EFFECT OF VARIED PAUSE TIME ON MOBILITY MODELS WITH AODV & OLSR PROTOCOL IN MANET

[1]Smt. Rekha Shahapurkar, [2]Dr. Umesh Kumar Singh, [3]Sh.Yogesh Mishra

[1]Reasearch Scholar, [2]Reader, [3]Assistant Professor
[1]ICS, Vikram University, Ujjain
[3]Lokmanya Tilak Sc & Comm College

***ABSTRACT*: A mobile Ad-hoc network (MANET) is a dynamic multi hop wireless network established by a group of nodes in which there is no central administration. Due to mobility of nodes and dynamic network topology, the routing is one of the most important challenges in ad-hoc networks. There are many routing protocols in Mobile Ad hoc Networks, the popular ones being AODV, DSR, OLSR, and DSDV. Although a lot of research work is done on individual protocol but not enough research is done on comparing these protocols under different Mobility Models. These mobility models play a significant role in determining the performance of MANET routing protocols. So there is a real need to study and evaluate different mobility models and their effect on MANET by using routing protocols parameters. The research is carried out using discrete event simulation environment software known as OPNET Modeler Version 14.5. In this research paper the main objective is to analyze, simulate and do a comparative analysis of different Mobility Model with MANET routing protocols namely AODV (Ad Hoc On Demand Distance Vector) and OLSR (Optimized Link State Routing). This paper will perform a comparison between these models considering the following performance metrics (Average End to End Delay, Throughput and Overheads, with respect to different Pause Time).**

***IndexTerms*: MANET, AODV, OLSR, RWP, RPGM**

1) Introduction

For almost two decades, mobile communication has become a major field of research and scientific discoveries. Mobile Ad hoc Network (MANET) has achieved a huge improvement due to its flexibility, easier maintenance, the non-existence of centralized control or fixed and static infrastructure as well as self administration and self-configuration abilities. The nodes can move randomly at random speeds in random directions. Each node in the network acts as a router, forwarding data packets to other nodes. There are many routing protocols of MANET. Each routing protocols have their own pros and cons. But mobility of nodes in the MANET follows some movement models. These models are called as Node Mobility Models. The mobility model is mainly designed to describe the movement pattern of mobile users, and how their location, speed and acceleration change with respect to time. The movement pattern of MANET nodes is characterized by mobility models and each routing protocols exhibits specific characteristics for these models. The mobility model is the one that is used to describe the pattern in which mobile nodes move. Based on the mobility model being used, the performance of a routing protocol can varies. Relative performance of the protocol also gets affected with these models.

While most of the work done related to the performance comparison of MANETs routing protocols includes either purely reactive protocols or purely proactive protocols. Some researchers have done a comparative study on reactive and proactive or reactive and hybrid protocols. The table 1 summarizes the work done by various researchers related to performance analysis of MANETs routing protocols

Table 1: Related work

Author Name Reference	Protocols Used	Simulator	Performance Metrics	Variable Parameters
Guntupalli et al. [1]	DSDV, DSR, AODV	NS2	Average End to End Delay, Normalized Routing Load, Packet Delivery Ratio	Number of Nodes, Speed, Pause time, Transmission Power
Yogesh et al. [2]	AODV, DSR	GLOMOSIM	Packet Delivery Ratio, End to End, Delay, Normalized routing overhead	Number of nodes, Speed, Pause time
Chenna et al [3]	DSDV, AODV, DSR, TORA	NS2	Throughput, Routing Overhead, Path Optimality, Packet Loss, Average delay	Traffic Loads, Movement patterns
G. Jayakumar et al[4]	AODV, DSR	NS2	Packet Delivery Ratio, Normalized Routing Load, MAC load and Average End to End Delay	Number of Sources, Speed,Pause time
Birdar et al.[5]	AODV, DSR	NS2	Packet Delivery Ratio, Routing Overhead, Normalized Routing Overhead and Average End to End Delay	Speed
Kapang et al. [6]	AODV, DSR, DSDV	NS2	Packet Delivery Ratio, Average End to End Delay and Routing Overhead	Pause Time
Vijayalaskhmi et al.[7]	DSDV, AODV	NS2	Packet Delivery Fraction, Average End to End Delay and Throughput	Number of Nodes, Speed, Time
Shaily et al. [8]	AODV, DSR, ZRP	QualNet	TTL based Hop Count, Packet Delivery Ratio and Average End to End Delay	Pause Time
Li Layuan et al. [9]	DSDV, AODV, DSR, TORA	NS2	Average Delay, Jitter, Routing Load, Loss Ratio, Throughput and Connectivity	Network Size

2) Mobility Models

In MANETs, mobile nodes roam around the network area. It is hard to model the actual node mobility in a way that captures real life user mobility patterns. Mobility models are designed to evaluate the performance of ad-hoc networks and characterize the movements of real mobile node in which variation in speed and direction must occur during regular time interval. Therefore, many researchers attempted to design approximate mobility models to resemble real node movements in MANET. Mobility models are generally classified into five categories. They are random mobility models, mobility models with temporal dependency, mobility models with spatial dependency, mobility models with geographic restrictions and hybrid mobility models.

In random mobility models, the nodes move independently by choosing a random direction and speed. In the case of mobility models with temporal dependency, the movement of nodes is affected by their movement history. In the mobility models with spatial dependency, the movement of nodes is correlated in nature. If the mobility model limits the movement of nodes owing to streets or obstacles, then such models fall under mobility models with geographic restriction. In hybrid mobility models, mobility models with spatial dependencies, temporal dependencies and geographic restrictions are integrated.

2.1 Random Waypoint Mobility Model

The Random Waypoint Model was first proposed by Johnson and Maltz[10]. Soon, it became a 'benchmark' mobility model to evaluate the MANET routing protocols, because of its simplicity and wide availability. In this model, the position of each node is randomly selected within a fixed area and after that moves to the selected position in linear form with random speed. This movement has to stop by a certain period called pause time before starting the next movement.

The pause time is determined by model initialization and its speed is uniformly distributed between [Min Speed, Max Speed]. The Random Waypoint Mobility Model is the most widely used mobility model. Many researchers use it to compare the performance of various mobile ad hoc network routing protocols. This model includes pause times between changes in direction and/or speed. Using the waypoint mobility model, each node starts the simulation by remaining stationary for pause-time seconds. Then, it randomly chooses a destination in the simulation area and moves towards that destination at a speed uniformly chosen between zero and maximum speed. When the node reaches the selected destination, it halts again for pause-time, selects another destination and starts to move towards the new destination.

This process is repeated for the duration of the simulation. In [11], it has been shown that the average speed of a mobile node decays with time. This is because of the fact that low speed nodes spend more time to reach their destinations than high speed nodes. It is also shown that increasing the speed of nodes results in increased network connectivity.

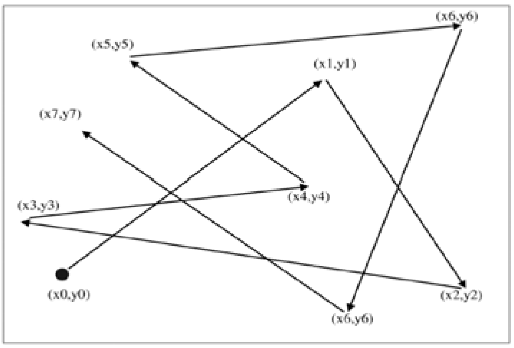


Figure 1: Node movement in the Random Waypoint Model

2.2 Reference Point Group Mobility Model

The whole group of mobile nodes moves randomly from one location to another. Then, the reference point of each node is determined based on the general movement of this group. Inside of this group, each node can offset some random vector to its predefined reference point. Represents the random motion of a group of mobile nodes as well as the random motion of each individual mobile node within the group.

- Group movements are based upon the path traveled by a logical center of the group.
- Individual MNs randomly move about their own pre-defined reference points.
- The RPGM model uses a group motion vector GM to calculate each MN's new reference point, RP (t +1), at time t +1.
- The length of RM is uniformly distributed within a specified radius centered at RP (t +1) and its direction is uniformly distributed between 0 and 2π.
- Both the movement of the logical center for each group, and the random motion of each individual MN within the group are implemented via the Random Waypoint Mobility Model.

Individual MNs do not use pause times while the group is moving. Pause times are only used when the group reference point reaches a destination and all group nodes pause for the same period of time.

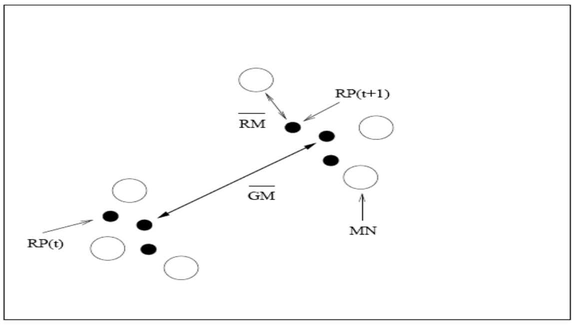


Figure 2: Movement of three nodes using RPGM model

3) Simulation Setup

The Simulation was set up to evaluate the effect of mobility model in performance of MANET routing protocols AODV and OLSR. We use OPNET Modeler version14.5. A Lokmanya Tilak campus network was modeled within an area of 1500m*1500m. The mobile nodes were spread within the area. We take the FTP traffic to analyze the effects on routing protocols. The nodes were wireless LAN mobile nodes with data rate of 11Mbps. Simulation time of each scenario was 300secs. We collected DES (global discrete event statistics) on each protocol. We examined average statistics of the delay, throughput and Routing Overhead for the MANET. Our key goal of our simulation was to evaluate the effect of mobility model in performance of MANET routing protocols.

In Table 2 we describe the simulation parameters that are used in this simulation in order to evaluate and compare the performance of selected routing protocols (AODV and OLSR) over a MANET network. Each and every scenario there is different numbers of mobile nodes. In the ad hoc network, we have simulated the following scenarios:

1. Node Speed with Random Way Point Mobility.
2. Node Speed with Reference Point Group Mobility.

Simulation Parameters	
Examined Protocols	AODV and OLSR
Number of Nodes	40
Types of Nodes	Mobile
Simulation Area	1500*1500m
Simulation Time	300 seconds
Mobility	10 m/s

Pause Time	0, 50, 100, 150 sec
Performance Parameters	Delay, Throughput and Routing Overhead
Traffic type	FTP
Mobility model used	Random Waypoint, Reference Point Group Mobility Model
Data Type	Constant Bit Rate (CBR)
Packet Size	512 bytes

Table 2: Simulation parameters

4) Performance Metrics

Delay: It is the time that a packet takes to go across the network. This time is expressed in sec. Hence all the delays in the network are called packet end-to-end delay, like buffer queues and transmission time. Mathematically it can be shown as equation

dend-end = N [dtrans + dprop + dproc]

Where, dend-end= End to end delay
dtrans = Transmission delay
dprop = Propagating delay
dproc = Processing delay

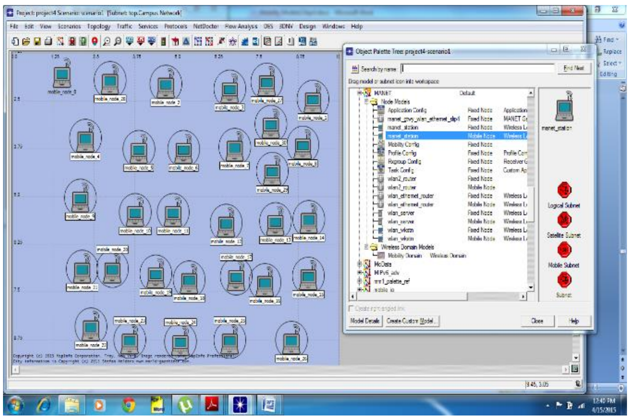
Throughput: It is the ratio of the total data reaches at the receiver from the sender, the time it takes by the receiver to receive the last message is called as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec). A high throughput is absolute choice in every network. Throughput can be represented mathematically as in equation;

$$\text{Throughput} = \frac{\textbf{Number of delivered packet * Packet size * 8}}{\textbf{Total duration of simulation}}$$

Routing Overhead: Ad hoc networks are designed to be scalable. As the network grows, various routing protocols perform differently. The amount of routing traffic increases as the network grows. An important measure of the scalability of the protocol, and thus the network, is its routing overhead.

5) Results Analysis

Simulation Environment: We analyze and discuss the results of simulations we done. We begin the analysis of AODV and OLSR protocols by parameters such as delay, throughput and Routing Overhead. The results obtained in the form of graphs. Here in first scenario we used 40 mobile nodes and one fixed wlan server. The network size is of 1500*1500 meters. After that IPv4 addressing was assigned to all the nodes. All the settings must be done according to the requirement. The scenario is shown in Table 1. The protocols such as AODV OLSR are tested against parameters i.e. delay, throughput, Routing Overhead.



5.1 Evaluation of Random Waypoint Mobility Model with varying Pause time.

5.1.1 Average Delay:

Average end to end delay is the time a data packet takes in traversing from the time it is sent by the source node till the point it is received at the destination node. This metric is a measure of how efficient the underlying routing algorithm is, because primarily the delay depends upon optimality of path chosen, the delay experienced at the interface queues and delay caused by the retransmissions at the physical layer due to collisions. In this set of simulations, the effect of different pause time (0, 50, 100 and 150 sec.) to routing protocols with fix number of nodes (40) was observed. All of the remaining parameters are the same as the previous scenario.

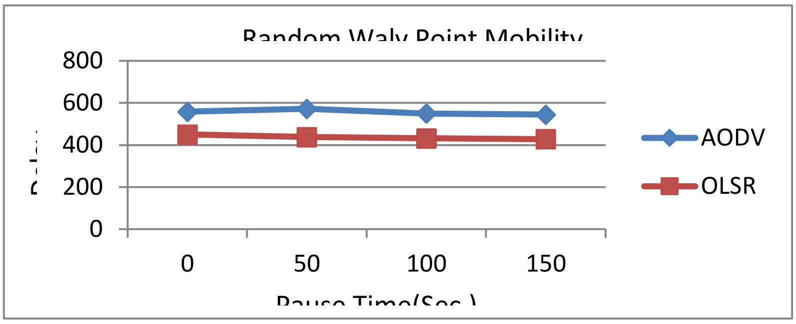


Figure 4: Average Delay with respect to Pause time in Random Way Point Mobility Model

The figure 4 shows the delay of AODV and OLSR protocol with respect to Pause time. To analyze the delay of AODV and OLSR protocol against varying Pause time from 0, 50, 100 and 150 sec in Random Way Point Mobility model. Above graph shows that consistent decreased in delay with both protocols.

5.1.2 Throughput

Throughput is the time the total size of useful packets that received at all the destination nodes. It is the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

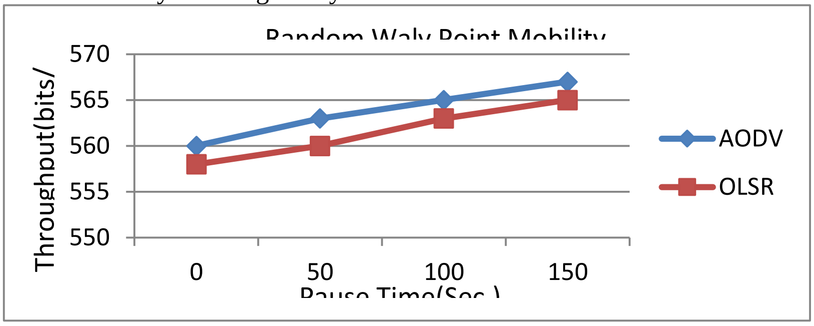


Figure 5: Throughput with respect to pause time in Random Way Point Mobility Model

The figure 5 shows the throughput of AODV and OLSR protocol with respect to Pause time. To analyze the delay of AODV and OLSR protocol varying Pause time from 0, 50, 100 and 150 sec in Random Way Point Mobility model. AODV had a higher throughput in comparison of OLSR AODV. Both protocols had a consistent increase in throughput with increase in pause time.

5.1.3 Routing Overhead

The total number of routing packets transmitted during the simulation. For packets sent over multiple hops, each transmission of the packet (each hop) counts as one transmission. Routing packets are those that are originated by the routing protocol and do not also include user data.

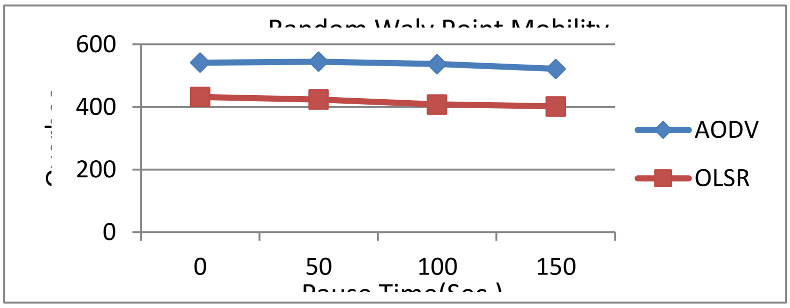


Figure 6: Routing Overhead with respect to Pause time in Random Way Point Mobility Model

The figure 6 shows the routing overhead of AODV and OLSR protocol with respect to Pause time. To analyze the delay of AODV and OLSR protocol varying Pause time from 0, 50, 100 and 150 sec in Random Way Point Mobility model. AODV and OLSR had consistent decrease in overhead with increase in pause time.

5.2 Evaluation of Reference Point Group Mobility Model

5.2.1 Average Delay:
The packet end-to-end delay is the time of generation of a packet by the source up to the destination reception. So this is the time that a packet takes to go across the network. This time is expressed in sec. Hence all the delays in the network are called packet end-to-end delay. Sometimes this delay can be called as latency; it has the same meaning as delay.

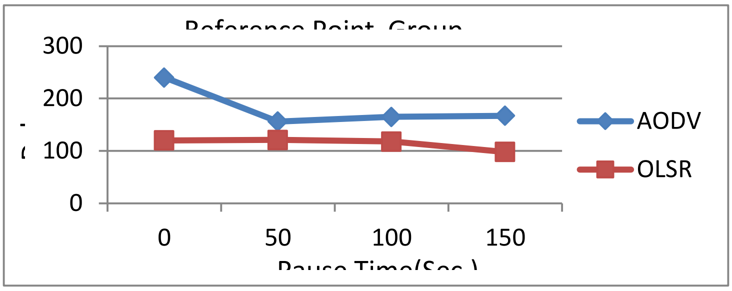


Figure 7: Average Delay with respect to Pause time in Reference Point Group Mobility Model

The figure 7 shows the delay of AODV and OLSR protocol with respect to Pause time. To analyze the delay of AODV and OLSR protocol varying Pause time from 0, 50, 100 and 150 sec in Reference Point Group Mobility model. It shows when the the pause time is 0 the average end to end delay is 240 Sec. So, the pause time is increased to 50 and the result for this scenario is decreased to 156Sec. Then we increased the pause time up to 100, so the delay is also increased up to 165 Sec. Finally, we increased the pause time up to 150 and result increased as well 167 Sec. It seems that the average end to end delay is not that much affected by the varying of pause time

5.2.2 Throughput:
Throughput is the time the total size of useful packets that received at all the destination nodes. It is the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

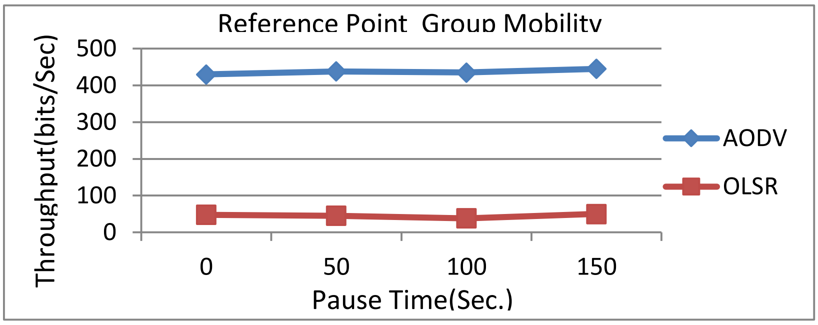


Figure 8: Throughput with respect to Pause Time in Reference Point Group Mobility Model

The figure 8 shows the throughput of AODV and OLSR protocol with respect to Pause time. To analyze the delay of AODV and OLSR protocol varying Pause time from 0, 50, 100 and 150 sec in Reference Point Group Mobility model. when we increase the pause time in AODV from 0 to 50 sec the Throughput became 438, then 435, and finally when the pause time increase up to 40 sec the overhead is 445. With OLSR is the overhead started 48, then 45, 38 and finally when the pause time increase up to 150 sec the overhead is 50. AODV had increased routing overhead with higher pause time in the network. OLSR had a consistent decrease at pause time 100 and the increased in overhead. OLSR and AODV had a consistent throughput with increase in pause time.

5.2.3 Routing Overhead
The total number of routing packets transmitted during the simulation. For packets sent over multiple hops, each transmission of the packet (each hop) counts as one transmission. Routing packets are those that are originated by the routing protocol and do not also include user data.

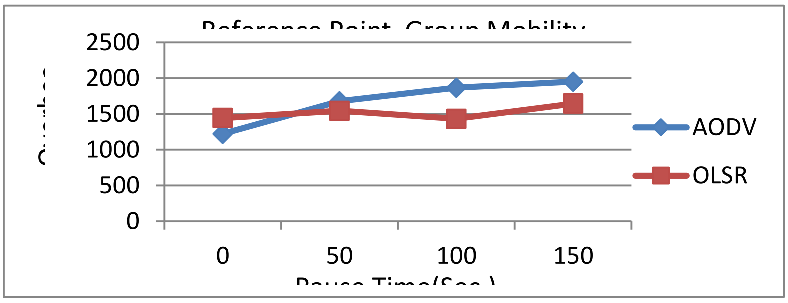


Figure 9: Routing Overhead with respect to Pause Time in Random Point Group Mobility Model

The figure 9 shows the routing overhead of AODV and OLSR protocol with respect to Pause Time. To analyze the Overhead of AODV and OLSR protocol varying Pause time from 0, 50, 100 and 150 sec in Reference Point Group Mobility model. when we increase the pause time in AODV from 0 to 50 sec the overhead became 1677, then 1865, and finally when the pause time increase up to 150 sec the overhead is 1952. With OLSR is totally different from AODV scenario because the overhead started 1444, then 1543, 1432 and finally when the pause time increase up to 150 sec the overhead is 1645. AODV had increased routing overhead with higher pause time in the network. OLSR had a consistent decrease at pause time 100 and the increased in overhead.

6) CONCLUSION

Table. 3 Comparison of Mobility with Matrices

Mobility	Protocol	Average Delay	Throughput	Routing Overhead
RWP	AODV`	Low	High	Low
	OLSR	Low	High	Low
RPGM	AODV`	Low.	Avg	High
	OLSR	Avg	Avg	Low

In this Paper performance evaluation of various mobility models with respect to routing protocols from reactive category Ad-hoc On-demand Distance Vector (AODV), from proactive category Optimized Link State Routing (OLSR) with different performance metrics is evaluated using OPNET simulator under the fix traffic size in FTP. In this work, a number of simulation experiments are performed by using OPNET simulator to evaluate the performance of mobility models (Random waypoint mobility and Reference Point Group mobility model) is used as pattern of mobility. As performance metrics average delay, throughput and routing overhead are examined with 40 nodes. In the simulation the pause time is varied from 0 to 150 with file size 512 bytes at node speed 10 m/s. From table 3, it has been observed that the mobility pattern influences the performance of MANET routing protocols. It has been observed that both protocol achieve the highest throughput and least overhead with RWPM when compared to RPG mobility models. From the results, it is analyzed that OLSR has better average delay and throughput and less overhead in comparison of AODV in RPGM model when compared to RWP model. Random Way Point Model outperforms than Reference Point Group Mobility model.

The average values are taken from the graphs. From the above given graph it is shown clearly that the AODV and OLSR gives the less delay and better throughput in RWP model in MANET according to our simulation results but it is not necessary that both protocol with Random waypoint mobility model performs always better in all the networks, its performance may vary by varying the network and parameters.

References

[1].Guntupalli Lakshmikant, A Gaiwak, P.D. Vyavahare, *"Simulation Based Comparative Performance Analysis of Adhoc Routing Protocols"*, in proceedings of TENCON 2008.

[2]. Yogesh Chaba, Yudhvir Singh, Manish Joon, *"Simulation Based Performance Analysis of On-Demand Routing Protocols in MANETs,"* Second International Conference on Computer Modeling and Simulation, 2010.

[3]. Chenna Reddy, P.; ChandraSekhar Reddy, P.,*"Performance Analysis of Adhoc Network Routing Protocols,"* ISAUHC '06, International Symposium on Ad Hoc and Ubiquitous Computing, vol., no., pp.186-187, 20-23 Dec. 2006.

[4]. G. Jayakumar and G. Gopinath, *"Performance comparison of two on-demand routing protocols for ad-hoc networks based on random way point mobility model,"* American Journal of Applied Sciences, vol. 5, no. 6, pp. 649-664, June 2008.

[5]. S.R. Birdar, Hiren H D Sarma, Kalpana Sharma, Subir Kumar Sarkar , Puttamadappa C, *Performance Comparison of Reactive Routing Protocols of MANETs using Group Mobility Model",* International Conference on Signal Processing Systems, 2009.

[6]. Kapang Lego, Pranav Kumar Singh, Dipankar Sutradhar, *"Comparative Study of Adhoc Routing Protocol AODV, DSR and DSDV in Mobile Adhoc NETwork"*, Indian Journal of Computer Science and Engineering Vol. 1 No. 4 364-371, 2011.

[7]. Vijayalaskhmi M. Avinash Patel, Linganagouda Kulkarni, *"QoS Parameter Analysis on AODV and DSDV Protocols in a Wireless Network"*, International Journal of Communication Network and Security, Volume-1, Issue-1, 2011.

[8]. Shaily Mittal, Prabhjot Kaur, *"Performance Comparison of AODV, DSR and ZRP Routing Protocols in MANET's",* International Conference on Advances in Computing, Control, and Telecommunication Technologies, 2009.

[9]. Li Layuan, Li Chunlin, Yaun Peiyan, "Performance evaluation and simulation of routing protocols in ad hoc networks", Computer Communications 30 (2007) 1890-1898.

[10] J. Broch, D. A. Maltz, D. B. Johnson, Y.-C. Hu, and J. Jetcheva, A performance comparison of multi-hop wireless ad hoc network routing protocols, in Proceedings of the Fourth Annual ACM/IEEE International Conference on Mobile Computing and Networking(Mobicom98), ACM, October 1998.

[11] Manijeh Keshtgary and Vahide Babaiyan in "Performance Evaluation of Reactive, Proactive and Hybrid Routing Protocols in MANET" International Journal on Computer Science and Engineering (IJCSE) vol. 4, pp. 248-254 Feb 2012.