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Performance Comparison of Different Mobility Model on Topology Managed MANET

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ABSTRACT

A wireless ad hoc network is a sovereign system in which users can communicate with each other freely. It can be deployed rapidly at a very low cost, and can be easily managed and extended. Topology management has main objective to maintain a topology connectivity that improves wireless network performance by minimizing energy consumption. Also Topology control with cooperative communication was recently research initiated .Cooperative Communication (CC) is a technique that allows no. of nodes to simultaneously transmit the same data. It can save power and extend transmission coverage. Topology management with cooperative communication is new research initiated in the field of Mobile Ad-hoc Network. In this paper, we analyze the effect of multi-traffic on the topology managed MANET. We implemented some applications on different mobility models that is OLSR move and random mobility. To simulate all scenario OPNET 14.5 software is used. OPNET is a comprehensive suite of tools for modelling large wired and wireless networks. It uses simulation and emulation to predict the behaviour and performance of networks to improve their design, operation and management.

In the first part of paper, implemented the existed network on the OPNET simulator and evaluate the performance (Download Response Time, Traffic Send and Traffic Receive) of OLSR move based topology control network.

In the second part of paper, evaluated the QoS performanc (Delay, Download Response Time, Traffic Send and Receive Response) of Random Mobility based topology control network. From the simulation results we observed that compare with OLSR move models, the Random mobility model performance is good. We implemented different traffic pattern on two Topology managed MANET.

In the third part of paper, implemented the dynamic traffic pattern like Email, FTP & Voice and video conferencing on the proposed network. Simulation results show that FTP and E-mail both have large download response time in case of OLSR move model rather than Random Mobility model. Traffic send and receive performance of email is good in OLSR-move model. Video Conferencing has good response of traffic send and receive in Random Mobility model.

Keywords: **MANET, OLSR, Random Mobility, OPNET 14.5**

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I. INTRODUCTION

It is an infrastructure less IP based network of mobile and wireless machine nodes connected with radio. In operation, the nodes of a MANET do not have a centralized administration mechanism. It is known for its route able network properties where each node act as a "router" to forward the traffic to other specified node in the network.

MANETs are a kind of Wireless ad hoc network that usually has a routable networking environment on top of a Link Layer ad hoc network. MANETs consist of a peer-to-peer, self-forming, self-healing network. MANETs circa 2000-2015 typically communicate at radio frequencies (30 MHz - 5 GHz). In VANETs – Intelligent vehicular ad hoc networks make use of artificial intelligence to tackle unexpected situations like vehicle collision and accidents. Vehicular ad hoc networks (VANETs) – Enables effective communication with another vehicle or helps to communicate with roadside equipments. Internet Based Mobile Ad hoc Networks (I MANET) helps to link fixed as well as mobile nodes.

II. RELATED WORK

- **Performance evaluation of AODV and DSR on-demand routing protocol with varying MANET size by Nilesh P. Bobade, Nitiket N. Mhala**

A mobile ad hoc network (MANET) is a collection of wireless mobile nodes dynamically forming a network topology without the use of any existing network infrastructure or centralized administration. Routing is the process which transmitting the data packets from a source node to a given destination. The main procedure for evaluating the performance of MANETs is simulation. The on-demand protocol performs better than the table-driven protocol. Different methods and simulation environments give different results. It is not clear how

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these different protocols perform under different environments. One protocol may be the best in one network configuration but the worst in another. In this research an attempt has been made to compare the performance of on demand reactive routing protocols i.e. Ad hoc On Demand Distance Vector (AODV) and Dynamic Source Routing (DSR). As per our findings the differences in the protocol mechanics lead to significant performance differentials for both of these protocols. Always the network protocols were simulated as a function of mobility, but not as a function of network density. In which the performance of AODV and DSR is evaluated with respect to performance metrics like Packet Delivery Fraction (PDF), Average end-to-end delay, Normalized Routing Load (NRL) and throughput by varying network size up to 50 nodes. These simulations are arried out using the NS-2 which is the main network simulator, NAM (Network Animator), AWK (post processing script). Results presented in this research work demonstrate the concept AODV and DSR routing protocols w.r.t. MANET size in an Ad hoc environment.

- **On MANET Routing Protocols for Mobility and Scalability by Ashish Shrestha and Firat Tekiner.**

This research focuses on performance investigation of reactive and proactive MANET routing protocols, namely AODV, DSR, TORA and OLSR. MANET is a type of Ad Hoc network, and here its functionality is based on 802.11 IEEE standards to communicate in a discrete and disperse environment with no central management.
Hence, the main investigation done in this research is of the discrete feature and routing in MANET.
The main issue of MANET is the breakage of link at certain moment and re-generation of link at certain state as it consists of routers which are mobile in nature i.e. are independent to roam in an arbitrary motion.
Therefore, this research presents a performance comparison of the selected MANET routing protocols in a varying network sizes with increasing area and nodes size to investigate mobility and scalability of the routing process.

- **Improved OLSR Protocol in MANET by Rashmi, Vaibhav Jain and Pawan kumar.**

An independent collection of mobile nodes is known as MANET. Manet's network is decentralized when the network organization and message delivery are executed by mobile nodes. The routing functionality is still integrated into the mobile nodes.This research using a proactive routing protocol that is Optimized Link State Routing Protocol (OLSR).OLSR is proactive routing protocol. The unique character of OLSR is that it minimizes the size of control messages and rebroadcasting by using the MRP. This research adds a new field namely threshold energy in the packet format of the OLSR. This field increases the life time of the node that improves the performance of the network. We will use set of nodes i.e. numbers of nodes for simulation. From the simulation re comparison will be made between the existing model and the proposed model on the basis of parameters namely end to end delay, routing overhead and remaining energy. And performance is analyzed for proposed model with respect to the existing model.
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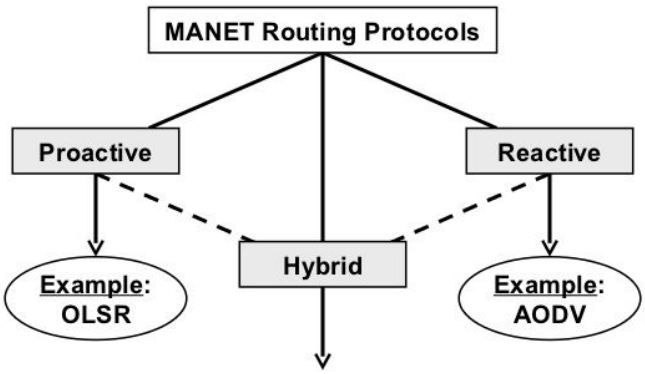
III. SYSTEM SIMULATION

1. Optimized Link State Routing Protocol (OLSR)

The Optimized Link State Routing Protocol (OLSR) is an IP routing protocol optimized for mobile ad hoc networks, which can also be used on other wireless ad hoc networks. OLSR is a proactive link-state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the mobile ad hoc network. Individual nodes use this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths. The mobile Ad hoc networks has the following features-

- Autonomous terminal
- Distributed operation
- Multi hop routing
- Dynamic network topology
- Fluctuating link capacity
- Light-weight terminals



Mobile Networks: IP Routing and MANET Routing Algorithms

In OLSR, a different approach is needed in order to optimize the flooding process. Using Hello messages the OLSR protocol at each node discovers 2-hop neighbor information and performs a distributed election of a set of multipoint relays (MPRs). Nodes select MPRs such that there exists a path to each of its 2-hop neighbors via a node selected as an MPR. These MPR nodes then source and forward TC messages that contain the MPR selectors. This functioning of MPRs makes OLSR unique from other link state routing protocols in a few different ways: The forwarding path for TC messages is not shared among all nodes but varies depending on the source, only a subset of nodes source link state information, not all links of a node are advertised but only those that represent MPR selections.

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2. Random-based Mobility Model

In mobility management, the random waypoint model is a random model for the movement of mobile users, and how their location, velocity and acceleration change over time. Mobility models are used for simulation purposes when new network protocols are evaluate. It is one of the most popular mobility models to evaluate mobile ad hoc network

(MANET) routing protocols, because of its simplicity and wide availability.

In random-based mobility simulation models, the mobile nodes move randomly and freely without restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes. This kind of model has been used in many simulation studies.

3. Description of model

The movement of nodes is governed in the following manner: Each node begins by pausing for a fixed number of seconds. The node then selects a random destination in the simulation area and a random speed between 0 and some maximum speed. The node moves to this destination and again pauses for a fixed period before another random location and speed. This behaviour is repeated for the length of the simulation.

4. Traffic Description

- **E-mail**: E-mail systems are based on a store-and-forward model. Email servers accept, forward, deliver, and store messages. The message header contains control information, including, minimally, an originator's email address and one or more recipient addresses.
- **Voice:** In voice transmissions, you need to have the packets to arrive in order and they have to take the same short time to transmit. Data stream packets generally do not have to arrive in sequence, or in similar time differences.
- **FTP:** The File Transfer Protocol (FTP) is a standard network protocol used to transfer computer files from one host to another host over a TCP-based network. FTP is built on a client-server architecture and uses separate control and data connections between the client and the server.
- **Video conferencing:** Videoconferencing is the conduct of a videoconference by a set of telecommunication technologies which allow two or more locations to communicate by simultaneous two-way video and audio transmissions. The core technology used in a videoconferencing system is digital compression of audio and video streams in real time. The hardware or software that performs compression is called a codec (coder/decoder).

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IV. BASIC SIMULATION SCENARIO

MANET is used for accessing small area for temporarily purpose. We are implementing the comparison of OLSR clustered and random way mobility in MANET. The objective of this scenario is to collect OLSR related/random mobility statistic analyze them as the network dynamic changes. OLSR is a proactive protocol and Radom mobility is a reactive protocol, uses Multi-Point Relay (MPR) optimization as number of MPR nodes change. By this environment, we very much control our topology control of MANET. General view of basic scenario is shown below in figure.

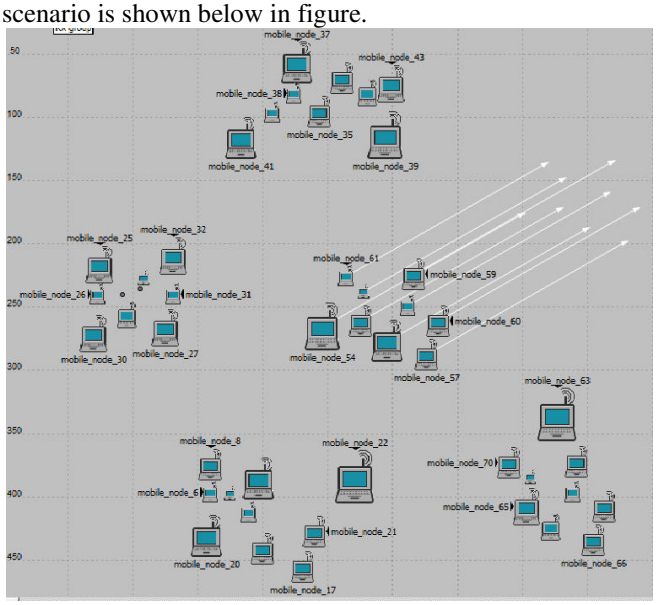

Figure 3.1: OLSR Clustered MANET

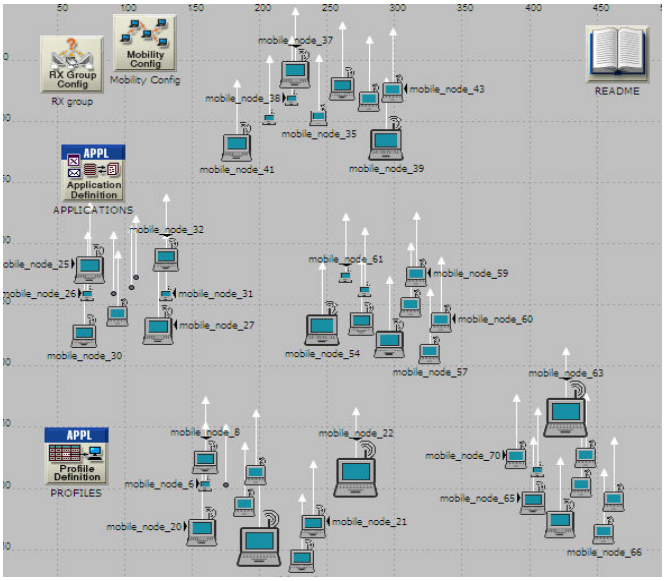

Fig 3.2 Random mobility clustered MANET

This network consists of 50 nodes, fig 3.1and fig 3.2 configured to run OLSR move and random mobility. The nodes in the networks are grouped in clusters. Nodes in the centre cluster are mobile. Those move along their

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trajectories at 50 seconds and stop at 60 seconds. IP demands are configured between pair of nodes.

Table 3.1: Parameter of Existed clustered network

Parameters	Default values
Network Grid	500x500 meters
Transmission Range	300 meters
OLSR Mobility	Only center cluster move
Random Mobility	Cluster move randomly
Routing protocol	OLSR move and random mobility

New scenario has been developed for evaluating routing protocols under topology management of cluster MANET. Simulation results are obtained to analyze effects on QoS performance of proposed cluster MANET by different traffic patterns. We analyze the effect on QoS of MANET by implementation of multi traffic such as E-mail, Ftp, Voice and video conferencing traffic. Finally, we compare routing protocol the OLSR move and random mobility with the existing clustered MANET. Therefore the project work represents performance of different types of traffics under topology management. Following table shows simulation parameters of proposed MANET. We assume these parameters for our prototype scenario.

Table 4.1: Simulation Parameters

Parameters	Value
Terrain size	500*500m
Physical Protocol	802.11b
Routing Protocol	OLSR
Transmission Range	300m
Trajectory	Olsr move, random mobility
Simulation Time	300s
Number of Nodes	70
Average speeds	20 m/s

1. Performance Metrics

There are various performance metrics of Topology control in MANET like delay, download response time and traffic receive or send etc. The following is a brief discussion of these metrics.

- **Delay time**- Delay indicates the length of time taken for a packet to travel from the source to the destination. It represents the average data delay an application experiences during transmission of data. The end-to-end delay is the time taken for a data packet to reach the destination node.
- **Response Time**- The elapsed time between end of an inquiry or demand on a computer system and beginning of the response e.g. the length of the time traffic to all received by the destination.
- **Traffic send time**-The information send from source side means packet send per sec from source. Total packet send time is how many packets is send per second.
- **Traffic receive time**-The information receive by receiver side in per second. Destination give information about how many packets are received by receiver in per second.

V. SIMULATION RESULTS

The proposed ad-hoc network, all the clusters are move with the similar trajectory of centre cluster and every node is behave as MPR (Multi point Relay) to establish a cooperative communications. All the performance of network is check on the highly mobile environment. Now on this network we optimize the various parameters like: delay, download response time, traffic receive and send value with different scenarios. Following are the different scenario for the proposed MANET:

1. **Analyze the download response time of E-mail under the performance of OLSR move and Random mobility**.

All clusters are moved in both OLSR move and Random way mobility. OLSR move is proactive routing and random mobility is reactive routing fig.4.1 shows the comparision of OLSR move and Random mobility in download response time.

- In fig 4.1, this graph show the download response time of random mobility is less as compare to OLSR move.
- Average value of OLSR move is maximum as compare with random mobility shown in below table.

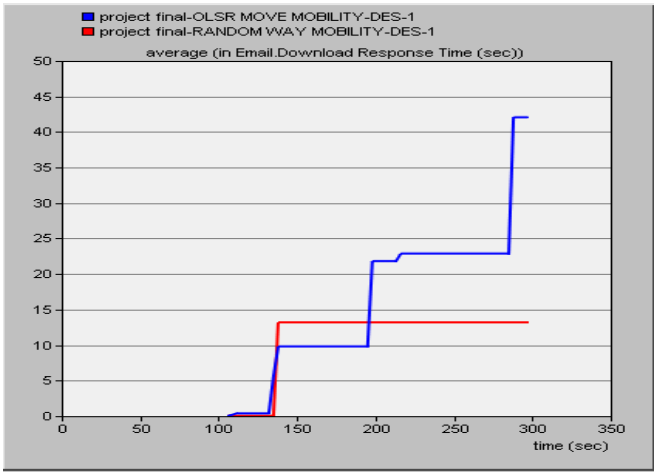

Fig 4.1: E-mail download response time /sec

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Table 4.2: Average response of E-mail

Routing protocols	OLSR move	Random mobility
Average value	16.21682	10.97938

2. Analyze the download response time of Ftp under the performance of OLSR and Random way mobility

Here, we shows the fig 4.2 graph of download response time of Ftp.

- This graph, give the comparison of download response time of random mobility and OLSR move. OLSR move has maximum download response time.
- Average value of OLSR move is maximum as compare with random mobility shown in below table.

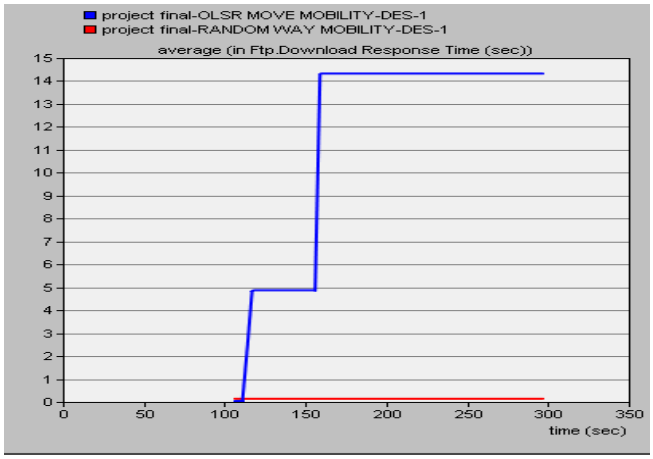

Fig 4.2: Ftp download response time/sec

Table 4.3: Average response of Ftp

Routing protocol	OLSR move	Random mobility
Average value	11.44476	0.13869

3. Analyze the response traffic send and receive of voice under the performance of OLSR and Random way mobility

Here, fig 4.3 and 4.4 show the graph of Traffic receive and send response of voice is given below:

IN VOICE TRAFFIC SENT PACKET PER SEC

- Fig 4.3 this graph, shows the Random mobility has sent more data as compare to OLSR move.
- Average value of random mobility is greater than to OLSR move shown in below table.

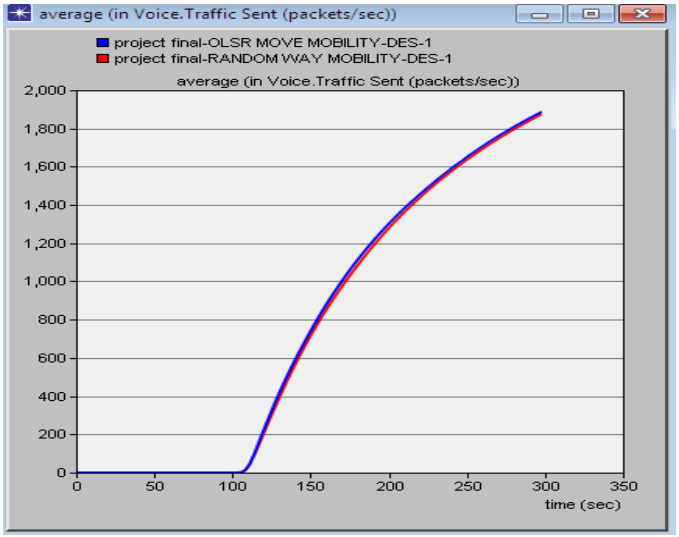

Fig 4.3 Traffic sent packets/sec in voice

Table 4.4: Average response of voice (traffic sent)

Routing protocol	OLSR move	Random mobility
Average value	1.764846	2.058925

IN VOICE TRAFFIC RECEIVED PACKET PER SEC

- Fig 4.4 this graph, shows the Random mobility received less data as compare to OLSR move.
- Average value of OLSR move is greater than to random mobility shown in below table.

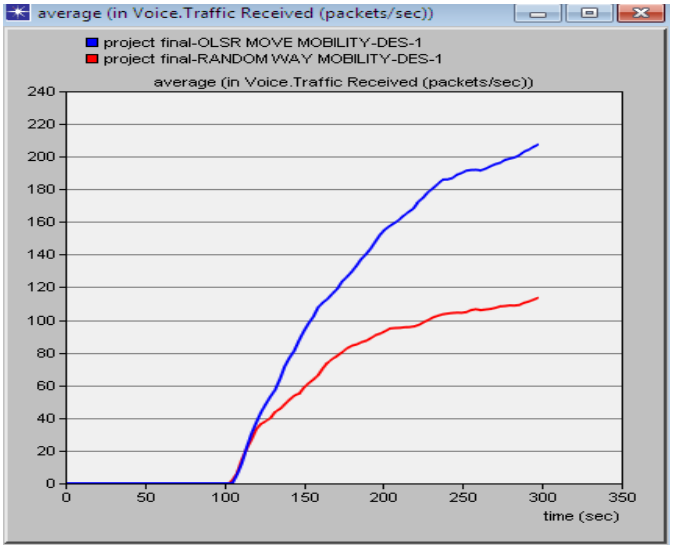

Fig 4.4 Traffic received packets/sec in voice

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Table 4.5: Average response of voice(traffic received)

Routing protocol	OLSR move	Random mobility
Average value	137.1776	81.06959

4. Analyze the response traffic send and receive of video conferencing under the performance of OLSR move and Random way mobility.

Here, we shows the fig 4.5 and 4.6 graph of Traffic receive and send response of video conferencing is given below:

IN VIDEO CONFERENCING TRAFFIC SENT PACKET PER SEC

- Fig 4.5 this graph, shows the Random mobility has sent more data as compare to OLSR move.
- Average value of random mobility is greater than to OLSR move shown in below table.

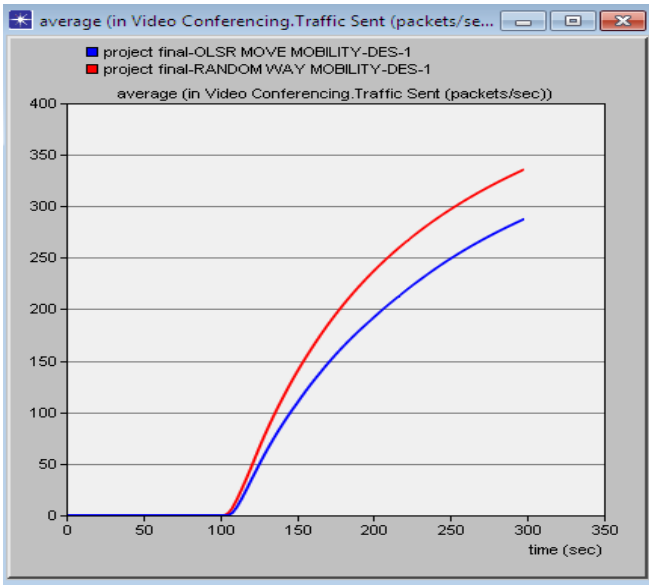

Fig.4.5 Traffic sent packets/sec in video conferencing

Table4.6: Average response of video conferencing(traffic sent)

Routing protocol	OLSR move	Random mobility
Average value	176.3221	214.1967

IN VIDEO CONFERENCING TRAFFIC RECEIVED PACKET PER SEC

- Fig 4.6 this graph, shows the Random mobility received large data as compare to OLSR move.
- Average value of random mobility is greater than to OLSR move shown in below table.

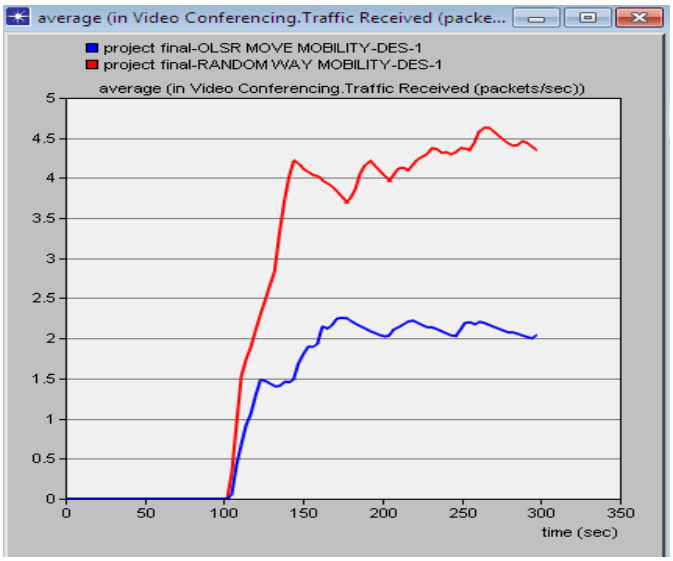

Fig 4.6: Traffic received packets/sec in video conferencing

Table4.7: Average response of video conferencing (traffic received)

Routing protocol	OLSR move	Random mobility
Average value	1.893735	3.831469

5. Analyze the delay response of Wireless LAN under the performance of OLSR and Random way mobility.

Here, we shows the fig 4.7 graph of Traffic receive and send response of voice given below:

- Fig 4.7 this graph, shows the Random mobility has large delay as compare to OLSR move.
- Average value of random mobility in delay is greater than to OLSR move shown in below table.

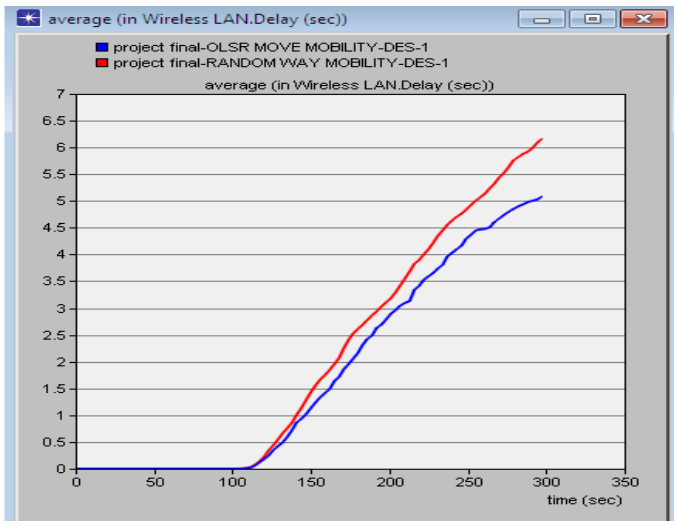

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Fig 4.7: wireless lan delay /sec

Table 4.8: Average response of Wireless LAN delay

Routing protocol	OLSR move	Random mobility
Average value	1.893735	3.831469

VI. CONCLUSION

Topology management has main objective to maintain topology connectivity, but with cooperative communication it is still a challenging work. To improve the QoS performance of MANET, we have implementing two topology management with cluster method and compare the performance of networks.

we implemented some applications (E-mail, Video Conferencing, Ftp and Voice) on different mobility models that is OLSR move and random mobility. From the performance of these models, we conclude that the download response time, traffic send and traffic receive in random mobility topology model give the good response as compare to OLSR move topology model. OLSR move topology give the good delay response as compare to random mobility topology.

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