Performance Investigation of DYMO, DSR, AODV and LAR Routing Protocols using Different Mobility in MANETs

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Abstract

An ad hoc network is a collection of mobile nodes, communicating with each other using multi-hop wireless links. MANET nodes are equipped with wireless transmitters and receivers. In these networks, communication between the nodes is multi-hop type i.e. nodes act as router as well as host enabling the cooperation between them. In this paper we focus on the impact of mobility models on the performance of reactive routing protocols AODV, DSR, DYMO, and LAR. With the help of Qualnet 5.2 simulator, we investigated various scenarios by varying number of nodes, maximum velocity, Pause time and Packet size.

***Keywords**: MANET, AODV, DSR, DYMO, LAR, Mobility Models.*

1. Introduction

Mobile Ad-Hoc Network is a self-configuring network of mobile nodes connected by wireless. It forms an arbitrary topology without any use of existing infrastructure [1]. Nodes of MANET are free to move randomly, therefore topology of the network may change rapidly and may be unpredictable and because of this traditional protocols are not suitable for mobile ad-hoc network.

1.1. Mobility models

Mobility Model is one of the key parameter that researchers have to consider when they want to analyze the performance of the certain protocol in their simulation environment. The mobility models describe the movement pattern of mobile models, and how their location, velocity and acceleration changes over time [2].

In this we consider two mobility models i.e. Random Waypoint and Group Mobility Model.

The Random Waypoint Mobility Model includes pause times between changes in direction and/or speed. An MN begins by staying in one location for a certain period of time (i.e., a pause time). Once this time expires, the MN chooses a random destination in the simulation area and a speed that is uniformly distributed between *[minspeed, maxspeed]* [3].

Group Mobility Model represents the scenarios in which multiple mobile nodes move in a group at the same time, generally in the same direction with a short distance of separation [3].

1.2. Routing Protocols

Due to dynamic topology of MANET, Routing in such networks is a challenge for transferring between nodes. Routing protocols for Mobile ad hoc networks has been classified into Proactive, Reactive and Hybrid protocols [2]. Proactive routing protocols attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. Each node maintains tables to store routing information [2]. DSDV, OLSR are example of this type. Reactive or on demand protocols are based on source initiated on-demand reactive routing. This type of routing creates routes only when a node requires a route to a destination [2]. DSR, AODV, DYMO and LAR are examples of Reactive Routing Protocols. On-demand routing protocols were designed to reduce the overheads in Table-Driven protocols by maintaining information for active routes only [5].

1.2.1. Dynamic Source Routing (DSR). Dynamic Source Routing (DSR) [9] is a beacon-less protocol. During route construction phase, RREQ is flooded in network. The destination nodes respond by RREP, which carries the route traversed by the RREQ packet. Each RREQ carries a sequence number generated by source which is used to prevent loop formation and to avoid multiple transmission of the same RREQ by intermediate node that receives it through multiple paths.

1.2.2. Adhoc on Demand Distance Vector (AODV). AODV adopts a very different mechanism to maintain routing information. It uses traditional routing tables, one entry per desti-nation. This is in contrast to DSR, which can maintain multiple route cache entries for each destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. All routing packets carry these sequence numbers [12].

1.2.3. Dynamic MANET On-Demand (DYMO). DYMO is an On-Demand and fast reactive routing protocol for multi-hop communication in MANET. The basic operations of the DYMO protocol are route discovery and route management. During route discovery, the source node initiates a RouteRequest (RREQ) throughout the network to find a route to the destination node. During this hop- by- hop dissemination process, each intermediate node records a route to the source node. When the destination node receives the RREQ, it responds with a Route Reply (RREP) sent hop-by-hop toward the source node. Each node that receives the RREP records a route to the destination node, and then the RREP is unicast hop-by-hop toward the source node. When the source node receives the RREP, routes have then been established between the source node and the destination node in both directions [9].

1.2.4. Location Aided Routing (LAR). LAR is a reactive unicast routing scheme. LAR exploits position information and was proposed to improve the efficiency of the route discovery procedure by limiting the scope of route request flooding. In LAR, a source node estimates the current location range of the destination based on information of the last reported location and mobility pattern of the destination. In LAR, an expected Zone is defined as a region that is expected to hold the current location of the destination node. During route discovery procedure, the route request flooding is limited to a request zone, which contains the expected zone and location of the sender node [11].

We have used the DSR, AODV, DYMO, LAR reactive routing protocols against two Mobility Models (Random Waypoint, Group Mobility Model). We tried to analyse the performance of these protocols on the basis of performance metrics like throughput, packet delivery ratio (PDR), end to end delay and jitter through simulations. The rest of the paper is organized as follows: Section 2 describes related work. Section 3 describes the simulation scenario, Section 4 describes results and Section 5 concludes the paper.

2. Related Work

Savita Gandhi, et. al's [6] presented a detailed simulation study of DSR, OLSR and ZRP in different mobile scenarios generated by the Random WayPoint model for Mobile Ad hoc networks. The impact of these routing protocols is evaluated with respect to average end-to-end Delay, Average jitter, Average Throughput, Normalized Routing Load (NRL) and Packet Delivery Fraction (PDF).

Nadir Shah, et. al's [7] evaluate the performance of multiple routing protocols (DSDV, DSR, OLSR, AODV) using most common mobility models (Random Walk, Random Direction, Random Way Point) for mobile ad hoc networks.

Asma Tuteja, et. al's [8] have compared the performance of three protocols (AODV, DSDV, DSR). In this paper, The performance matrix PDR, Throughput, End to End Delay, Routing Overhead compared when Packet size changes, when time interval between packet sending changes, when mobility of node changes.

Lakhan Dev Sharma, et. al's [9] analysed analyzes the effect of mobility on performance of three MANET on-demand routing protocols i.e. DYMO, DSR, AODV. The performance metrics for analysis consists of different parameters such as throughput, Packet delivery ratio, average end-to-end delay and average jitter.

S. Mohapatra, et. al's [10] analysed the performance of AODV, DSR, OLSR and DSDV protocols using NS2 simulator. The delay, throughput, control overhead and packet delivery ratio are the four common measures used for the comparison of the performance of above protocols.

3. Simulation Scenario

In this paper, an attempt has been made to study and investigate the impact of mobility of four reactive routing protocols named AODV, DSR, DYMO and LAR1 using mobility models and Energy models. The simulations are successfully carried out using Qual-Net 5.2 simulator. For the entire simulations traffic source used is CBR, queue length is 50 simulation time is 300 seconds transmission range is 250m within an area of 1500m*1500m.

Table 1: Simulation parameters

Simulation parameters	Value
Dimension of space	1500*1500
Network Type	Mobile
Node Placement Strategy	Random
Traffic source	C B R
Network size (Number of nodes)	20,40,60,80,100
Pause time	2s,4s,6s,8s,10s
Velocity	10mps, 20mps, 30mps, 40mps, 50mps
Protocols	AODV, DSR, DYMO, LAR1
Mobility Model	Random Waypoint, Group Mobility Model
Item size	500,1000,1500 bytes
Source data pattern	4 packets/sec
Maximum size of buffered packets	50
MAC protocol	802.11
Transmission range	250m
Simulation time	300 seconds

3. Results Investigation

An attempt has made to evaluate the performance of (DSR, AODV, DYMO and LAR1) reactive routing by varying the Mobility pattern (Pause time and Velocity), Energy Model and Number of nodes.

4.1. Throughput

It is defined as the amount of data a receiver receives from the sender divided by the time it takes from the receiver to get the last packet.
From Figure 4.1.1 and 4.1.2, it is clear that with increasing nodes, on average, DYMO shows best performance for throughput in case of Random Mobility Model and DSR is best in Group Mobility Model. LAR1 shows worst performance for throughput in both Mobility models.

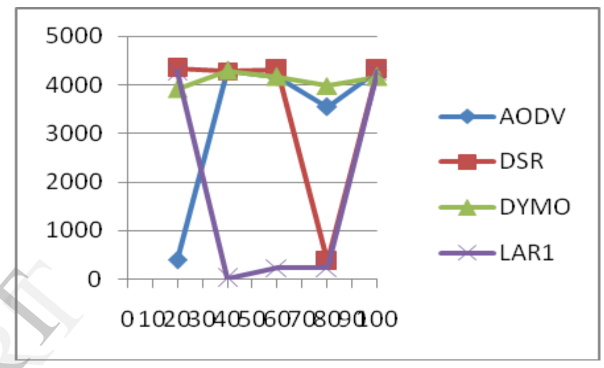

Fig. 4.1.1 No. of Nodes v/s Throughput for Random Waypoint

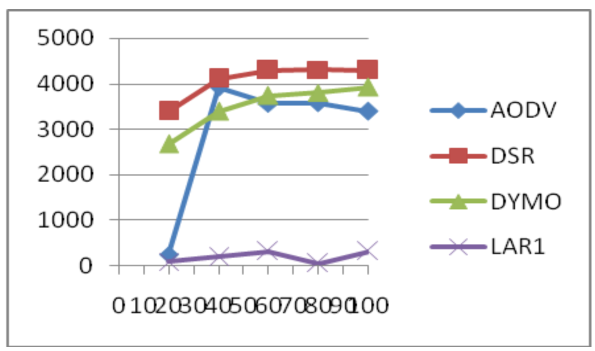

Fig. 4.1.2 No. of nodes v/s Throughput for Group Mobility Model

Figure 4.1.3 and 4.1.4 shows the throughput with respect to increasing pause time. It shows that AODV shows the best performance in terms of throughput of for variable pause time under both Mobility Models. LAR1 shows poor performance in both cases.

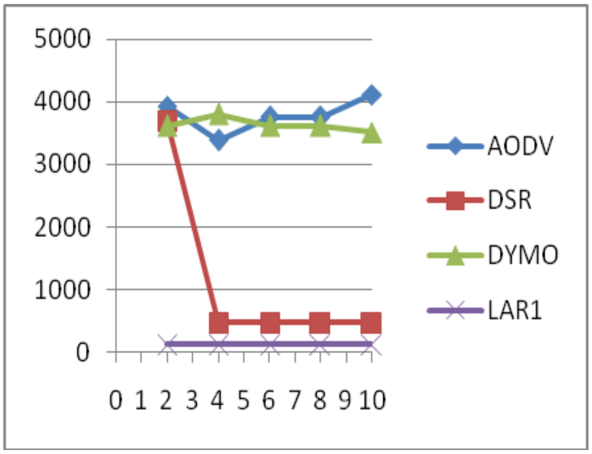

Fig. 4.1.3 Pause Time v/s Throughput for Random Waypoint

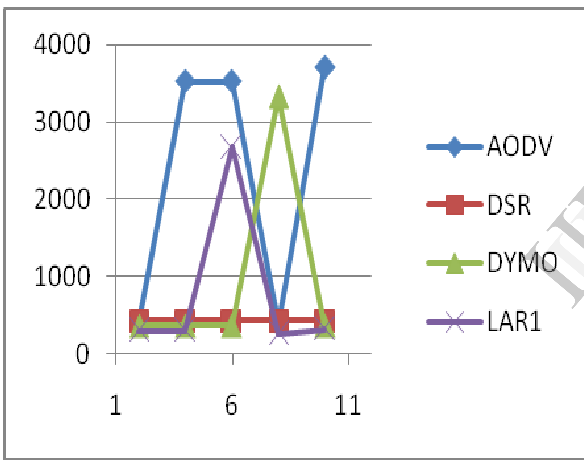

Fig. 4.1.4 Pause Time v/s Throughput for Group Mobility Model

Figure 4.1.5 and 4.1.6 shows Throughput with respect to increasing maximum velocity. With increase in velocity, performance of AODV increases in random Mobility Model and decreases in Group Mobility model. Overall AODV shows best performance in both mobility Models. LAR1 shows worst performance in both cases.

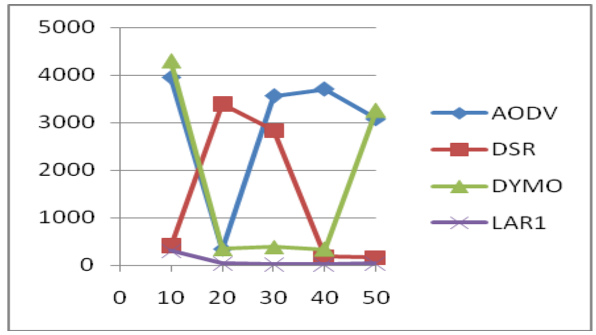

Fig. 4.1.5 Maximum Velocity v/s Throughput for Random Waypoint

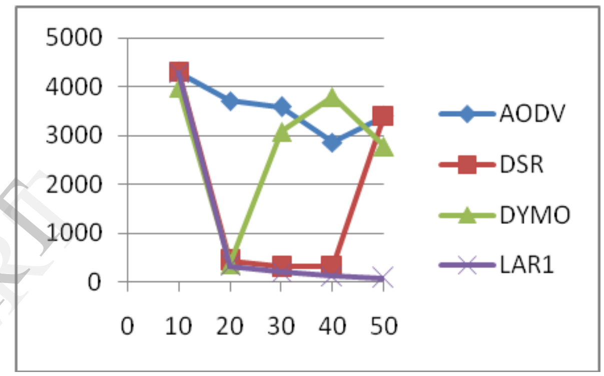

Fig. 4.1.6 Maximum Velocity v/s Throughput for Group Mobility Model

Figure 4.1.7 and 4.1.8 shows throughput with respect to increasing Pause Time. DSR and AODV are best in both cases and perform almost equally and its throughput increases with increase in packet size.LAR1 gives worst performance in both Mobility Models.

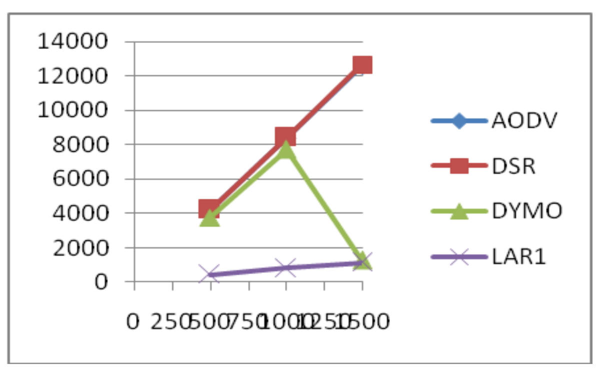

Fig. 4.1.7 Packet Size v/s Throughput for Random Waypoint

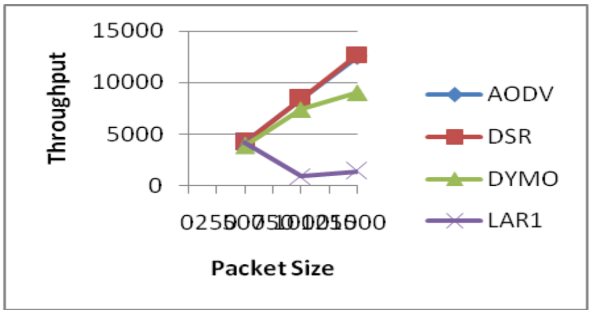

Fig. 4.1.8 Packet Size v/s Throughput for Group Mobility Model

4.2. Packet delivery ratio

It is obtained by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source i.e. (CBR source).

From Figure 4.2.1 and 4.2.2, it is clear on average; DSR shows best performance for PDR in case of both Random and Group Mobility Model. LAR1 shows worst performance for throughput in both Mobility models and its performance first decreases and then increases in Random mobility model.

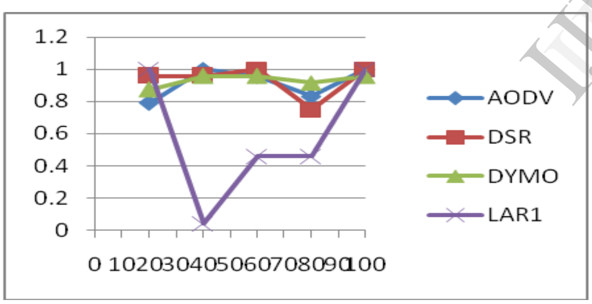

Fig. 4.2.1 No. of Nodes v/s PDR for Random Waypoint

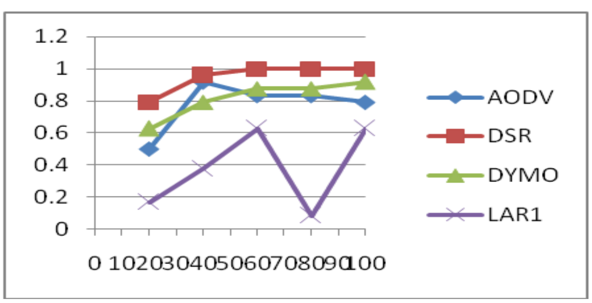

Fig. 4.2.2 No. of Nodes v/s PDR for Group Mobility Model

Figure 4.2.3 and 4.2.4 shows the PDR with respect to increasing pause time. It shows that DSR shows the best performance in terms of PDR for variable pause time under both Mobility Models. LAR1 shows poor performance in both cases and its performance increases with increase in pause time in Group Mobility model.

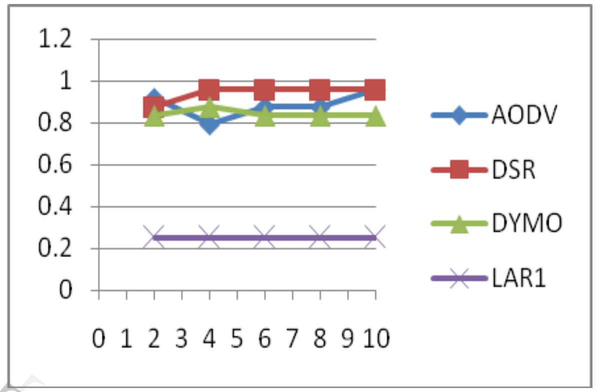

Fig. 4.2.3 Pause Time v/s PDR for Random Waypoint

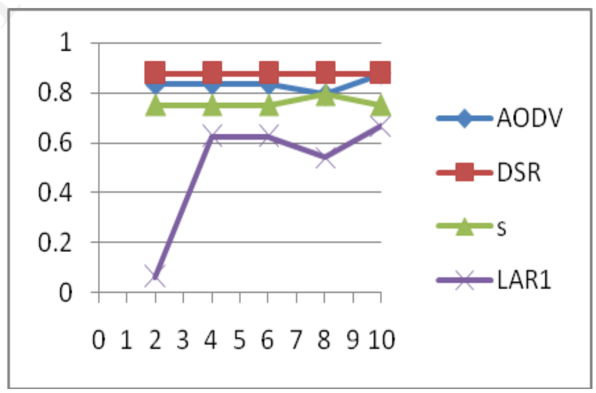

Fig. 4.2.4 Pause Time v/s PDR for Group Mobility Model

Figure 4.2.5 and 4.2.6 shows PDR with respect to increasing maximum velocity. AODV and DYMO perform almost equally and show highest performance for PDR and Lar1 shows poor performance in both Mobility Models. Overall AODV shows best performance in both mobility Models. On average performance of all protocols decrease with increase in velocity of nodes.

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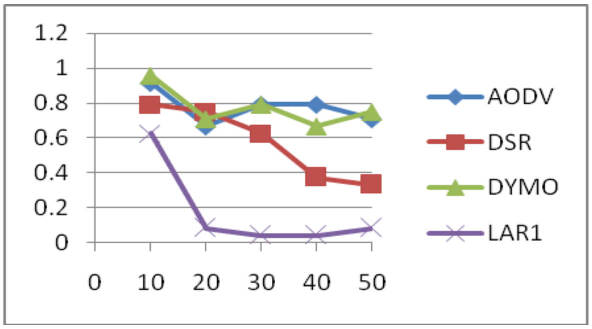

Fig. 4.2.5 Maximum Velocity v/s PDR for Random Waypoint

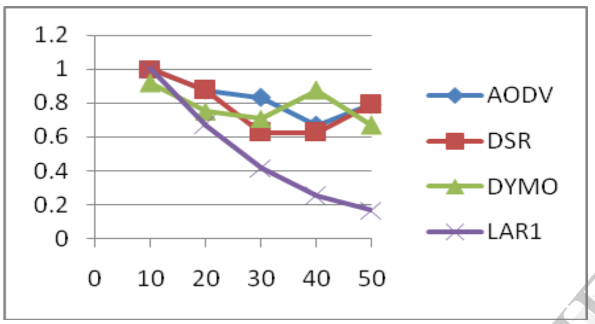

Fig. 4.2.6 Maximum Velocity v/s PDR for Group Mobility Model

Figure 4.2.7 and 4.2.8 shows PDR with respect to increasing Pause Time. DSR is best in both cases and its PDR remains constant with increase in packet size.LAR1 and DYMO gives worst performance in both Mobility Models and their performance decrease with increase in packet size.

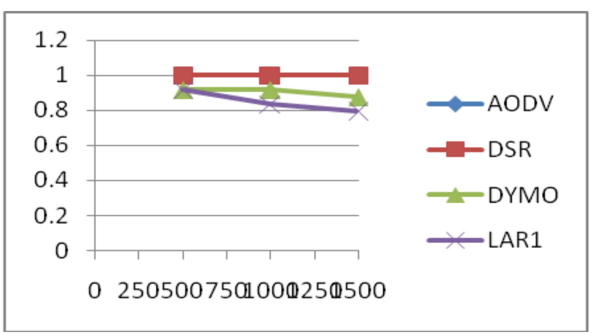

Fig. 4.2.7 Packet Size v/s PDR for Random Waypoint

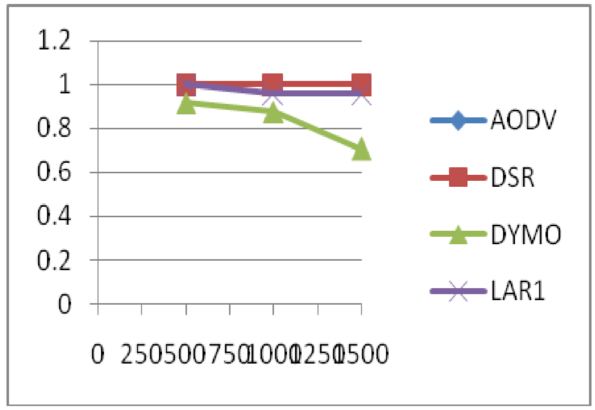

Fig. 4.2.8 Packet Size v/s PDR for Group Mobility Model

4.3. The average End-to-End Delay

It is the time interval when a data packet generated from the CBR source is completely received to the application layer of the destination.
From Figure 4.3.1 and 4.3.2, it is clear that with increasing nodes, on average, LAR1 shows best performance for average End to End Delay in case of both Mobility Models and DYMO shows worst performance for average End to End Delay in both Mobility models.

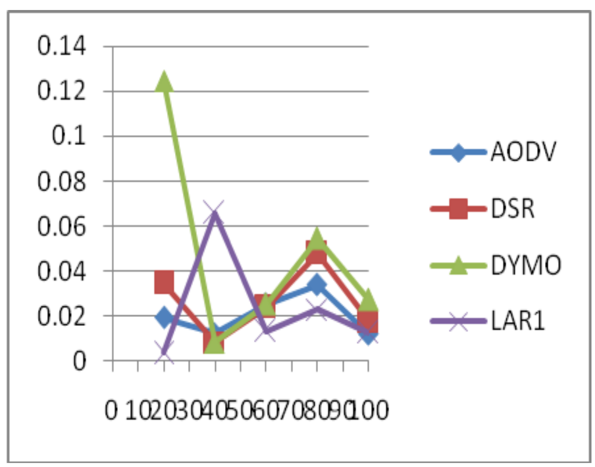

Fig. 4.3.1 No. of Nodes v/s Average End-to-End Delay for Random Waypoint

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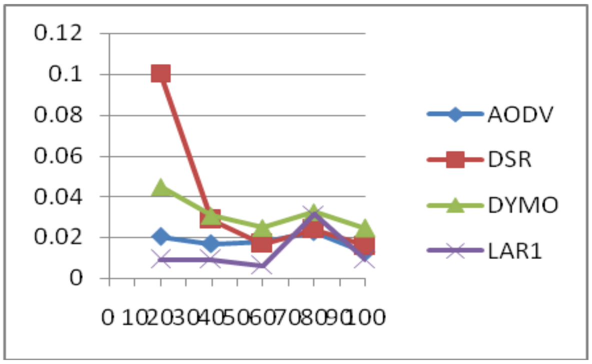

Fig. 4.3.2 No. of Nodes v/s Average End-to-End Delay for Group Mobility Model

Figure 4.3.3 and 4.3.4 shows average End to End Delay with respect to increasing pause time. On average AODV shows the best and DYMO shows worst performance in terms of average End to End Delay for variable pause time under both Mobility Models.

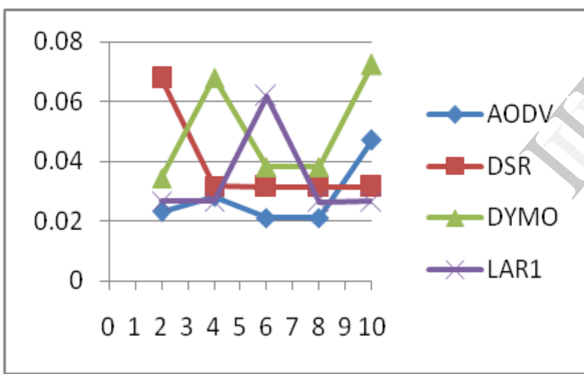

Fig. 4.3.3 Pause Time v/s Average End-to-End Delay for Random Waypoint

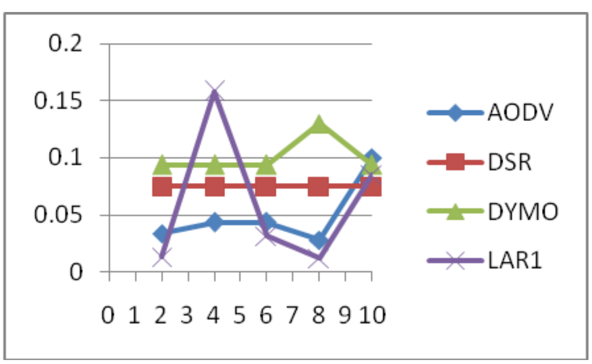

Fig. 4.3.4 Pause Time v/s Average End-to-End Delay for Group Mobility Model

Figure 4.3.5 and 4.3.6 shows average End to End Delay with respect to increasing maximum velocity. With increase in velocity, AODV and LAR1 are better than DSR and DYMO in both Mobility models. Overall AODV shows best performance in both mobility Models. DSR has poor performance for average End to End Delay and increases with increase in velocity in Random Mobility model.

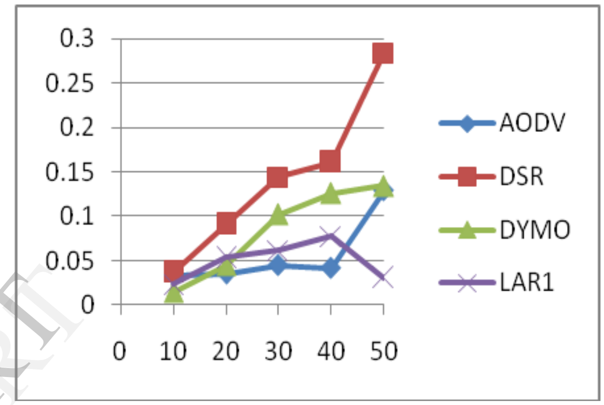

Fig. 4.3.5 Maximum Velocity v/s Average End -to -End Delay for Random Waypoint

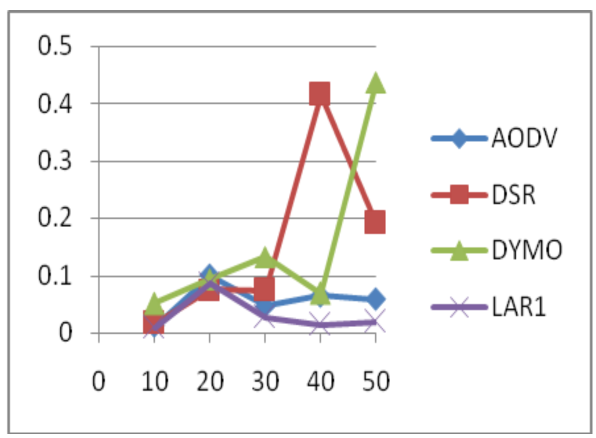

Fig. 4.3.6 Maximum Velocity v/s Average End -to -End Delay for Group Mobility Model

Figure 4.3.7 and 4.3.8 shows average End to End Delay with respect to increasing Pause Time. LAR1 is best in both cases. DYMO gives worst performance in both Mobility Models. Packet size has minor effect on the performance of all four protocols.

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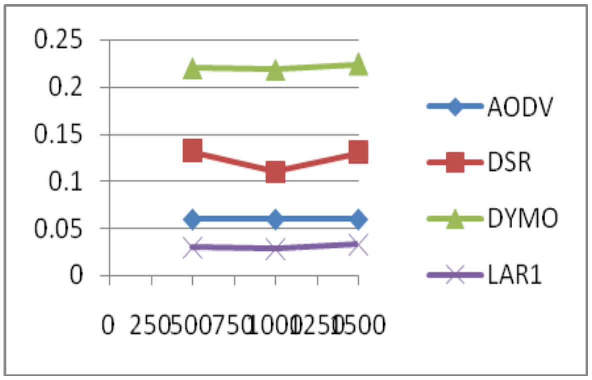

Fig. 4.3.7 Packet Size v/s Average End -to -End Delay for Random Waypoint

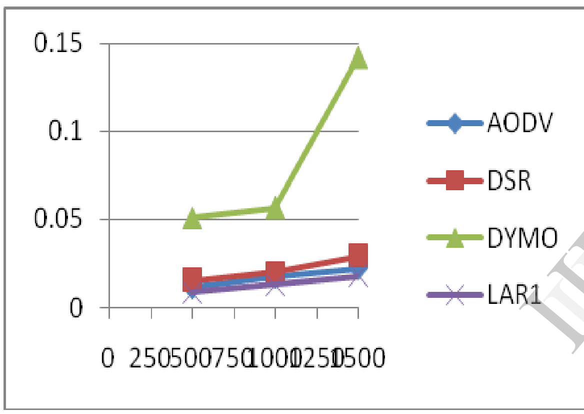

Fig. 4.3.8 Packet Size v/s Average End -to -End Delay for Group Mobility Model

4.4. Average Jitter

It is the time interval between subsequent packet arrivals.

From Figure 4.4.1 and 4.4.2, it is clear that with increasing nodes, on average, LAR1 shows best performance for Average Jitter in both Mobility Models and DSR is best in Group Mobility Model. LAR1 shows worst performance for throughput in both Mobility models. On average DYMO is worst for Average Jitter in Random Mobility Model and DSR is worst in Group mobility Model.

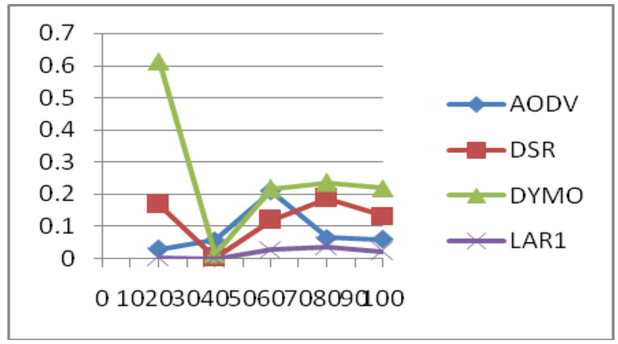

Fig. 4.4.1 No. of Nodes v/s Average Jitter for Random Waypoint

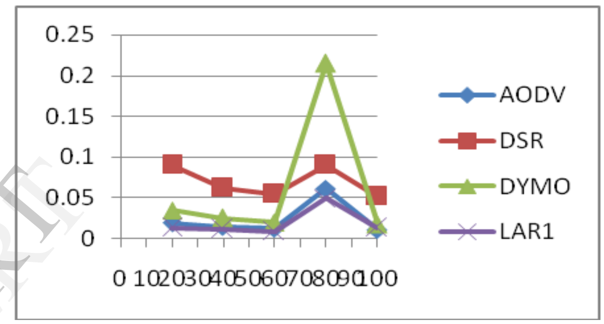

Fig. 4.4.2 No. of Nodes v/s Average Jitter for Group Mobility Model

Figure 4.4.3 and 4.4.4 shows the Average Jitter with respect to increasing pause time. It shows that LAR1 shows the best performance in terms of Average Jitter for variable pause time under both Mobility Models. DYMO shows poor performance in both cases.

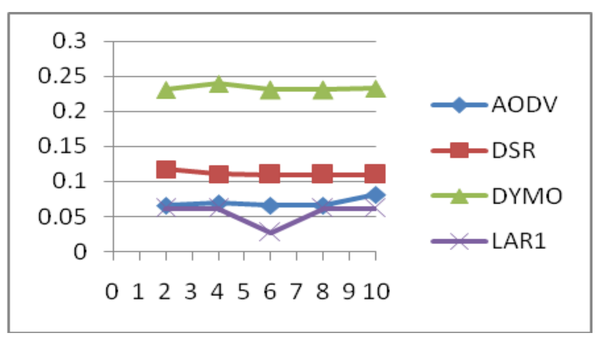

Fig. 4.4.3 Pause Time v/s Average Jitter for Random Waypoint

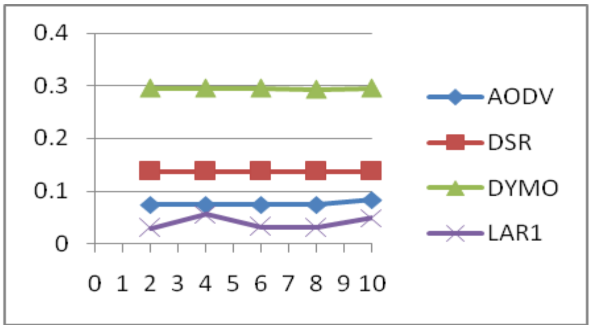

Fig. 4.4.4 Pause Time v/s Average Jitter for Group Mobility Model

Figure 4.4.5 and 4.4.6 shows Average Jitter with respect to increasing maximum velocity. With increase in velocity, performance of AODV, DSR, DYMO decrease in both Mobility Models. Overall LAR1 shows best performance for Average Jitter in both mobility Models.

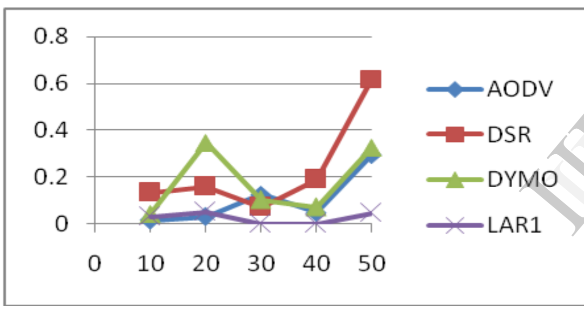

Fig. 4.4.5 Maximum Velocity v/s Average Jitter for Random Waypoint

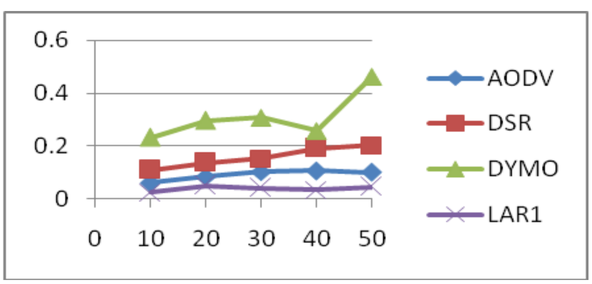

Fig. 4.4.6 Maximum Velocity v/s Average Jitter for Group Mobility Model

Figure 4.4.7 and 4.4.8 shows Average Jitter with respect to increasing Pause Time. LAR1 gives best performance in case of jitter and DYMO gives poor performance in both Mobility Models.

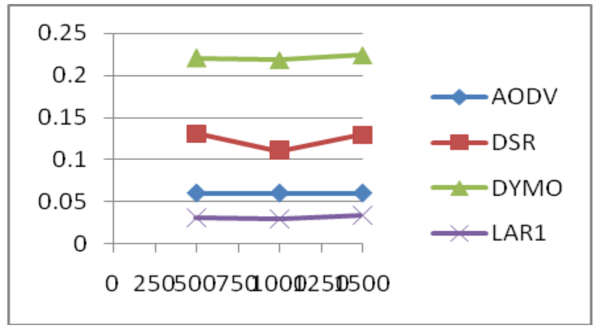

Fig. 4.4.7 Packet Size v/s Average Jitter for Random Waypoint

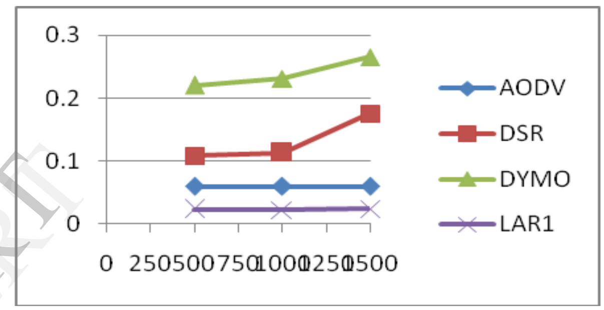

Fig. 4.4.8 Packet Size v/s Average Jitter for Group Mobility Model

4. Conclusion

We have compared the performance of four reactive routing protocols (AODV, DSR, DYMO, LAR) using four metrics (Throughput, Average Jitter, Average End to End Delay, PDR). From above investigation it is clear that mobility models have great effect on the performance of all protocols. There are large variations in the value of performance metrics in different Mobility Models. It is clear none of the protocol gives best performance for all the performance metrics. The protocol which gives best performance for one performance metric may poor worst for other metric. LAR1 is better choice for Average Jitter and End to End Delay sensitive application with respect to all performance metrics and in both Mobility Models. AODV is better for PDR with increasing nodes, increasing maximum velocity in Random Mobility Model and DSR is better for PDR in Group Mobility Model. DSR is better for Throughput with increasing nodes, velocity in both Mobility Models.

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