ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

"Evaluation of the effect of Node Movements in Mobile Ad Hoc Networks (MANETs)"

Gurbinder Singh[1], Sarabjit Singh[2]

M.Tech. Student, E.C.E. Department, Guru Kashi University, Talwandi Sabo, India [1]

Assistant Professor, E.C.E Department, Guru Kashi University, Talwandi Sabo [2]

Abstract: This work, focuses on performance evaluation of reactive, proactive and hybrid MANET routing protocols, namely AODV, DSR, OLSR and GRP. OLSR is designed to work in a completely distributed manner and does not depend on any central entity. The AODV protocol consists of two important mechanisms, Route Discovery and Route Maintenance. It is designed to be self-creating in an environment of mobile nodes, withstanding a variety of network behaviours such as a node movement, link failures and packet losses. The GRP is not so much a distinct protocol as it provides a framework for other protocols. The research is carried out using discrete event simulation environment software known as OPNET Modeller version 14.5. It is one of the most widely used commercial simulators based on Microsoft Windows platform and incorporates more MANET routing parameters as compared to other commercial simulators available. Network performance is evaluated in terms of end-to-end delay, retransmission attempts, network load and throughput. Simulation results shows that the overall performance of proactive protocols performs better than both reactive and hybrid protocols. It is concluded that proactive protocols and hybrid protocols performs better in the case of end-to-end delay. If the performance of the network is evaluated on the basis of the network load, AODV performs better than the DSR, OLSR and GRP.

Keywords: HTTP Heavy browsing, Mobile Ad hoc Networks, OPNET, Mobitiy Models, Routing Protocols.

I. INTRODUCTION

A mobile ad hoc network is a collection of wireless stations called nodes which are free to move and communicate with each other in the absence of any fixed infrastructure [1, 2]. There is lack of central administration. Any node within the transmission range of other node can directly communicate with it. In this paper we explore several mobility models and compare their effects on an ad hoc network. The final outcome of this study is to provide suggestions to the researchers and illustrate them the importance in carefully selecting and implementing a mobility model when evaluating ad hoc network protocols. A Mobility model (MM) is used to describe the movement of a mobile node, its location and speed variation over time while the simulation of a routing protocol. It is one of the key parameters that researchers have to consider before analyzing and simulating the performance of the routing protocols. We have studied how different mobility model scan influence the performance of routing protocols. Thus, it becomes necessary to choose a right mobility model when evaluating a MANET protocol.

II. ROUTING PROTOCOLS

In MANET, routing protocols are divided in three categories: Proactive protocols, Reactive protocols and Hybrid protocols. Proactive protocols are also known as table driven protocols. Table-driven protocols might not be considered an effective routing solution for MANET. Nodes in mobile ad-hoc networks operate with low battery power and with limited bandwidth. There are various examples of proactive protocols, like OLSR, DSDV, CGSR, WRP etc. Reactive protocols are also known as on-demand protocols. On-demand routing protocols were designed to reduce the overheads in networks by maintaining information for active routes only [7]. This means that routes are determined and maintained for nodes that require sending data to a particular destination. Various examples of reactive protocols are AODV, DSR, CBR, ABR etc. Hybrid routing protocols inherit the characteristics of both on-demand and table-driven routing protocols. Such protocols are designed to minimize the control overhead of both proactive and reactive routing protocols. ZRP is an example of hybrid protocols [3]. This paper compares one table driven routing protocol, OLSR, one on-demand routing protocol, AODV and one hybrid routing protocol, GRP [6].

III. MOBILITY MODEL

Mobility model accurately represents the mobile nodes (MNs) that will eventually utilize the given protocol. Currently there are two types of mobility models used in the simulation of networks: traces and synthetic models .Traces are those mobility patterns that are observed in real life systems. Traces provide accurate information, especially when they involve a large number of participants and an appropriately long observation period [4]. However, new network environments (e.g. ad hoc networks) are not easily modeled if traces have not yet been created. In this type of situation it is necessary to use synthetic models. Synthetic models attempt to realistically represent the behaviors of MNs without the use of traces. A mobility model should attempt to mimic the movements of real MNs. Changes in speed and direction must occur

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

and they must occur in reasonable time slots. [5] Various mobility models for ad hoc networks are explained below:

A. Random Walk Mobility Model:
A simple mobility model based on random directions and speeds.

B. Random Waypoint Mobility Model:
A model that includes pause times between changes in destination and speed.

C. Pursue Mobility Model:
A group mobility model in which a set of MNs follow a given target.

D. Pursue smart mobility model:
A group mobility model obtained by modifying pursue mobility model.

IV. SIMULATION ENVIRONMENT

The research is carried out using discrete event simulation environment software, known as OPNET (Optimized Network Engineering Tool) Modeler [10] version 14.5. It is one of the most widely used commercial simulators based on Microsoft Windows platform.

A. Wireless LAN Parameters

For an optimized working of the network, along with the configuration of the routing protocols various Wireless LAN Parameters are chosen. The buffer size was set to 102400000 bits as heavier flow of application was generated. In addition, the channel settings were set to “auto assigned” in order to avoid manual error. Also the transmission power was changed from 0.005 watt to 0.030 watt. The retransmission Threshold is 1024 bytes, short Retry limit is kept 7 and long Retry limit is kept 4.

Table 1: Wireless LAN Parameters

Attributes	Value
Physical Characteristics	Extended Rate PHY(802.11g)
Data Rate	54 Mbps
Transmit Power	0.005-0.030 watt
RTS Threshold(bytes)	1024
Fragmentation Threshold(bytes)	1024
Short Retry Limit	7
Long Retry Limit	4
Buffer size (bits)	102400000
Large Packet Processing	Fragment

B. Application Configuration

Application definition includes a name and a description table that specifies various parameters. A heavier application traffic flow in the network was generated, which each node will be processing from the respective application server in the network. The application traffic generated was as, HTTP Application: Heavy Browsing. Several example application configurations are available under "Default" setting.

For example, "Web Browsing (Heavy HTTP1.1)" indicates a web browsing application performing heavy browsing using HTTP 1.1 protocol. All the configuration parameters of HTTP application are given in table 2.

Table 2: HTTP Application Parameters

Attribute	Values
HTTP specification	HTTP 1.1
Page Interarriaval Time (sec)	Exponential(60)
Initial Repeat Probability	Browse
Pages Per Source	Exponential(10)
Type of Service	Best Effort(0)

C. *Performance Metric:*

For the comparison of protocols under the applications generating heavy traffic, four different metrics have been chosen:

a. Retransmission Attempts (packets):
Total number of retransmission attempts by all WLAN MACs in the network, until either packet is successfully transmitted or it is discarded as a result of researching short or long retry limit.

b. Average End to End Delay (sec):
This is average end to end delay of all successful transmitted data packet. It is used to represent the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layers.

Average Delay =

$$\sum_{i}^{n}(\mathrm{CBR\_sent\_time\_CBR\_receive\_time}) / \sum_{i}^{n}(\mathrm{CBR\_receive})$$

c. Network Load (bits/sec):
Network Load is a statistic represents the total data traffic received (in bits/sec) by the network from the higher layers of the MACs that accepted and queued for transmission. This statistic doesn’t include any higher layer data traffic that is rejected without queuing due to full queue or large size of the data packet.

d. Throughput (bits/sec) :
Represents the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network. It is the number of packets passing through the network in a unit of time.

Throughput=

$$\sum_{i}^{n}\mathrm{data\_packets} / \mathrm{Time\_Duration}$$

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

V. SIMULATION RESULTS AND ANALYSIS

After choosing metrics, the simulation is done:

5.1 Random Walk Mobility Model

a) Throughput

Figure: 1 shows the throughput for random walk mobility model. The graph depicts that GRP gives the highest throughput because of its hybrid nature.

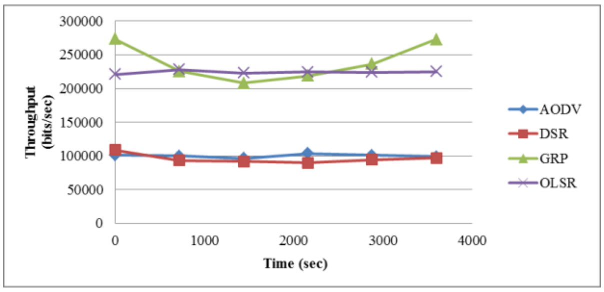

Figure 1: Throughput for random walk Mobility Model

For the neighbor nodes, GRP act as a reactive protocol and for the nodes other than the neighbor nodes, it works like the proactive protocol. Due to this nature, the protocol has to send less control packets than the other protocols to reconstruct the routes. AODV and DSR shows the least throughput because of their reactive nature in random walk since for this model, mobility is high and thus has to send more control packets to cache roots. Proactive protocol OLSR performs better than reactive protocol since it has prior routing tables and can send more data packets in unit time.

b) Retransmission Attempts

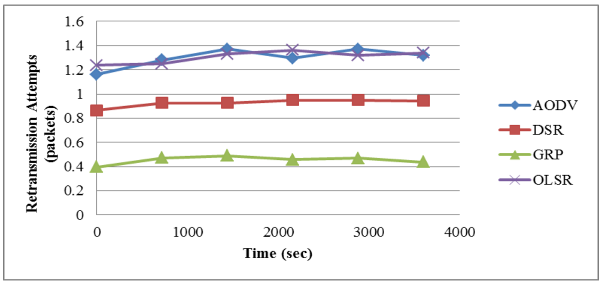

Figure 2: Retransmission attempts for Random Walk Mobility Model

Figure: 2 shows the retransmission attempts for random walk mobility model. In Random walk mobility model all the nodes move vigorously so the performance of OLSR degrades or has the max average retransmission attempts. Since with high mobility it has to refresh the routing information more rapidly and normally the timer expires before the route gets refreshed and hence the number of attempts to send a packet increases. It is seen that the performance of AODV is also worse since it has to find the routes on demand. Although being reactive protocol, DSR has less retransmission attempts as compared to AODV because it has a route maintenance mechanism in case of link failure and thus the no of attempts to send packets is reduced. GRP outperforms all the protocols because of its hybrid nature since every node has a route cache. For the neighbor nodes these route caches are not used because at that instance the protocol will act like a reactive protocol.

c) Network Load

Figure 3 depict the network load for random walk mobility model. Network load includes only the data packets that are successfully received by the destination. Dropped packets and control packets won't be considered in network load. It has been seen that the hybrid protocol such that GRP gives the maximum network load. GRP protocol is able to deliver more data packets to the destination than any other protocol due to its hybrid nature.

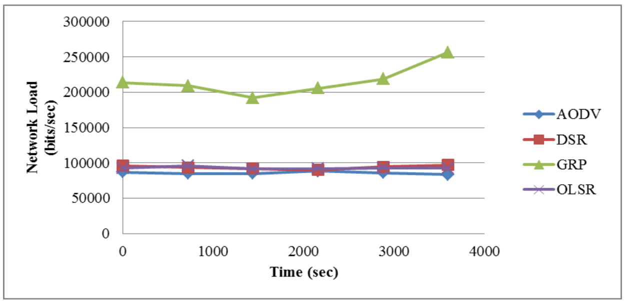

Figure 3: Network Load for Random Walk Mobility Model

Rest of the protocols such as AODV, OLSR and DSR are outperformed by GRP protocol. Among all the protocols, AODV gives the minimum network load because it needs to share number of control messages before transmitting any packets and those control messages are not included in network . As compared to AODV, DSR has higher network load due to less routing overhead.

d) Media access Delay

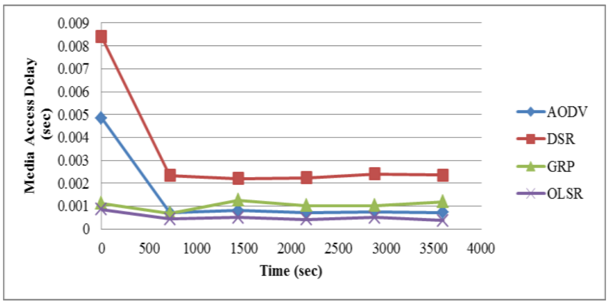

Figure 4: Media Access Delay for Random Walk Mobility Model

Figure 4 depicts that OLSR possess least delay as it is effectively a link state algorithm. As it is a proactive protocol the routes are predefined so it takes least time to place the packets on to the medium. AODV being a reactive protocol possess higher delay than OLSR due to reinitializing the route flooding process every time while discovering new routes and determining changes in topology. Similarly DSR experiences even higher average delay as compared to AODV. This is because DSR maintains a large cache to store data. This results in higher delay in updating periodically with frequent changes occurring due to high mobility. GRP being hybrid in nature stood in the middle of both reactive and proactive protocols.

DOI 10.17148/IJARCCE.2015.4966

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

5.2 Random Way Point Mobility Model

a) Throughput

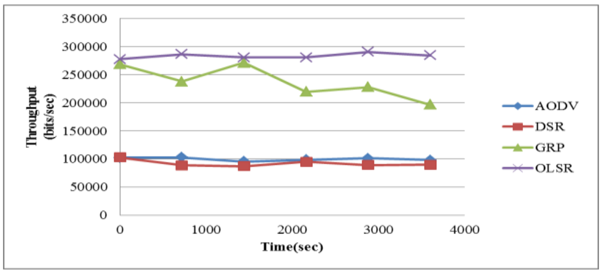

Figure 5: Throughput for Random way Point Mobility Model

Due to pause timings the nodes get enough time to refresh the routing information. As a result the numbers of data packets sent per unit time increases.

b) Retransmission attempts

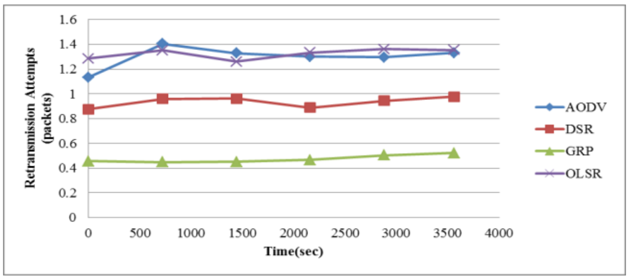

Figure 6: Retransmission Attempts for random way Point Mobility Model

Random way point model possess retransmission attempts almost similar to randomwalk mobility model with a little improvement seen for OLSR and GRP protocols because of the introduction of pause times. Due to the pause times the nodes get time to refresh the routes and thus the timer does not expire before a transmission occurs.

c) Network Load

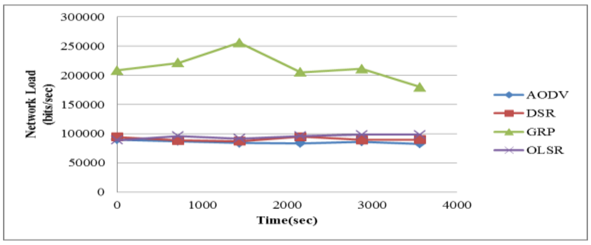

Figure 7: Network load for random way Point Mobility Model

Network load has shown a slight increase for random waypoint mobility model. Since in this model there are pause timings so the probability of link failures has been reduced as the nodes get time to refresh there routes information in case of route failure. GRP as in random walk model possess the highest load because of its hybrid nature. Proactive protocol performs bit better than reactive protocol due to availability of prior routing tables

d) Media access Delay

Delay in case of random way point mobility model is reduced as compared to random walk mobility model due to the introduction of pause timings. Due to the pause times the nodes get enough time to refresh the routes and the delay to place the packets on the medium decrease.

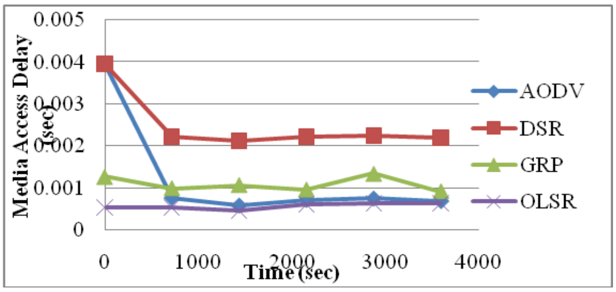

Figure 8: Media Access Delay for Random Way Point Mobility Model

5.3 Pursue Mobility Model

a) Throughput

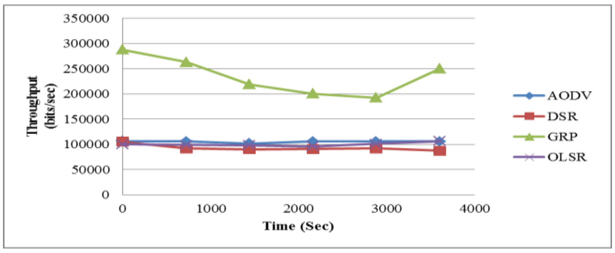

Figure 9: Throughput for Pursue Mobility Model

In this model, again GRP outperforms all the other protocols because of its hybrid nature. As compared to random walk and random way point models the throughput of OLSR protocol has drastically decreased due the continuity in the change of the position of escort node. As instantly, the position of the nodes will be changed, nodes need to send more control messages to update the routing caches in case of proactive protocols (OLSR) and degradation in the performance of the protocols will occur. On the other hand, the reactive protocols (AODV and DSR) are performing consistently.

b) Retransmission attempts

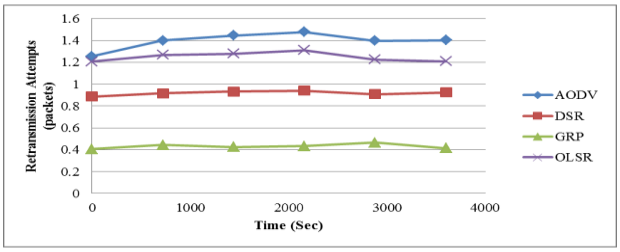

Figure 10: Retransmission Attempts for Pursue Mobility Model

Average retransmissions attempts have been decreased in this model as compared to other mobility models for all the protocols because every node will follow the same trajectory with same pause time and moving speed and the control messages will be exchanged only periodically to update the routing caches of the nodes and find out the optimized path towards the destination, such that very less number of control messages will be exchanged between the nodes due the unexpected change in the position of a

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

node. Due to its hybrid nature, GRP protocol possess lest number of retransmission attempts and due to its reactive nature, AODV protocol possess maximum number of retransmission attempts.

c) Network Load

Network load for pursue model has been reduced compared to other models. Since in this model all the nodes follow the escort node and due to high mobility of escort node there is lot of control information to be exchanged. Therefore the data packets that need to be exchanged are reduced in comparison to the control packets.

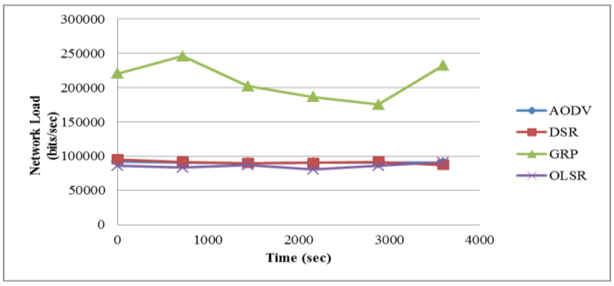

Figure 11: Network Load for Pursue Mobility Model

Thus the network load gets reduced. As in the previous graphs, GRP still shows it superiority over the other protocols.

d) Media Access Delay

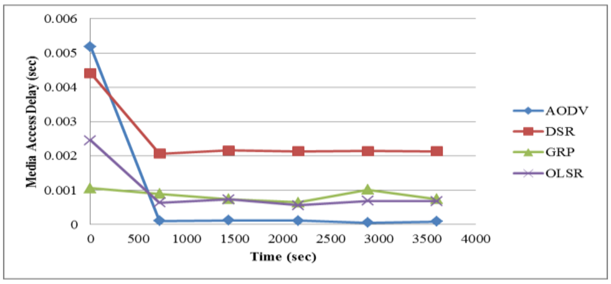

Figure 12: Media Access Delay for Pursue Mobility Model

Delay in pursue mobility model is increased due to the continuity in the change of the position of escort node. As instantly, the position of the nodes will be changed; nodes need time to update the routing caches and automatically time to place the data on the medium increases.

5.4 Pursue smart Mobility Model

a) Throughput

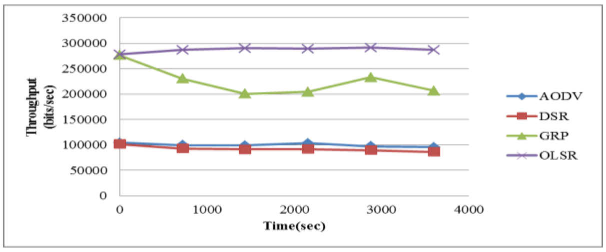

Figure 13: Throughput for Pursue smart Mobility Model

The rendered graph depicts the throughput of two reactive routing protocols, such as, AODV and DSR, one proactive protocol (OLSR) and one hybrid protocol, i.e. GRP. It has been seen that hybrid protocol, GRP outperforms all the reactive and proactive protocols

This is because of the hybrid behavior of the protocol such that for the neighbor nodes, GRP act as a reactive protocol and for the nodes other than the neighbor nodes, it works like the proactive protocol. Due to this nature, the protocol has to send less control packets than the other protocols to reconstruct the routes. A very minute variation has been seen for AODV and DSR protocols and has shown the lowest throughput than the other protocols.

b) Retransmission Attempts

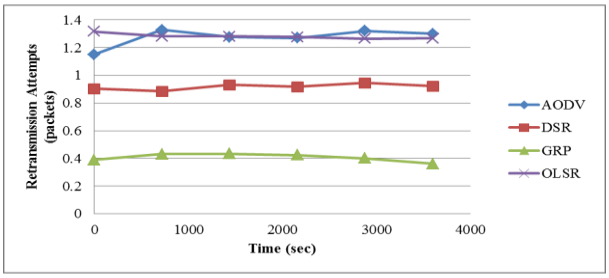

Figure 14: Retransmission Attempts for Pursue smart Mobility Model

Figure 5.14 has shown the retransmission attempts done by the nodes to send the data packets. GRP due to its hybrid nature, it has to done less retransmission attempts to send a data packets than the other nodes, because every node has a route cache. For the neighbor nodes these route caches are not used because at that instance the protocol will act like a reactive protocol. But for the other nodes the protocol has the alternative of the route cache. DSR and AODV possess high retransmission attempts, due to their reactive nature.

c) Network Load

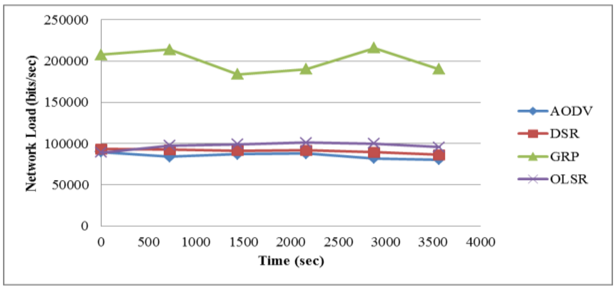

Figure 15: Network Load for Pursue smart Mobility Model

Network Load possesses by the nodes using Pursue Smart Mobility Model is given in figure 19.Network load includes only the data packets that are successfully received by the destination. Dropped packets and control packets won't be considered in network load. In the figure, it has been seen that the hybrid protocol such that GRP gives the maximum network load. GRP protocol is able to deliver more data packets to the destination than any other protocol due to its hybrid nature. GRP also possess minimum retransmission attempts to transmit the packets to the destination. Rest of the protocols such as AODV, OLSR and DSR are outperformed by GRP protocol.

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

d) Media Access Delay

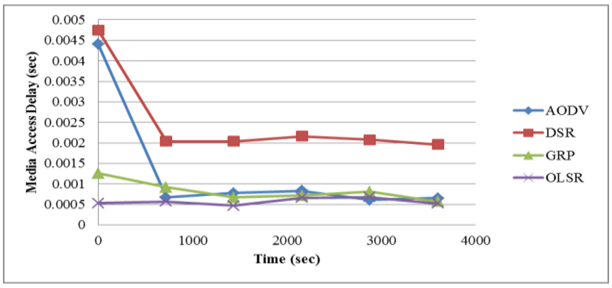

Figure 16: Media Access delay for Pursue smart Mobility Model

Media Access Delay is a delay possessed by the packets to get placed over the transmission medium. DSR protocol has given the maximum media access delay due to its reactive nature. It has to create the routes on demand after the generation of a data packet. Time taken to get a route is a waiting time for the packet and a part of media access delay. On the other hand, proactive protocol, such that, OLSR has the minimum media access delay due to the presence of routing information.

VI. CONCLUSION

Performance evaluation of the MANETS routing protocols with respect to various mobility models with different performance matrices i.e. Throughput, MAC Delay, Network load and Retransmission Attempts has been done. Simulation results have indicated that the relative performance of routing protocols may vary depending on mobility model. Though reactive routing protocols for e.g. AODV does not gave an impressive performance but it can be seen that they are very consistent. Very less variations in the results has seen in the results of AODV routing protocol whereas a lot of variation has seen in the results of proactive protocols for e.g. OLSR, such that, the movement patterns of the nodes in a MANETSs cause high degradation over the performance of the protocol. Hybrid protocols for e.g. GRP outperforms all the protocols in almost all the mobility models. Pursue smart mobility model out performs the pursue mobility model in retransmission attempts and MAC delay. Group mobility model shows the least Mac delay, highest throughput and highest network load whereas retransmission attempts are least for pursue mobility model. In Future there are lots of other mobility models and metrics that could be evaluated under different reactive, proactive and hybrid protocols to make the results more justified. Also simulations can be carried out by varying the number of nodes in each scenario, the topology and the choice of the traffic between the mobile nodes. The work can be extended by designing new mobility models that could remove the drawbacks of existing mobility models.

REFERENCES

[1]. Mobile ad hoc networks (MANET). http: //www.ietf.org/html.charters/manet-charter.html, 1997. IETF Working Group Charter
[2]. Anuj K. Gupta, Harsh Sadawarti, Anil K. Verma, "Review of various Routing Protocols for MANETs", International Journal of Information & Electrical Engineering, Article No. 40, 1(3): 251-259, November 2011.
[3]. Asad Amir Pirzada, Saad Khan et al., "Performance Comparison of Reactive Routing Protocols for Hybrid Wireless Mesh Networks." In 2nd International Conference on Wireless Broadband and Ultra Wideband Communications (Aus Wireless 2007), Pages 1-6, February 2007. IEEE Computer Society.
[4]. Ashish Shrestha and Firat Tekiner, "On MANET Routing Protocols for Mobility and Scalability." In International Conference on Parallel and Distributed Computing, Applications and Technologies, Pages 451-456, November 2009. IEEE Computer Society.
[5]. M.K. Jeya Kumar and R.S. Rajesh, "Performance Analysis of MANET Routing Protocols in Different Mobility Models." In IJCSNS International Journal of Computer Science and Network Security, Pages 22-29, VOL.9 No.2, February 2009
[6]. Nicklas Beijar, " Zone Routing Protocol (GRP)." Networking Laboratory, Helsinki University of Technology."
[7]. Patil.V.P, "on-demand and table –driven routing protocol energy efficiency performance evaluation in mobile ad hoc networks", International Journal of Computer Science and Management Research, Vol 1, Issue 2 September 2012, ISSN: 2278-733X
[8]. Valentina Timcenko, Mirjana Stojanovic et al., "MANET Routing Protocols vs. Mobility Models: Performance Analysis and Comparison." In Proceedings of the 9th WSEAS
[9]. Vasanthi.V, Romen Kumar.M, Ajith Singh.N and M.Hemalatha [2011] "A Detailed Study Of Mobility Models In Wireless Sensor Network" In Journal of Theoretical and Applied Information Technology Vol. 33 pp. 7-14
[10]. Xinjie Chang, "NETWORK SIMULATIONS WITH OPNET." In Proceedings of the 1999 Winter Simulation Conference, Pages 307-314, 1999.