Analysis of VoIP by varrying the number of nodes failure in WiMAX Network

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Abstract— WiMAX stands for Worldwide Interoperability for Microwave Access. Multimedia applications are gaining much of the user attention with the introduction of new broadband technologies. VoIP is the most well known service of WiMAX and is a growing rapidly in world of telecommunication. Not only for improved quality but for also a wide range we prefer wireless networks. As in wireless networks nodes are mobile mean they can move freely so in thesis work basic analysis is done on the performance under nodes failure, as they are mobile so there are chances that nodes can be failed so in case of failure ,what is its effect on the entire performance of the network has been analysed. Three codecs have been used to check the performances that are g711, g723, g729.Various codecs have been used to check the performance. In this Paper, the performance of WiMAX for Voice over IP (VoIP) by varying no. of nodes failure is analyzed for two transmitter techniques MIMO and SISO. The performance is analysed by using OPNET Modeller. The performance is compared in terms of Load, Delay and Traffic Received, Traffic sent, Throughput, End-to-End Delay.

Keywords—VoIP, codec, MIMO

I. INTRODUCTION

Worldwide Interoperability for Microwave Access (WiMAX), is a wireless communications technology aiming to provide wireless data over long distances in a variety of ways as an alternative to cable and DSL, from point-to-point links to full mobile cellular type access [1]. It is based on the IEEE 802.16 standard. The name WiMAX was created by the WiMAX Forum, which was formed in 1st April 2001 as an industry-led, not-for-profit organization to promote conformance and interoperability of the standard. The increasing demand of WiMAX for VoIP and high-speed multimedia is due to the simplicity of installation and cost reduction compared with the traditional wired DSL cable [2]. A vast growth rate of WiMAX users in market studies last years, 133 million subscribers will be supported at the end of 2012 [3]. There is an increasing trend to install WiMAX technology for offering different application, such as voice, data, video, and multimedia services. Each of these applications has different QoS requirements. The IEEE wireless standard has a range of up to 30 miles, and can deliver broadband at around 75 megabits per second.

VoIP as a communication technology supports transportation of voice data via Internet Protocol (IP) based networks.VoIP is a protocol that allows users to make calls over the internet.

Protocols that are used to carry voice signals over the IP network are commonly referred to as voice-over-IP (VoIP) protocols[12]. VoIP is also referred as Internet telephony, IP telephony or voice over the internet. Voice over IP entails that VoIP is based upon IP hence, the transmission technology is basically in digital form [11]. Few of commercial computer applications which make use of VoIP applications such are Skype, yahoo messenger and goggle talk [4].

II. LITERATURE SURVEY

In, 2008, Emir Halepovic,et al. [10] used experimental measurements to study the performance of multimedia applications over a commercial IEEE 802.16 WiMAX network. Voice-over-IP (VoIP) and video streaming (RealPlayer) applications are tested. The WiMAX-based network solidly supports VoIP, providing adequate quality for short to medium duration calls. The voice quality degradation compared to high-speed Ethernet is only moderate, despite higher packet loss and network delays. Their results show that WiMAX networks can adequately support currently popular multimedia Internet applications.

In 2012, S. Alshomrani,et al. The impact of various voice codec schemes and statistical distribution for VoIP over WiMAX has been investigated in detail [5]. Through various simulation experiments under realistic networking scenarios, this study provides an insight into the VoIP performance in the WIMAX networks. Parameters that indicate the Quality of Service such as delay, jitter, packet loss and MOS are analyzed in these scenarios. The simulations results indicate that better

choice of voice codecs and statistical distribution have significant impact on VoIP performance in the WiMAX networks.

In 2013, Elechi Onyekachi et al. adopted a simulation-based network performance analysis to investigate the effects of the application of different voice encoder schemes on QoS of VoIP system deployed with IEEE 802.16e standard WiMAX network[6].Through different network simulation experiments using realistic network scenarios in OPNET environment, this research provided an in-depth network performance comparative analysis of VoIP over WiMAX using performance parameters which indicate QoS such as voice jitter, voice packet ETE delay, packet-sent-packet-received, WiMAX network delay, voice packet delay variation and throughput. The obtained simulation experiment results indicated that choice of suitable codec scheme can affect the QoS of VoIP traffic over WiMAX network. The results also indicated that the choice of suitable voice encoder scheme with a small number of voice frame-size per packet have a significant impact over VoIP traffic performance when deployed with WiMAX access technology.

In 2014, Preetinder Singh et al., studied that Worldwide interoperability for Microwave access (WIMAX) is a 802.16 wireless communication standard that provides high speed, throughput and cover larger area[7]. VOIP through WiMAX is most prominent service and is a growing rapidly in world of telecommunication. In this paper basic overview of VOIP is given and performance of WiMAX over different parameters like jitter, MOS and packet end to end delay have been addressed. In same manner, VOIP is expected to be a low cost communication medium.

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III. SIMULATION SETUP

In this experiment the Effect of Nodes failure on VOIP over WiMAX is analyzed by using OPNET Simulator. OPNET Simulator 14.5 [8] 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 [8]. In this experiment in each scenario eight Hexagonal cells are taken. Each cell has a radius of 2 Km. and in each cell there is one Base station and 20 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 VOIP server through ppp Sonet os12 link as shown in fig 3.1. To analyze the performance of node failure different experiments are carried out as follows:-

Experiment 1: here we used scenarios simulation to study the effect of different codecs on VoIP services over WiMAX networks without nodes failure. Then we make scenario with nodes failure to study the effect of different codecs on VoIP services over WiMAX networks by varying nodes failure. The no. of nodes failure taken is 4 and 6 in different scenarios the encoder schemes used for the investigation include ITU-T G711 (default encoder scheme), G723 and G729 with voice frame size used per packet set to “7”. These experiments are repeated for two Transmitter techniques STC 2x1 MIMO and SISO.

Experiment 2: here we used scenarios simulation to study the effect of different codecs on VoIP services over WiMAX networks without nodes failure. Then we make scenario with nodes failure to study the effect of different codecs on VoIP services over WiMAX networks by varying nodes failure. The no. of nodes failure taken is 4 and 6 in different scenarios the encoder schemes used for the investigation include ITU-T G711 (default encoder scheme), G723 and G729 with voice frame size used per packet set to “13”. These experiments are repeated for two Transmitter techniques STC 2x1 MIMO and SISO.

A. Voice Application Configuration

In this experiment the Effect of Nodes Failure on VOIP over WiMAX is analyzed by using OPNET Simulator. OPNET Simulator 14.5 [9] was used to analyze the performance of WiMAX. We used OPNET modeller, as OPNET modeller provides a comprehensive development environment supporting the modelling of communication network and distributed systems. OPNET modeller provides better environment for simulation, data collection and data analysis [8].

As shown in the fig 3.1 the placement of nodes are circular. Within hexagonal cell of radius 2 km. Here the speed of each node is 5m/s. The BS connected to the IP backbone via a DS3 WAN 38 link. The base stations are connected to backbone cloud through ppp_DS3 link.

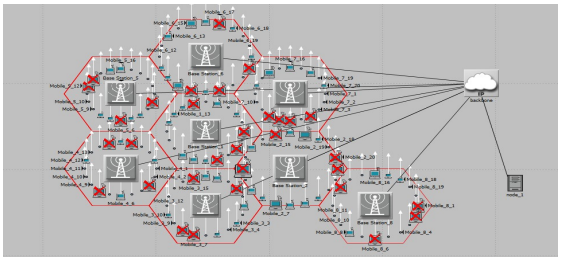


Fig 3.1: Model of WiMAX Network

It is followed by the voice table of voice application that is being shown in fig 3.2, voice table shows the various parameters that are being established for the size of frames as per voice packets.

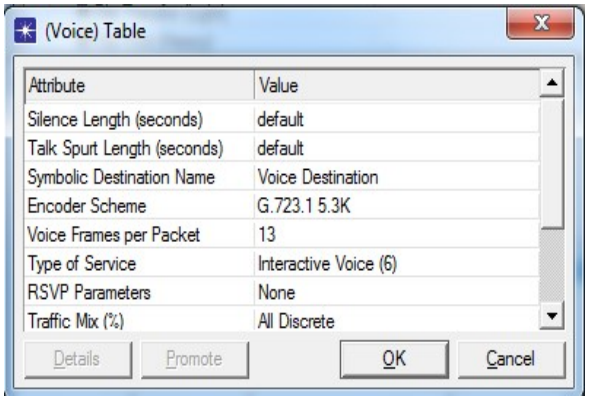


Fig 3.2 Voice table

And the following table shows the parameters and their values that we are going to use in our thesis work.

Table 3.1: Simulation Parameter

Parameters	Value
Bandwidth	20 MHz
Antenna Gain	14dBi
Data Rate	5 Mbps
Physical Profile	SISO,MIMO
Max. Power Transmission	10 Watt

The table shown above shows the various parameters that we have chosen for the simulation work. We have mention the basic parameters like antenna gain in this attribute it can be used to bypass the antenna gain computations at the node and can be used as a provided gain value for all directions. Next is power transmission in this the power specified in this attribute refers to the total transmission power that this transmitter can output over the entire channel bandwidth.

B. **WiMAX Configuration**

In WiMAX model ErtPS and best effort scheduling class was created for the downlink and uplink to support the voice. The scheduling was configd with 5 Mbps Maximum sustainable traffic rate, and 1 Mbps Minimum sustainable traffic rate as shown in Fig 3.3.

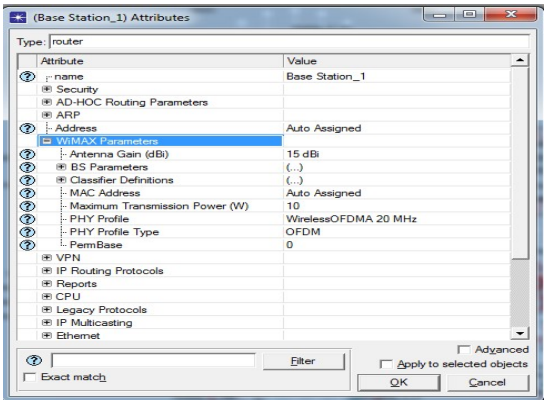


Fig 3.3: Base Station Parameters

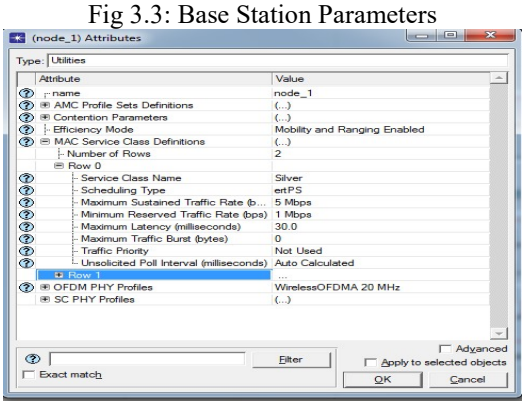


Fig 3.4: Classes Configuration

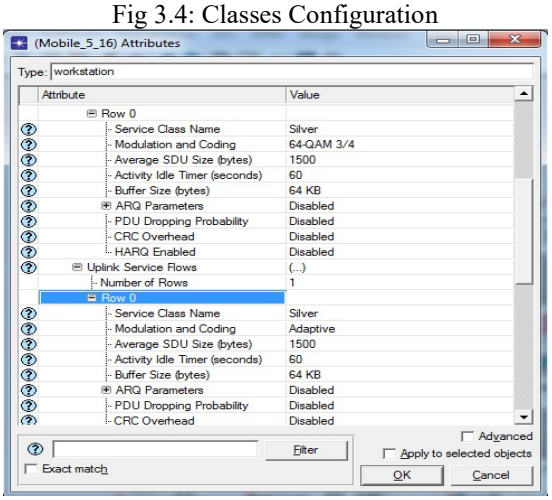


Fig 3.5: WiMAX Subscriber Station Parameters

The Mobile WiMAX Subscribers and Base Station is configd with match property of Type of service (ToS). In Each WiMAX Subscribers the 64 QAM modulation and coding scheme is used for Downlink and 16 QAM is used for uplink as shown in fig 3.4 and fig 3.5.

IV. SIMULATION RESULTS

The effect of VoIP over WiMAX under nodes failure by using various modulation techniques is being analyzed. The comparison is done in terms of Load, Delay, Traffic Sent, Throughput.

The analysis is done over various codecs but we examine the performance by varying the number of

nodes failure in particular g711 codec as it is best among other codecs as per our analysis work shows. Different scenarios have been created separately for SISO and MIMO by taking voice frame per packet 7 and 13.

Packet Size	Voice Codecs	No. Of Nodes Failure	Traffic Sent (bytes/sec)	Delay (sec)	Load (bits/sec)	Throughput (bits/sec)
7	g711	0	1.28E+06	0.033871	11065300	34562.5
		1	1.23E+06	0.026456	1.06E+07	36824.4
		2	1.16E+06	0.027495	9.97E+06	27709.6
		3	1.10E+06	0.028125	9.40E+06	30300
		4	1.05E+06	0.032246	9035420	59008.9
		6	9,10,000	0.037039	7925770	69,120
		8	812625	0.035687	6.98E+06	7.81E+04
		12	564928	0.036666	4.88E+06	136899
		16	322442	0.038555	2.84E+06	265986
		20	1	No Graph	1728.89	1
13	g711	0	1.29E+06	0.04243	10705100	69436.4
		1	1.22E+06	0.043012	1.01E+07	93528.5
		2	1.16E+06	0.042873	9.64E+06	77163.2
		3	1.10E+06	0.045863	9.11E+06	70193
		4	10,49,090	0.037346	87,23,700	53,000
		6	10,10,010	0.036609	76,80,720	65,200
		8	801915	0.040212	6.68E+06	9.67E+04
		12	551119	0.043449	4.60E+06	146398
		16	308129	0.040997	2.58E+06	174752
		20	0	no grph	1728.89	1

Fig 4.1 Comparison of g711 SISO scenarios

Packet Size	Voice Codecs	No. Of Nodes Failure	MIMO Traffic Sent (bytes/sec)	MIMO Delay (sec)	MIMO Load (bits/sec)	MIMO Throughput (bits/sec)
7	g711	0	12,90,990	0.033203	1,10,00,000	69,999
		1	1.23E+06	0.034035	1.06E+07	65544.6
		2	1.16E+06	0.033872	9.95E+06	66733.2
		3	1.11E+06	0.034646	9.50E+06	77364.7
		4	10,20,000	0.036979	90,00,000	68,956
		6	9,00,010	0.038	80,00,000	71,000
		8	807492	0.039208	6.92E+06	7.25E+04
		12	568599	0.0383	4.90E+06	116891
		16	314518	0.038192	2.73E+06	122631
		20	1	No Graph	1728.89	1
13	g711	0	12,90,990	0.047538	10980000	68,000
		1	1.23E+06	0.047842	1.02E+07	79948.9
		2	1.16E+06	0.064555	9.64E+06	29333.3
		3	1.11E+06	0.025003	9.08E+06	30728.9
		4	10,20,000	0.044364	8.67E+06	6500
		6	9,00,010	0.045	75,91,340	31,740
		8	807492	0.026309	6.56E+06	2.84E+04
		12	568599	0.040887	4.49E+06	150945
		16	314518	0.355254	2.63E+06	535884
		20	1	No Graph	1728.89	0

Fig 4.2 Comparison of g711 MIMO scenarios

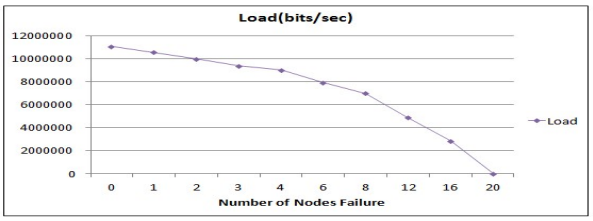
Three codecs have been analyzed namely g711, g723, g729 over different scenarios by varying the number of nodes failure. Among them the g711 codec has shown us the best analysis value that's why further analytical work is done by taking it in consideration. There are number of scenarios have been created over them all parametric values have been analyzed.

Following different graphs will show their analytical values.

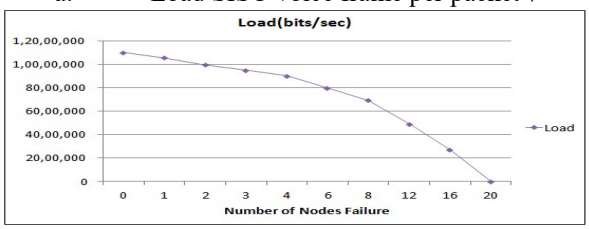
Analysis is being done on the basis of varying transmitters that are SISO and MIMO and also over voice frame per packet size either 7 or 13.

A. **Load**

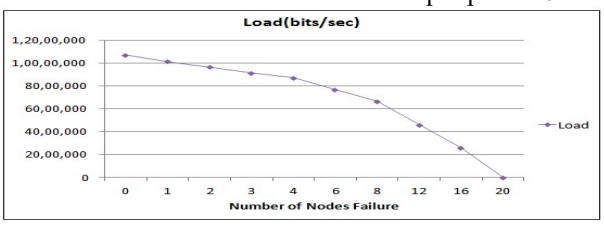
Load shows the performance of nodes with or without nodes failure for different codec schemes and having different frame size. Following figs shows that as we increase the no. of nodes failure the load will decrease. Load in networking or in the network we can say that the amount of data or we can say traffic being carried by the network.



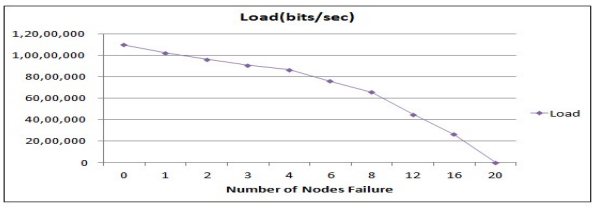
a. Load SISO voice frame per packet 7



b. Load MIMO voice frame per packet 7



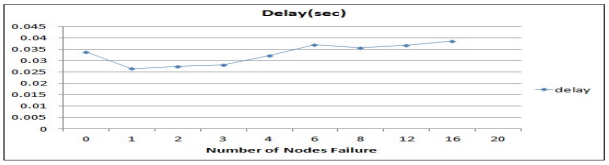
c. Load SISO voice frame per packet 13



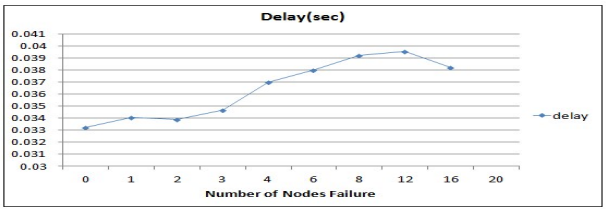
d. Load MIMO voice frame per packet 13

B. **Delay**

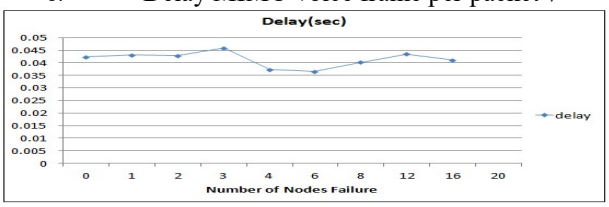
Figs show that as we increase the no. of node failure the delay will increase. These figs also shows that if we increase the no. of voice frame per packet there is no effect in delay, which shows delay is not dependent on the number of voice frames per packet.



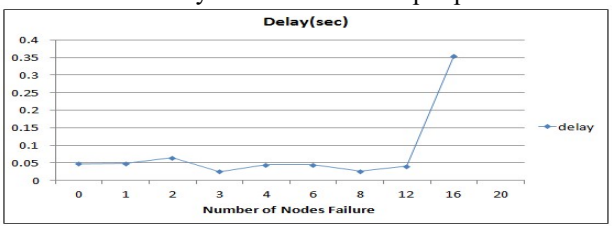
a. Delay SISO voice frame per packet 7



b. Delay MIMO voice frame per packet 7



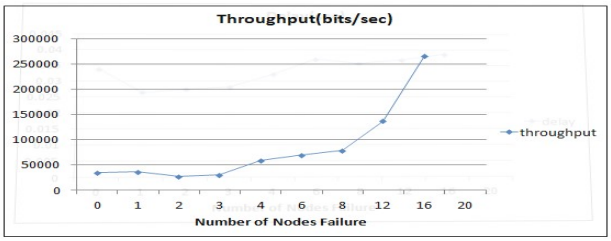
c. Delay SISO voice frame per packet 13



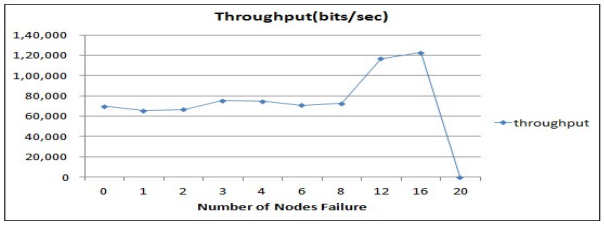
d. Delay MIMO voice frame per packet 13

C. **Throughput**

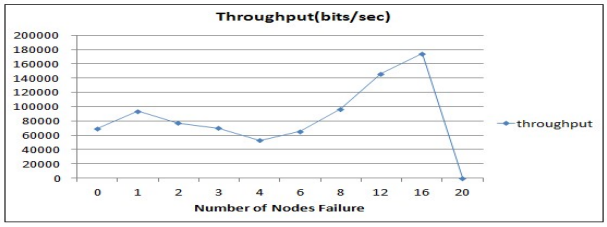
Fig shows that when the node failure is increased the throughput also increase but it is still less than when their no failure of node.



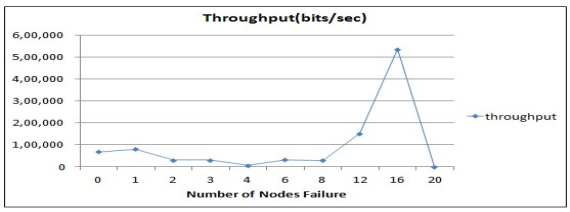
a. Throughput SISO voice frame per packet 7



b. Throughput MIMO voice frame per packet 7



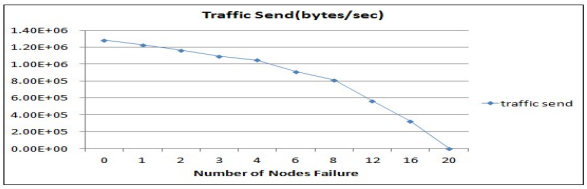
c. Throughput SISO voice frame per packet 13



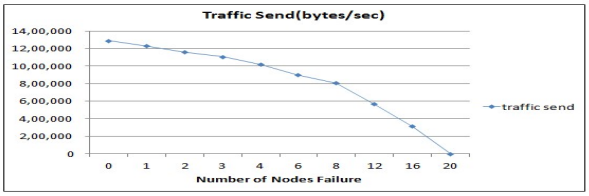
d. Throughput MIMO voice frame per packet 13

D. **Traffic Sent**

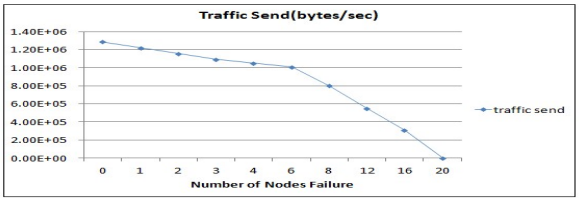
Fig shows that as we add the node failure nodes the traffic sent decrease.



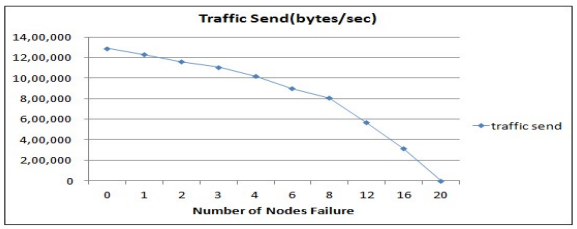
a. Traffic Sent SISO voice frame per packet 7



b. Traffic Sent MIMO voice frame per packet 7



c. Traffic Sent SISO voice frame per packet 13



d. Traffic Sent MIMO voice frame per packet 13

V. CONCLUSION

The OPNET Modeller 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 three minutes. The results showed that with increase in nodes failure delay, throughput increases and traffic send, load decreases.

The result also shows that the performance of g711 is better than other in terms of load and delay, Throughput, Traffic sent.

So overall performance of g711 is better than other. The

result shows that for SISO Traffic received is less and delay is more than MIMO. So the performance of MIMO is better than SISO.

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