

# Study of Simulation Comparing WiMAX Network Fixed and Mobile using OPNET Modeler

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## ABSTRACT

In the WiMAX (Worldwide interoperability for Microwave Access) the standard based on two modes: fixed and mobile, this provides wireless broadband to fixed and mobile terminals. WiMAX is an enhanced approach of wireless broadband. This paper focus on comparing between two networking approach Fixed and mobile terminal considering a video and voice over IP (VOIP) technology. It is using signal video with VOIP. to study similarity and difference in performance delay, load and Throughput in both fixed and mobile WiMAX.

## Keywords

WiMAX, Delay , Load , Throughput , OPNET.

## 1. INTRODUCTION

WiMAX standards defines formal specification to provide wireless broadband to fixed and mobile terminals. WiMAX operates on two frequencies range 10-66 GHZ(licensed frequency band) for line of sight (LOS) as well as 2-11 GHZ (unlicensed frequency band) Non-line of sight operation. WiMAX Network growth uses OFDM (orthogonal frequency division multiplexing) which makes transmission more resisting to signals interference [1].

### 1.1 IEEE 802.16d-2004 – Fixed WiMAX

The IEEE.16 standard owns High development in different stages during different part of technology. Fixed WiMAX on operational frequencies spanning from 10 to 66GHz, the Physical is based on SC modulation. For (NLOS) propagation conditions at frequencies below 11GHz the connection using (SC.OFDM) Single-carrier is a frequency-division multiple access scheme. The modulation in early of WiMAX was based on the Wireless Metropolitan Area Network (Wireless MAN),Therefore the fixed WiMAX does not support mobility [2].

### 1.2 IEEE 802.16e-2005 – Mobile WiMAX

WiMAX continues the developments on different stages to support the mobility. it supports subscriber stations(SCs) moving at vehicular speeds, thereby Specification it introduced a system for combined fixed and mobile broadband Wireless Access(BWA), the mobility services also known as mobile [2].WiMAX System used 4G (Fourth generation)system to solve the problems of 3G (Three generation) systems. 4G designed to give new services like high-quality voice to high-definition video to high –data-rate wireless channels. [3] Video conferencing contains the transfer of audio and video between two users point to point (PTP) or among multiple users multiple users to multiple users (MTM). The video is encoded as a series of video frames, with frame rates ranging from 8 frames per second (fps) for low-bandwidth, video with low quality, to 30 fps or higher for video with high-quality. The video is compressed by using lossy compression codes like MPEG-4 or H.264 to

save bandwidth [4]. VoIP voice over IP may deliver voice communications and multimedia sessions over Internet Protocol (IP). This process includes fragmentation defragmentation of voice, isolation of jam signals and then compression the voice signal with the use of compression/decompression (coding/ encoding) algorithms. [5] The communication basic role in WiMAX network consists of one Base Station (BS) and one or more Subscribers Station (SS) Fig. 1 shows . In IEEE 802.16 specifies the following modes of development architectures :

Point-To-Point: A connection between one BS and one SS.

Point-to-Multipoint: A connection between one BS and multiple SS nodes. The BS always coordinates the uplink and downlink transmission.

Mesh: Subscriber Station(SS) can communicate with each other without the coordination of a Base Station(BS). Both BS and SS are stationary while clients connected to SS can be mobile. [6]

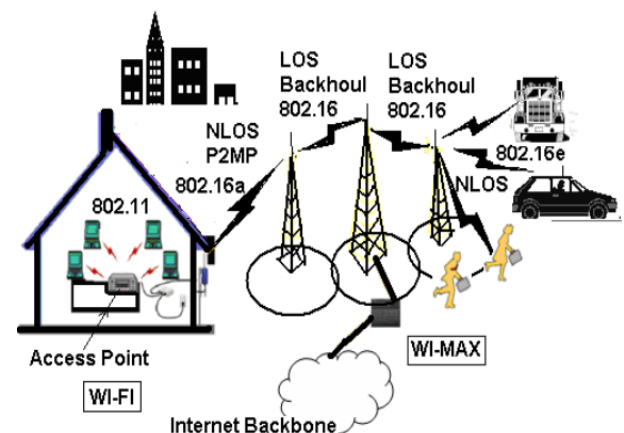


Fig.1 Point to Point, Point to Multipoint and Mesh [7].

Quality of Service in WiMAX (QoS):

The IEEE802.16d standard provides of (QoS) by using applications in different methods for example video, VOIP and other types. The quality of service in IEEE 802.16 is divided in to five classes: [8]

1. UGS (Unsolicited Grant Service):designed to provide constant bit rate (CBR) services, such as VoIP without silence suppression.
2. Real-Time Polling Services (rtPS): designed to provide real-time services that generates variable data size packets, such as MPEG video or VoIP with silence suppression.
3. Non-Real-Time Polling Services (nrtPS): designed to provide non-real-time services that requires variable size data grant burst types on a regular basis.

- Best Effort (BE) Services: the services are typically provided by the Internet today for web surfing.

## 2. SIMULATION MODEL

The Network consists of two WiMAX cell i.e. and two BS(base station) and number of SS (subscriber station) per cell. The parameters of SS and BS are given in configuration figures.

Each BS is connected to the IP backbone. In addition it is connected to IP cloud with connect to server to provide two types of application for example VOIP and Video in network. The channel was configured to vary according to ITU Pedestrian A multipath fading model. All scenarios running in 600 sec, and traffic configuration, all configuration in figures 2,3,4,5,6

Attribute	Value
Row 0	
Service Class Name	Gold
Scheduling Type	UGS
Maximum Sustained Traffic Rate (b...	0.5 Mbps
Minimum Reserved Traffic Rate (bps)	0.5 Mbps
Maximum Latency (milliseconds)	30.0
Maximum Traffic Burst (bytes)	0
Traffic Priority	Not Used
Unsolicited Poll Interval (milliseconds)	Auto Calculated
Row 1	
Service Class Name	Silver
Scheduling Type	rtPS
Maximum Sustained Traffic Rate (b...	0.5 Mbps
Minimum Reserved Traffic Rate (bps)	0.5 Mbps
Maximum Latency (milliseconds)	30.0
Maximum Traffic Burst (bytes)	0
Traffic Priority	Not Used
Unsolicited Poll Interval (milliseconds)	Auto Calculated

Fig.2 WiMAX Network configuration

In Fig.2 configuration of WiMAX used two types from Quality of Service UGS and rtPS represented video and VOIP systems.

Attribute	Value
name	Base Station_1
WiMAX Parameters	
Antenna Gain (dBi)	15 dBi
BS Parameters	(...)
Classifier Definitions	(...)
MAC Address	Auto Assigned
Maximum Transmission Power (W)	0.5
PHY Profile	WirelessOFDMA 20 MHz
PHY Profile Type	OFDM
PemBase	0
IP Routing Protocols	

Fig.3 Base station configuration

In Fig.3 configuration of base station interactive specification of application multimedia.

Attribute	Value
name	node_1
Application Definitions	(...)
Number of Rows	2
Video Conferencing (Light)	
Name	Video Conferencing (Light)
Description	(...)
Video over IP Call (PCM Quality)	
Name	Voice over IP Call (PCM Quality)
Description	(...)
MOS	
Voice Encoder Schemes	All Schemes

Fig.4 Application configuration (Video with Voice over IP)

In this Fig.4 provided the network WiMAX of two application video and voice over IP.

Attribute	Value
name	node-2
Profile Configuration	(...)
Number of Rows	1
Multimedia User	
Profile Name	Multimedia User
Applications	(...)
Number of Rows	2
Video Conferencing (Light)	...
Voice over IP Call (PCM Quality)	...
Operation Mode	Simultaneous
Start Time (seconds)	uniform (100,110)
Duration (seconds)	End of Simulation
Repeatability	Once at Start Time

Fig.5 Profile WiMAX configuration

In Fig.5 provided applications to profile WiMAX .

WiMAX Parameters	
Applications	
Application: ACE Tier Configuration	Unspecified
Application: Destination Preferences	None
Application: Multicasting Specification	None
Application: RSVP Parameters	None
Application: Segment Size	64,000
Application: Source Preferences	None
Application: Supported Profiles	(...)
Number of Rows	1
Multimedia User	...
Application: Supported Services	None
Application: Transport Protocol Specifi...	Default

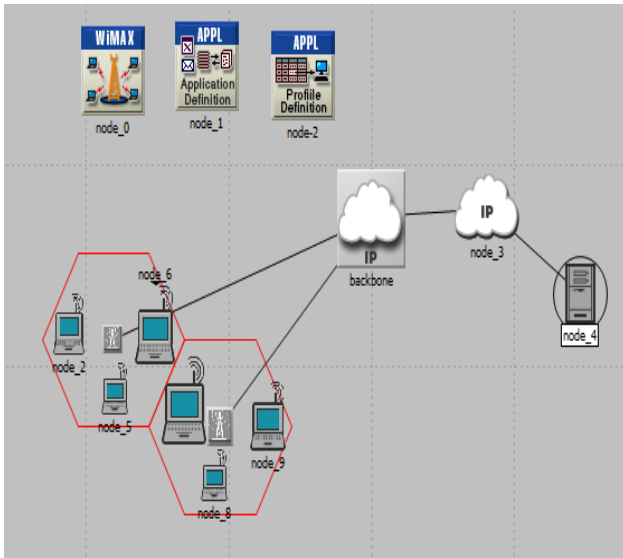
Fig.6 Subscriber Station configuration

Also (SS) application is provided with type multimedia user.

In this paper two different number of scenarios are used fixed and mobile WiMAX with increase number of(SS) subscriber station both fixed and mobile WiMAX . used

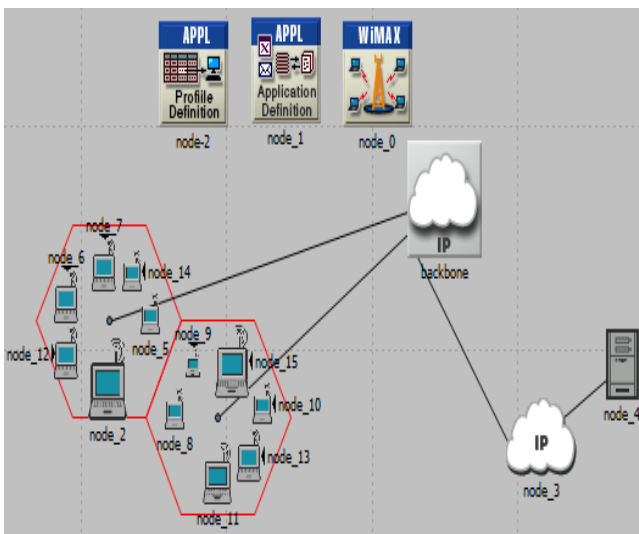
OPNET modeler 14.5 for simulation [10]. In start base station is provided with subscribe station and two type of application .

**Scenario1:** is shown in Fig.7 two base station (BS) connected to six(SS) Subscriber Station of fixed type.



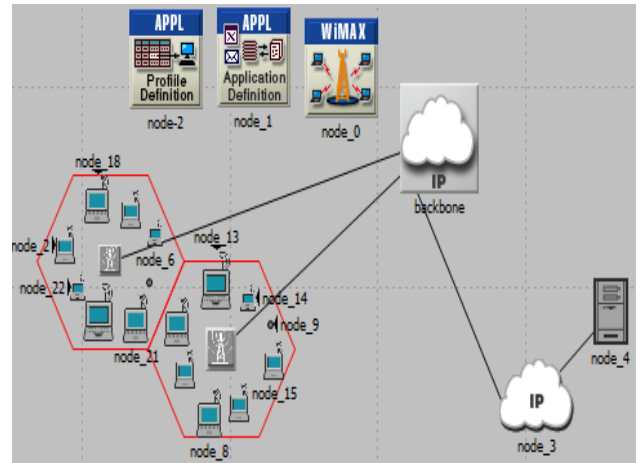
**Fig.7 Scenario1**

**Scenario 2:** shown in fig.8 used two Base station with increase number of (SSs) Subscribe station from type fixed to become 12 nodes.



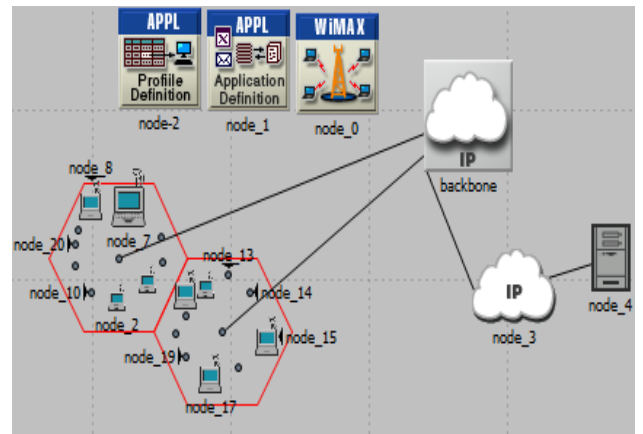
**Fig.8 Scenario 2**

**Scenario 3:** Fig.9 show two Base station is used and increase number of (SSs) Subscribe station from type fixed to become 16 nodes.



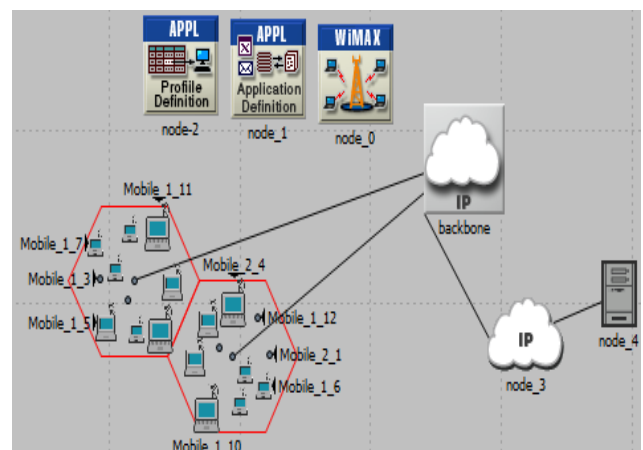
**Fig.9 Scenario 3**

Also in Scenario 4 two Base station is used with 16 Subscriber Station of fixed type as shown in Fig.10 .



**Fig.10 Scenario 4**

**Scenario 5:** In this scenario two Base station is used but it is connected to 20 number of mobile nodes. As shown in Fig.11



**Fig.11 Scenario 5**

In addition in Scenario 6 also two base station are connected to number of mobile nodes after increasing the number of mobile nodes 28 nodes this Scenario is shown in Fig12 .

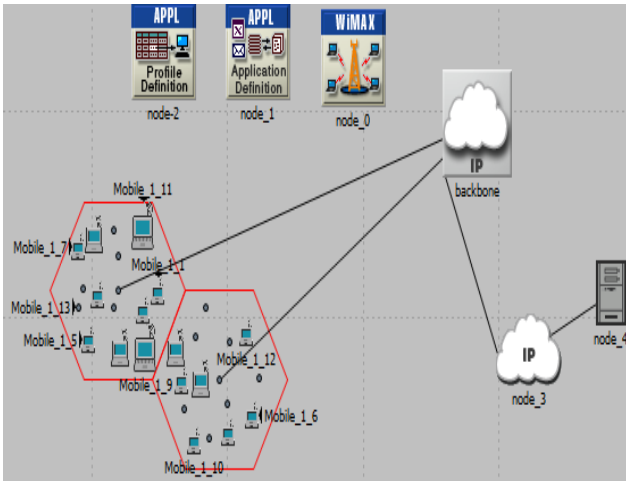


Fig.12 Scenario 6

Also in Scenario 7,8 two Base Station is used with increase number of mobile node Fig13 ,Fig14 .

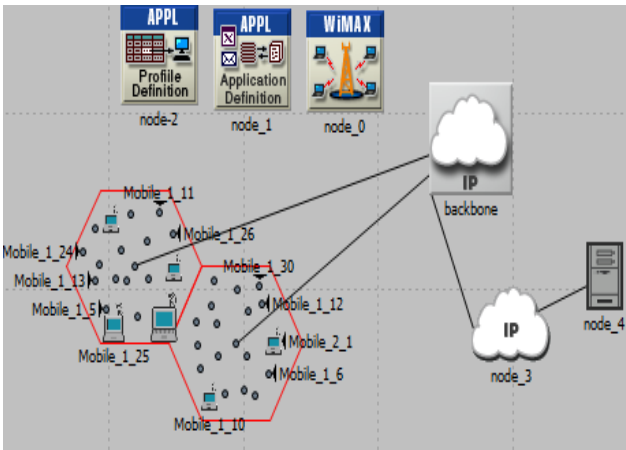


Fig.13 Scenario 7

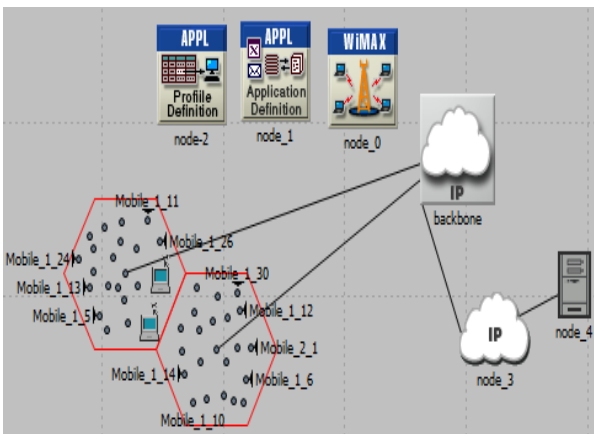


Fig.14 Scenario 8

Continues, After running each Scenario in time 600 Sec with size constant all scenarios of cells 1m to find delay to fixed WiMAX .On Opnet modeler 14.5 it is found curves of delay allocated to fixed node and to get results to find average on excel sheet shown on Fig.15 .From results that the notes average delay increase starting from value 0.270 to reach the value 2.071, linearly as the number of SSs increases causing higher delay with more SSs.

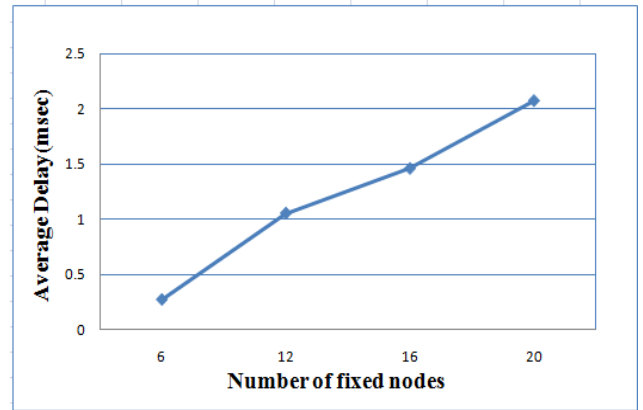


Fig.15 Average Delay in fixed nodes

Also after running each Scenario mobile nodes at same time to get curves of delay in state of mobile starting from value 0.860 to Reach value 1.729 and to get results to find average delay on excel sheet shown in fig.16 .That notice there is an increase in mobile node higher from a fixed node.

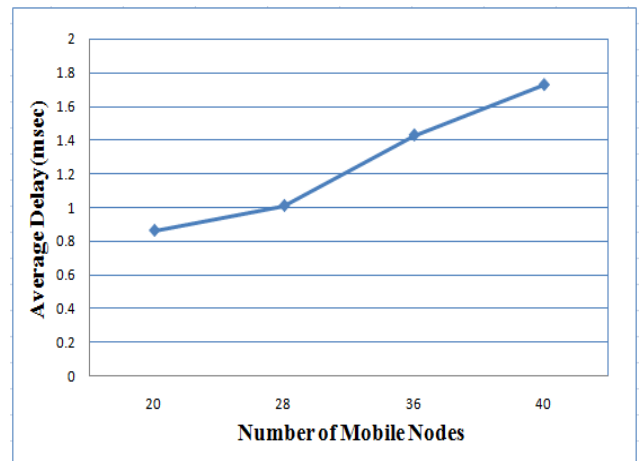


Fig.16 Average Delay in mobile nodes

Also it is noticed an increase in average delay with increase in number of nodes. But in a less values.

As well as after running to get curves of load and results from curves to find average of load allocated to fixed nodes on excel sheet shown in Fig17 . starting from value 8.647 to reach value 25.615.

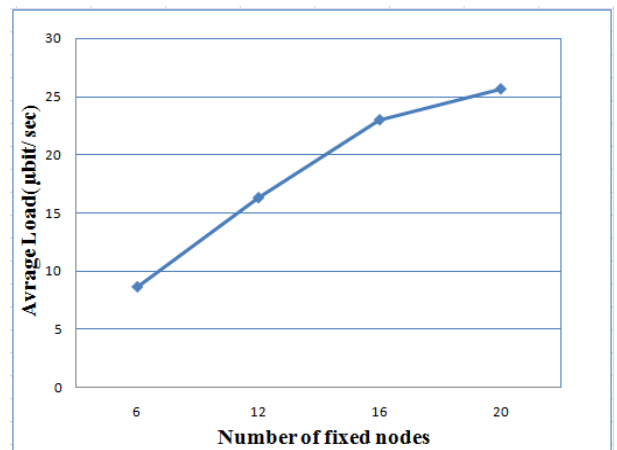


Fig.17 Average Load in fixed nodes

Also after running the network of mobile it is get curves of load which represented results of curves to get on average of load on excel sheet shown on Fig18 .Starting from value 28.133 to reach value 50.789.As the result it is notice increase in mobile node higher from fixed node.

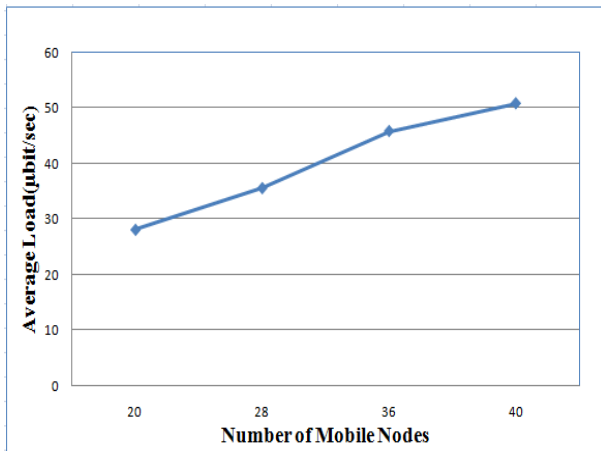


Fig.18 Average Load in mobile nodes

In addition, also after running curves of throughput is got and is converted to excel sheet to get on average Throughput to fixed nodes as shown in Fig19 .In average throughput that different the values in state fixed node suffer an increase in values with decrease in values according amount of the data transmitter and receiver.

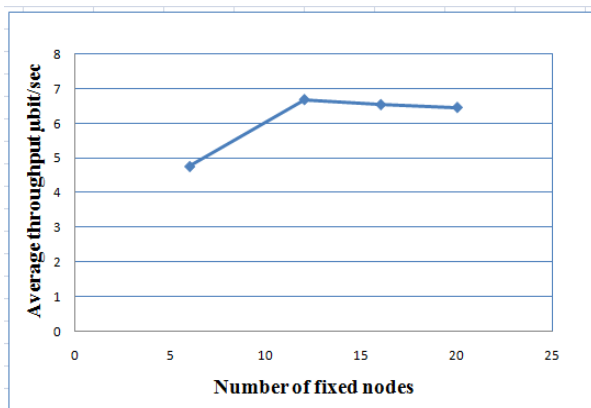


Fig.19 Average throughput in fixed nodes

In similar, in this work average of throughput is get related to mobile nodes from results on excel sheet shown on Fig.20 .the values decreases to reach the limited values and starting increase according of data between base station and subscribe station.

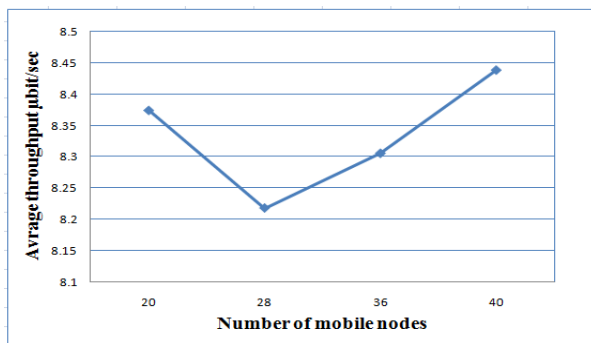


Fig.20 Average throughput in mobile nodes

In Fig.21 notice changing in application of video conferencing after running all of scenarios. notice changing in application of video.

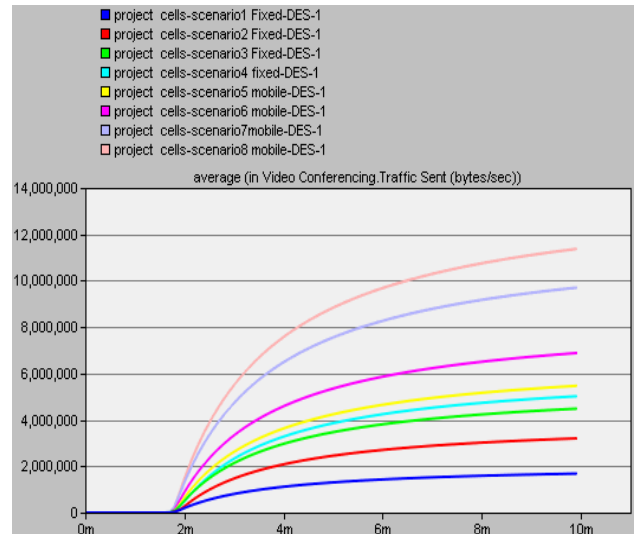


Fig.21 Average video conferencing. Traffic sent

Also in Fig.22 after running notice changing in application the voice in all scenarios. notice changing in application in traffic sent of voice .

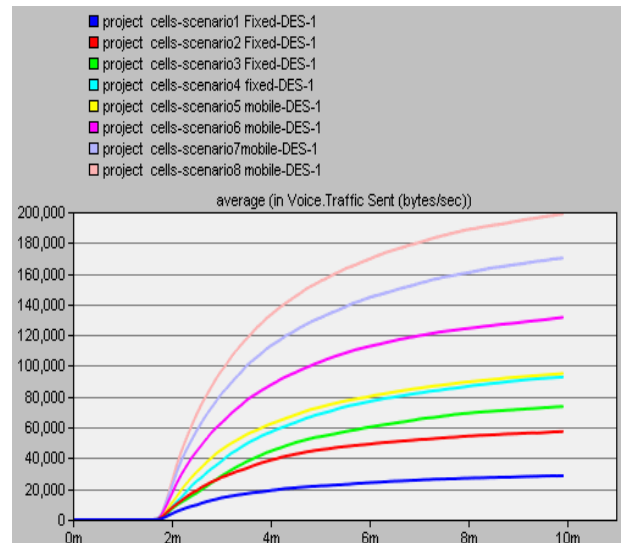


Fig.22 Average voice. Traffic sent

### 3. CONCLUSION

In this paper study to find comparative analysis fixed WiMAX and mobile WiMAX through this work after providing two type form applications video and voice over IP using simulation tools OPNET 14.5. Also all results obtained from curves found that changing in level on delay ,load, throughput depending on number of nodes fixed and mobile WiMAX , Noticed from results of fixed nodes and mobile nodes increase in parameters delay ,load and changing in level curves of throughput depending on increase of number of nodes that technical development in mobile or fixed WiMAX. Also notice average traffic send both video and voice when increasing number of nodes Through these statistics found two different types of works.



The future work is study the performance analysis of mobile using the video system in mobility state as well as improve the transmission and receiver of data for the video signal and try to reduce the effect of external factors on video system, for example delay time and interference signals.

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