nodes that packet delay variation decreases. The fig also shows that when we increase the buffer size packet delay variation decreases. Fig also shows that for qpsk when we increase the buffer size packet delay variation increase.

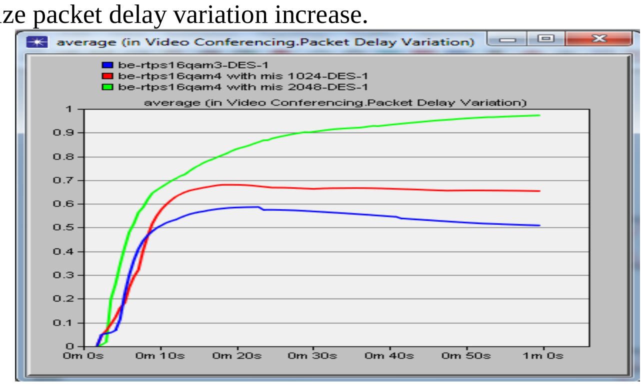

Fig 15: packet delay variation for 16qam for rtps

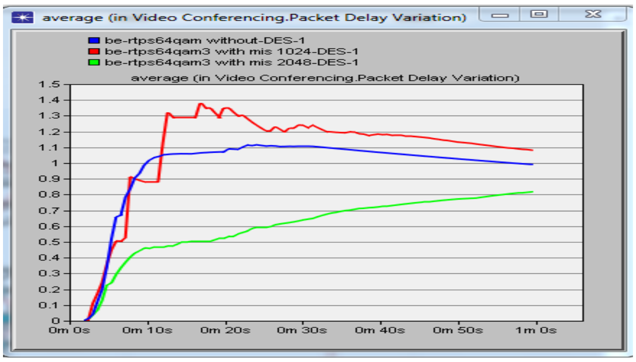

Fig 16: packet delay variation for 64qam for rtps

Fig 15,16,17 shows that for 16qam packet delay variation as we increase the buffer size the packet delay variation decrease fig also shows that when there is no misbehavior nodes than packet delay variation is less. Fig 10 shows that as we increase the buffer size the packet delay variation decrease. For qpsk there is no effect of buffer size.

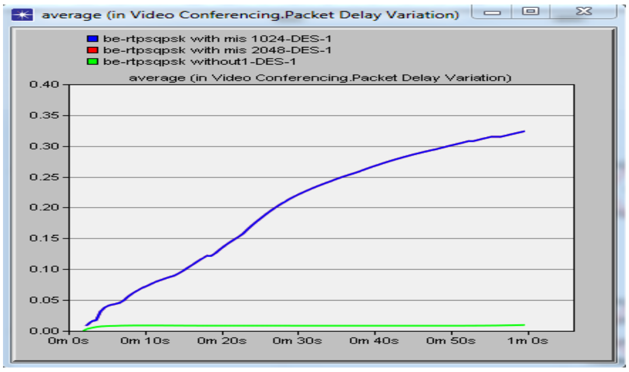

Fig 17: packet delay variation for qpsk for rtps

Fig 18,19,20,21,22 & 23 shows comparision of packet delay variation for best effort and rtps with misbehaviour and without misbehaviour nodes using SC.

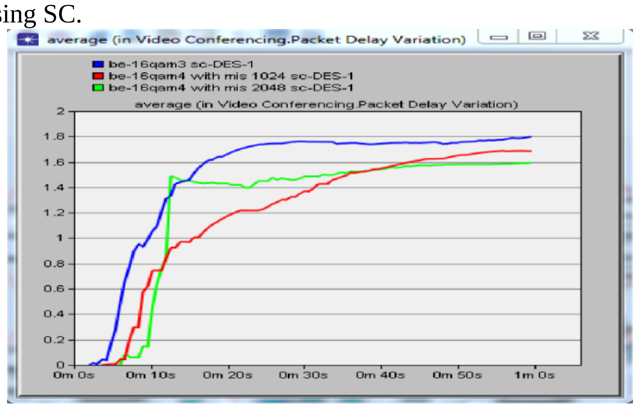

Fig 18: packet delay variation for 16qam3/4 for be

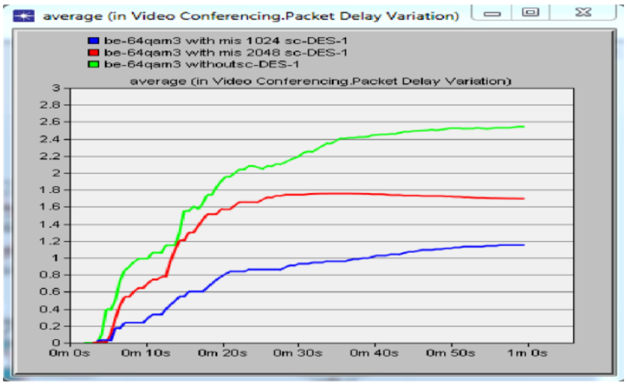

Fig 19: packet delay variation for 64qam3/4 for be

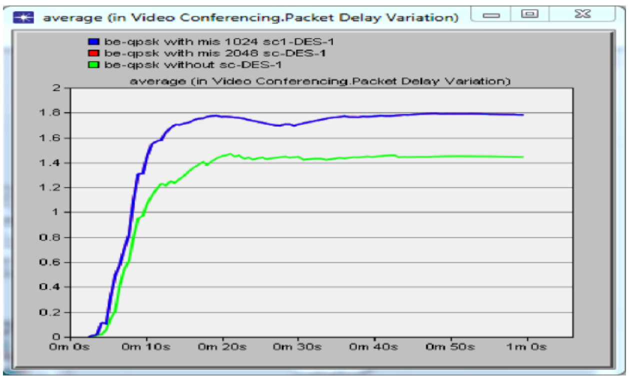

Fig 20: packet delay variation for qpsk3/4 for be

Fig 18, Fig 19& fig 20 show the result for best effort. fig shows that when we increase the buffer size the packet delay variation is increase for 64 qam and decrease for 16qam and there is no change for qpsk. fig also shows that when there is no misbehavior nodes the packet delay variation is high for 16qam and 64 qam and is less for qpsk.

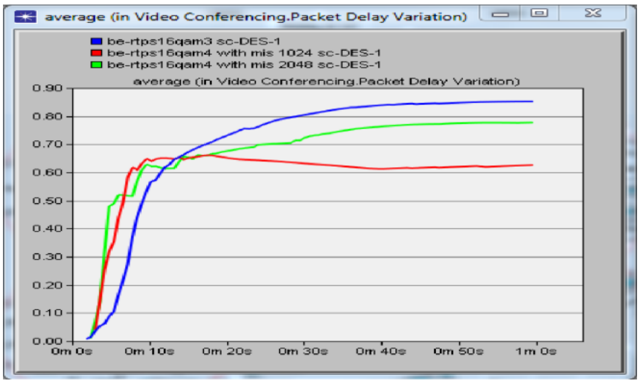

Fig 21: packet delay variation for 16qam3/4 for rtps

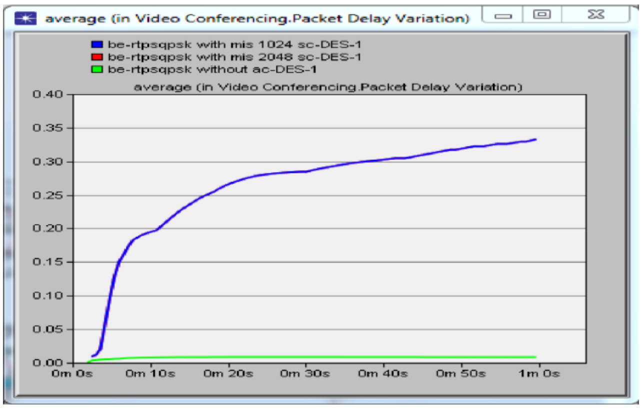

Fig 22: packet delay variation for qpsk3/4 for rtps

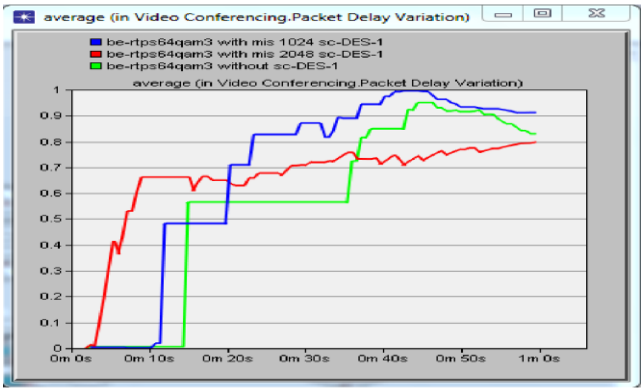

Fig 23: packet delay variation for 64qam3/4 for rtps

Fig 21, Fig 22 & Fig 23 shows the result for packet delay variation for rtps. The fig shows that when we increase the buffer size packet delay variation decrease for 64qam and increase for 16qam and there is no effect on qpsk. Fig also shows that when there is no misbehavior node packet delay variation is less for 64qam and qpsk and more for 16qam.

End to End delay: Fig 24, 25,26,27,28 & 29 shows comparision of End to end delay for best effort and rtps with misbehaviour and without misbehaviour nodes using OFDMA

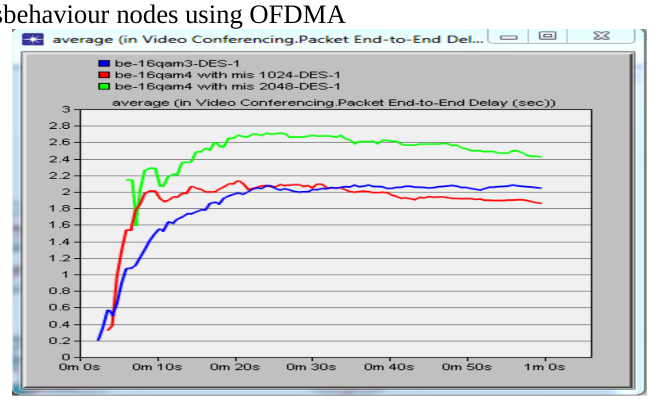

Fig 24: End to End delay for 16 qam for be

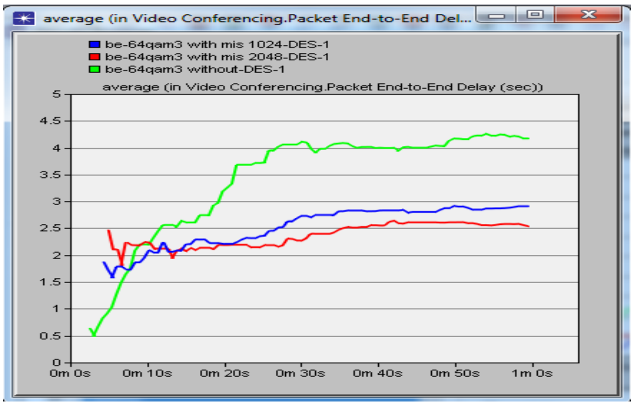

Fig 25: End to End delay for 64 qam for be

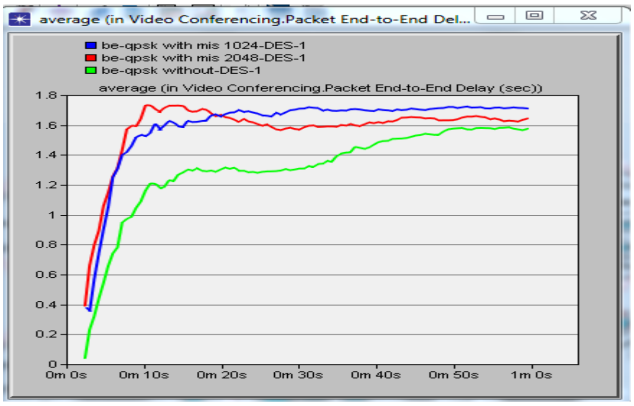

Fig 26: End to End delay for qpsk for be

Fig 24, fig 25 & fig 26 shows that as we increase the buffer size end to end delay decrease for qpsk and 64qam. But for 16qam it increases. Fig also shows that if there is no misbehavior nodes end to end delay is less for qpsk and 16 and for 64 it is high.

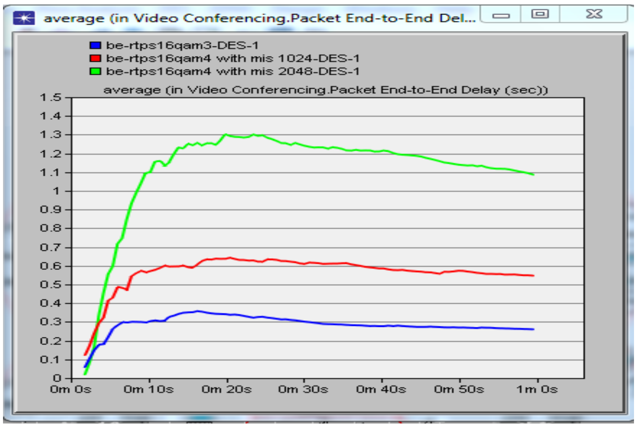

Fig 27: end to end delay for 16qam for rtps

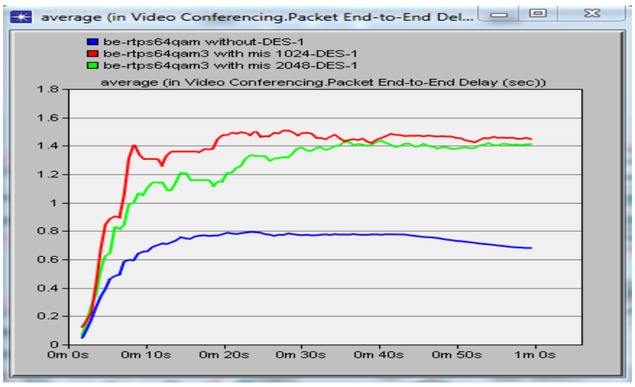

Fig 28: end to end delay for 64qam for rtps

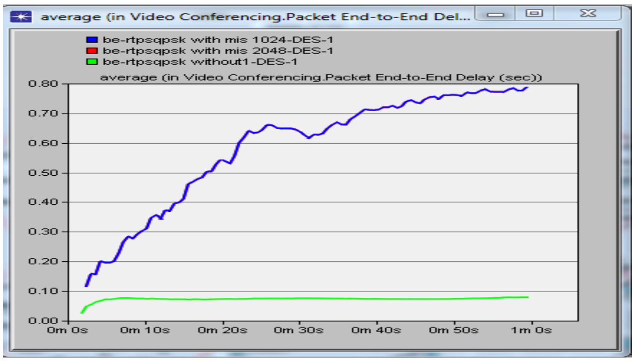

Fig 29: end to end delay for qpsk for rtps

Fig 27,28,29 shows that as we increase the buffer size the end to end delay for 16qam increase and for 64qam it decrease and for qpsk it has no effect. The fig also shows that when there is no misbehavior nodes end to end delay is less.

Packet end to end delay: Fig 30,31,32,33,34 & 35 shows comparision of packet end to end delay for best effort and rtps with misbehaviour and without misbehaviour nodes using OFDMA.

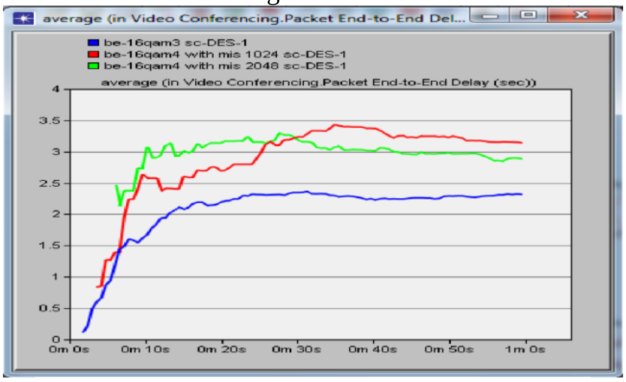

Fig 30: packet end to end delay for 16qam3/4 for be

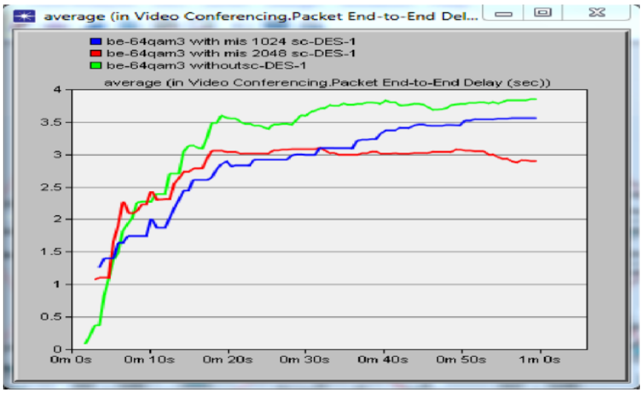

Fig 31: packet end to end delay for 64qam3/4 for be

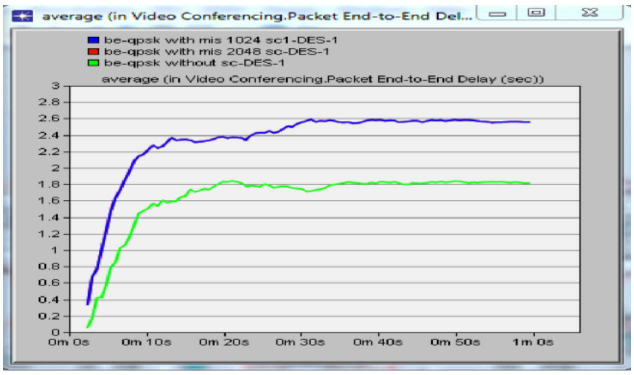

Fig 32: packet end to end delay for qpsk3/4 for be

Fig 30,fig 31& Fig 32 shows the result for best effort . fig shows that when we increase the buffer size of misbehaviour nodes the packet end to end delay will decrease for 16qam and 64 qam and for qpsk there is no effect. the fig also shows that when there is no misbehavior nodes than packet end to end delay is less for 16qam and qpsk and high for 64qam.

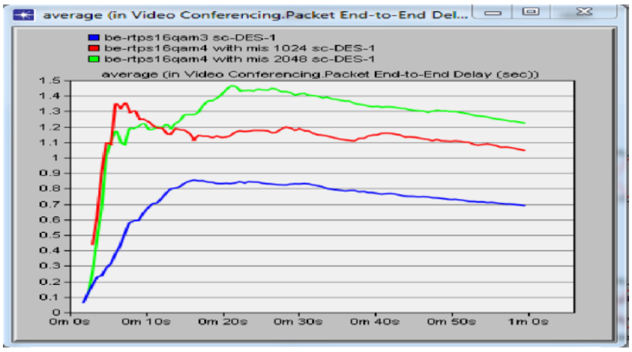

Fig 33: packet end to end delay for 16qam3/4 for rtps

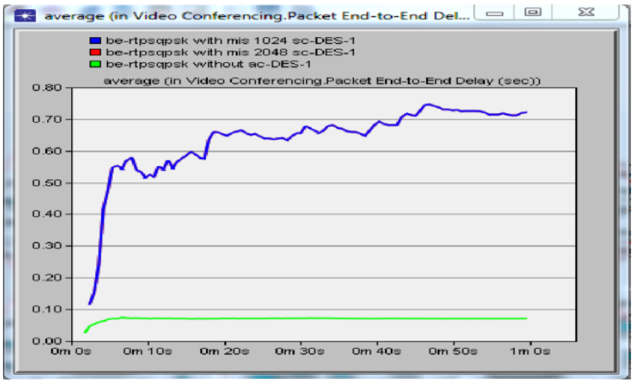

Fig 34: packet end to end delay for qpsk3/4 for rtps

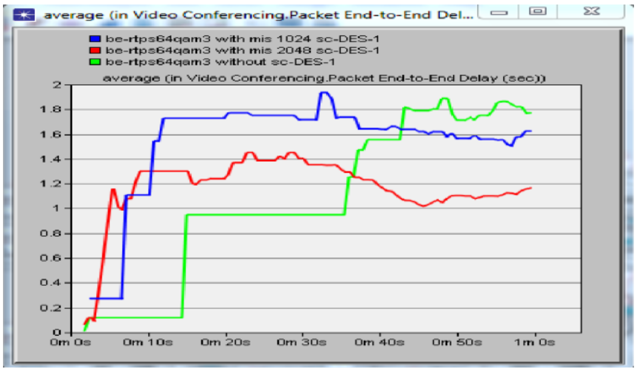

Fig 35: packet end to end delay for 64qam3/4 for rtps

fig33, fig 34 & fig 35 show the result for packet end to end delay for rtps. The fig shows that when we increase the buffer size packet end to end delays decreases for 64qam and increases for 16qam and there is no effect for qpsk. The fig also shows that when there is misbehavior node packet end to end delay is less for 16qam and qpsk and high for 64qam.These figures show that the performance for single carrier is better than OFDMA.

V. CONCLUSION

In this research analysis the performance of IPTV (VOD) over WiMAX by varying no. of misbehavior nodes in terms of End to End Delay, Packet delay Variation and Load is carried out. Its aim is to address the performance metrics of QoS for VoD over WiMAX access technology. To analysis the performance different service classes are used like best effort and rtps and different physical layer profile is used like OFDMA and SC. To ANALYZE the performance different modulation techniques also used like 16qam3/4, 64qam3/4 and qpsk3/4) The OPNET Modeler is used to design and characterize the performance parameters of WiMAX. In this experiment the placement of nodes are circular within hexagonal cell of radius 2 km. Here the speed of each node is 5m/s. simulation is carried out for one minute. the result shows that for best effort the performance of qpsk is better and for rtps the performance of 64 qam3/4 is better because Load is high than other and Delay, End to End Delay, Packet delay Variation is less and The results also shows that the value of Packet delay Variation and Delay is less for sc and End to End Delay, throughput, Traffic Received and Load is more in sc. So the overall performance of sc is better than OFDMA.

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