Analysis of Mobility Models using DSDV Protocol

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ABSTRACT

In Mobile Ad-hoc Network (MANETs), no fixed infrastructure is required. Completely different wireless hosts are free to move from one region to another without any centralized administration, so, the topology is changed from one instance to another in quickly manner. Routing in MANETs has been a tough task ever since the wireless networks got into existence. One of the important task in MANET keeps adjustments in network topology because degree of node mobility is higher. In most of the studies, the focus has been at the versions in pause instances and network length to measure the performance of various MANET routing protocols. A very few work has been done on the performance analysis of protocols by changing the underlying mobility models. In this paper, we are analyzed various mobility models: Random Waypoint model, Random Direction model and Manhattan Grid Mobility Model using DSDV protocols by using Network Simulator (NS 2.35).

Keywords - DSDV, MANETs, Manhattan, NS2, Random Direction, Random Way point, Throughput.

1. Introduction

Wireless technology came into existence since the 1970s and is getting extra advancement every day. The reason behind that the unlimited use of internet at present, the wireless technology has reached new heights. Nowadays, two kind of wireless networks are existing. The first one which is a wireless network built on-top of a wired network and thus creates a trustworthy infrastructure wireless network. The wireless nodes also connected to the wired network and these nodes are attached to base stations. An instance of this is the cellular phone networks where a mobile-phone connects to the base-station with the excellent signal quality.

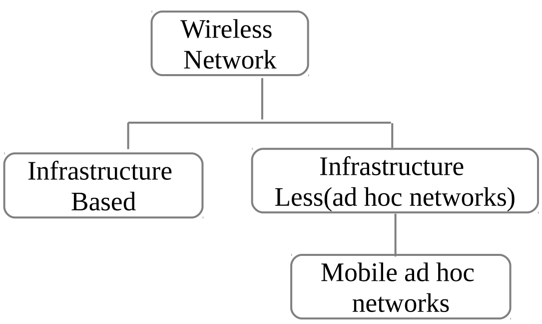

Fig. 1: Classification of Wireless Networks.

The second form of wireless technology is where no infrastructure exists in any respect except the participating mobile nodes. This is called an infrastructure less wireless network or an Ad hoc network. The word Ad hoc means something which is not constant or not organized i.e. dynamic. Latest advancements including Bluetooth introduced a clean sort of wireless systems which is often referred to as mobile Ad-hoc networks.

1.1 Mobile Ad-hoc Network Routing Protocols

A Protocol is a hard and fast of rules which administer something. To send packets containing useful data from source to destination node in MANETs, different routing protocols has been implemented with their suitability in a particular scenario. The protocols can be divided into two types: Proactive and Reactive. And those protocols which employ each proactive and reactive modes are termed as Hybrid ones.

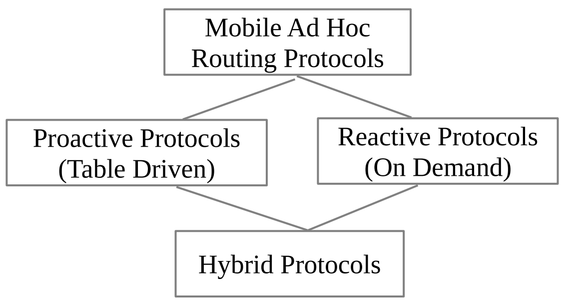

Fig. 2: Classification of mobile ad hoc routing protocols

1.1.1 Proactive Routing Protocols

It is also known as "table driven" routing protocols. In this, every node keeps one or more routing tables which include information about the whole network topology. These tables are stored up-to the minute by means of regular amendments in order that routing of information from one node to another may be executed in an efficient manner. For updating purpose, nodes alternate the routing information on a regular basis and this leads to huge overhead at the network . Some of the Proactive routing protocols are DSDV, WRP (Wireless Routing protocol).

1.1.2 Reactive Routing Protocols

Reactive protocols is also called as "on-demand" routing protocols. In these protocols, routes are searched most effective while wanted. A route discovery process started which is terminated either the route has been found or the route is not available. Route maintenance is a crucial operation of these protocols. As compared to proactive protocols, control overhead is much less and reactive protocols are more scalable. With these benefits, there may be a disadvantage of long delays suffered through nodes while searching for routes before actually transmitting the data. Some Reactive Routing protocols are AODV (Ad-Hoc On Demand Distance Vector), DSR (Dynamic Source Routing), TORA (Temporally Ordered Routing Algorithm, LAR (Location Aided Routing)[6].

2. DSDV Routing Protocol

In DSDV the records approximately unique paths are for each hop saved in routing tables in advance. Every time source want to send data to destination, then it will search the path from the routing table. In DSDV every routing table having the Hop count and Sequence Number. Hop count tells the wide variety of hops happens inside the path for source to destination. Path is updated by using Sequence Number. The path with the old sequence number is changed with the new sequence number. The New Sequence number defines the new path from source to destination.

2.1 Packet Transmission Using DSDV Protocol

Figure 3 shows that Node 1 wants to send a packet to the Node 5 . The Node 1 checks its routing table and locates that the next hop for routing the packet is Node 6. Then Node 1 sends the packet to Node 6.

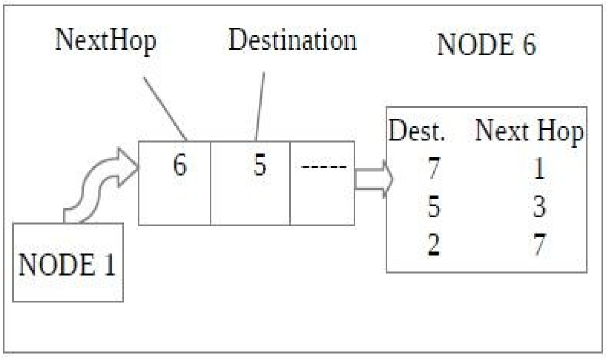

Fig. 3: Node 1 sends packet to Node 5 via Node 6

Figure 4 shows that Node 6 looks up the next hop for the destination Node 5 in its routing table when it receives the packet.

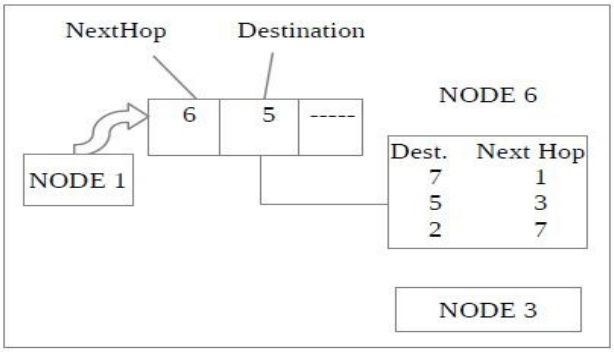

Fig. 4: Node 6 has node 3 as next hop to reach the destination node 5

Figure 5 shows that Node 6 then forwards the packet to the Next hop 3 as specified in the routing table of Node 6. The routing procedure repeated along the path until the packet finally arrives its destination 5.

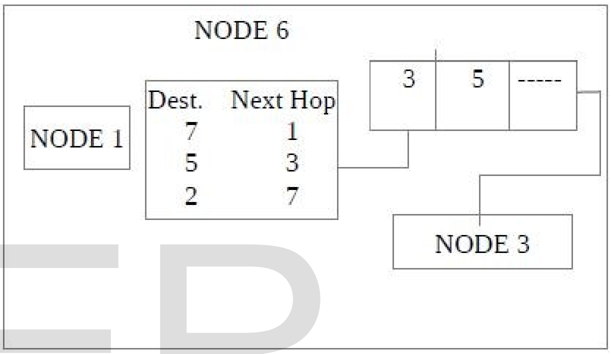

Fig.5: Node 6 forwards the packet (meant for destination node 5) to node 3

2.2 Managing the Routing Table

The pivotal factor of DSDV is the generation and maintenance of the routing tables. Every time the network topology changes, the routing table needs updating and when routing tables are not updated, loops may be shaped. To carry out routing table maintenance, little additional information is also stored in the routing table i.e. Destination Address, Next Hop Address, Route Metric, and Route Sequence Number. Every node will broadcast a routing table update packet periodically as well as immediately when there is a topology alternate. Update packet begins out with a metric of 1. Each receiving next-neighbour node is one hop at some distant from node that sends the Update packet. The neighbours will increment this metric after which retransmit the update packet. Process is repeated round the clock till each node in the network has received a duplicate update packet with a corresponding metric. If node gets duplicate update packets, it will only consider the packet with smallest metric and ignore the rest [11].

2.3 Distinguishing the Stale Packets

To differentiate the stale packets from valid ones, each update packet is earmarked by the unique node with a Sequence number which essentially is a monotonically increasing number that provides the unique identity of each update packet from the given node. If a node gets an update packet from some different node, the sequence number inside that update packet must be either equal to or more than sequence number already present in the routing table; otherwise the update packet is considered stale and ignored. If sequence number matches the sequence number already in the routing table, then the metric is compared and updated. Updated packet is forwarded every time and thereafter the packet have the address of the concluding destination as well as the address of the node which transmits the packet [11].

i) When Sequence number in update packet < Sequence number already in routing table.

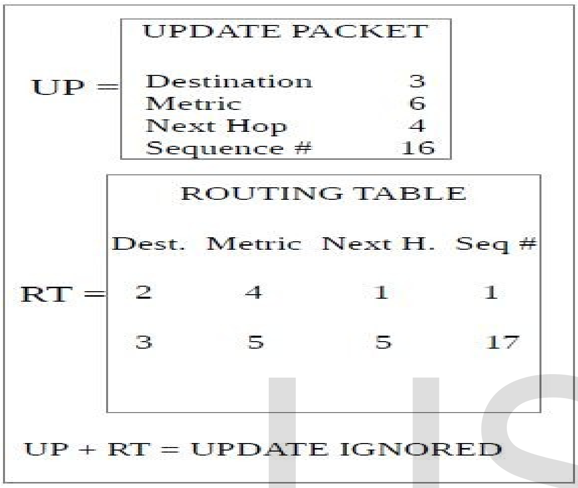

Fig. 6: Smaller sequence number in update packet.

ii) When Sequence number in update packet = Sequence number already in routing table.

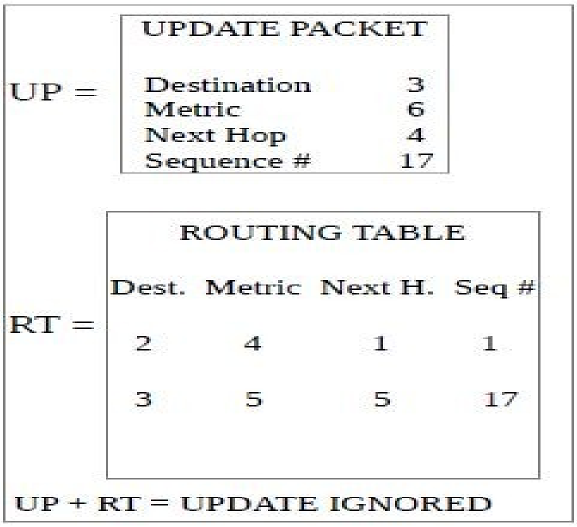

Fig. 7: Equal sequence number in Update packet.

iii) When Sequence number > Sequence number already in routing table, then UPDATE is PERFORMED.

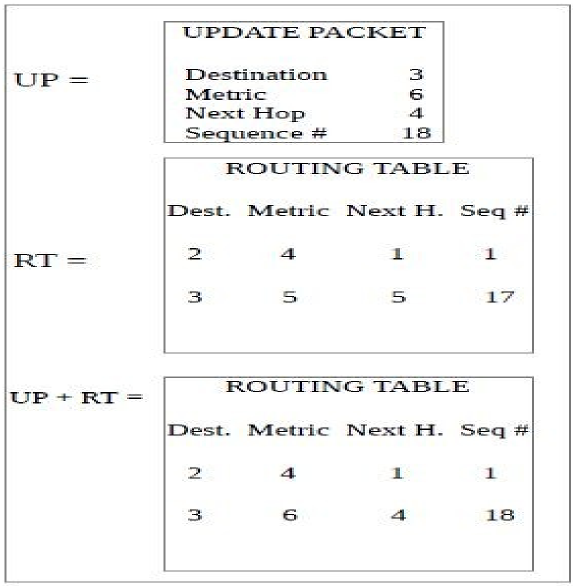

Fig. 8: Greater Sequence number in Update packet.

Every node periodically transmits its complete routing table to its neighbours using update packets. Neighbours will replace their tables based on this record, if required [11].

3. Mobility Models Used For Evaluation

Mobility model depicts the motion of the nodes. There are some of mobility models which have been used to mimic the movements of nodes and tell while to change the speed and direction [8]. In this study, 3 models were used for overall performance evaluation as mentioned below:

3.1 Random Waypoint Mobility Model

It is commonly used benchmark synthetic model for mobility and is a fundamental model which describes the movement pattern of impartial nodes by using simple terms. It is able to be generated at once using sedtest tool that is included within the ns2 itself. Every node action alongside a zigzag line from one waypoint Wi to the next Wi+1.The waypoints are uniformly distributed over the given region. It consists of pauses among the changes in direction or speed of nodes.

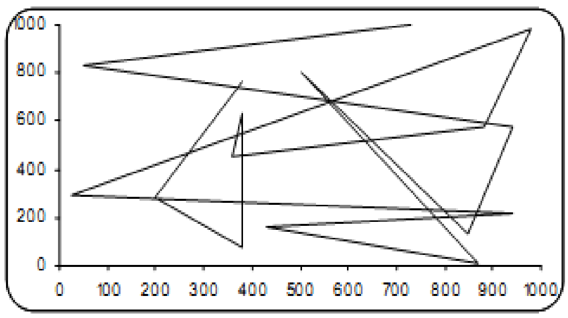

Fig. 9: Movements using Random Waypoint mobility model[7]

A Mobile node remains in a single region for some time interval called pause time and while this time expires, it chooses a random destination within the simulation area that is allotted uniformly among [min-speed, max-speed].The node then travels towards its newly selected destination at the chosen speed. This procedure is repeated again while the node reaches the destination and pauses for a specific time. The movements using this model are shown in Fig. 9.

3.2 Random Direction Model

It is a variant of random waypoint model. Mobile nodes pick out a random path where in to travel and the travels to the border of simulation region in that direction as depicted in Fig. 10. Once the simulation boundary is reached, the node pauses for a specified time and chooses another angular direction (between 0-180 degrees) and repeat the process again. Fig.10 shows that Node begins in the centre of the simulation area. While node reaches the border, it takes a pause and again chooses a new route. Considering the fact that nodes reach the border after which take pause and pick new path, for this region average hop count in this model is greater than that in Random Waypoint Model [9].

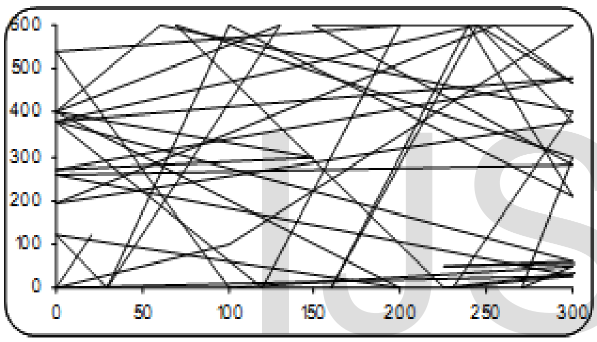

Fig. 10: Movements using Random Direction mobility model[9]

3.3 Manhattan Grid Mobility Model

The Manhattan model may be beneficial in modelling motion in an urban area .The scenario is composed of some of horizontal and vertical streets. Fig.11 shows the topography of movement of nodes for Manhattan Mobility Model with 17 nodes. The map defines the roads along the nodes can move.

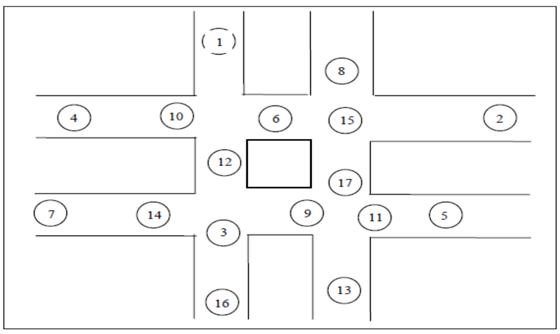

Fig. 11: Node movement's using Manhattan Grid mobility model[4]

At the intersection of a horizontal and a vertical street, the mobile node can turn left, right or head straight. The choice of motion at the intersection is probabilistic: the moving probability is 0.5 in same street with turning probability towards left is 0.25 and towards right is 0.25. The mobile node velocity at a time slot is dependable on its velocity at the previous time slot. The node's velocity is also constrained by the velocity of the node preceding it on the same lane of the street.

4. Performance Measurement of DSDV Protocol for Various Mobility Models

The modern studies has been constrained to using Random Waypoint mobility model for producing moves for the nodes in a mobile ad hoc network, But this model has been considered a poor choice in a study [8,9]. A very few investigations were made regarding the performance of mobile ad hoc network routing protocols based on different mobility models. It has been discovered by using a few studies that use of different mobility models affect the overall performance of various mobile ad hoc routing protocols. Variations can be seen in the performance of various protocols while examined different mobility models. In this paper, attempt has been made to analyze the overall performance of DSDV proactive routing protocol under 3 mobility models viz. Random Waypoint mobility model, Random Direction mobility model and Manhattan Grid mobility model. The reason is to find out whether or not under which model DSDV performs better. The overall performance metrics used for evaluation are Throughput,Average End to End delay, Routing overhead and Packet Delivery Ratio.

4.1 Simulation Environment

Simulation is basically a mixture of science and art. It is widely used in engineering research. There are a number of simulation tools available to simulate the behaviour of various networks and routing protocols.

TABLE 1: SIMULATION PARAMETERS FOR PERFORMANCE EVALUATION

Simulation Parameters used in the Tcl Script	
Propagation Model	Two Ray Ground
MAC	IEEE 802.11
Interface Queue (IFQ) Type	Droptail/PriQueue
Antenna	Omni Antenna
Routing Protocol	DSDV
Dimensions of Topography	500x400
Simulation Time	150 ms
Traffic Source	FTP over TCP
Number of nodes	10, 30, 50, 70, 100
Maximum Packet in IFQ	100
Mobility Models	Random Waypoint, Random Direction, Manhattan Grid

Since Mobile ad hoc networks have not been deployed widely, simulation is a good choice to model their behaviour and test their suitability under different scenarios. Simulation makes it possible to understand the behaviour of the networks and the underlying routing protocols so as to find out their applicability in different situations. In this study, the protocol DSDV was simulated in ns-allinone-2.35 simulation package which was installed on Ubuntu Linux version 12.04. The parameters used to carry out the simulation study have been listed in Table 1.

4.2 Experiments, Results & Analysis

The experiments were performed by using the above mentioned simulation parameters inside the Tcl Script. The movements were generated for 10, 30, 50, 70 and 100 nodes respectively by using 3 mobility models Random Waypoint, Random Direction and Manhattan. The Tcl script was run and eventually two files were generated for every scenario- Trace file and NAM file. The NAM file was used to analyze the movement of nodes and the packet transmission, in short for animation. The Trace file was analyzed and the performance metrics were evaluated using AWK scripts. The experiments were repeated for these three models to understand the behaviour of DSDV and find out under which model this protocol performs well.

4.2.1 Average End to End delay comparison

Average End-to-End delay is the time taken by a data packet travel through the network from source to the destination. Thus it is the average time a packet takes to reach the destination from the source.

Fig. 12 shows the Average End-to-end delay of DSDV with various mobility models and varying number of mobile nodes(10-100), which is indicated on x-axis. In this it is observed that the Average End-to-End delay is more in case of Random Waypoint model as compared to the other models. Random Direction model and Manhattan Grid model performed well in this case. The formula for Average End-to-End delay(D) is:

$$D = (TR - TS),$$

Where TR is receive Time and TS is sent Time.

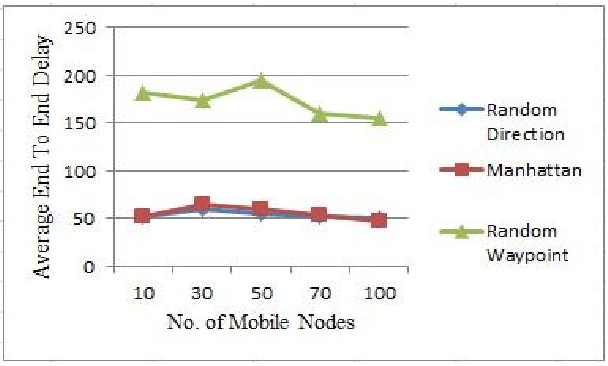

Fig. 12: Average End-to-End delay Vs No. of Mobile Nodes

4.2.2 Routing Overhead comparison

Control overhead is measured as ratio of no. of control packets transmitted during throughput simulation period. Fig. 13 shows the Routing Overhead of DSDV with various mobility models and varying number of mobile nodes (10-100), which is indicated on x-axis. In this it is observed that Manhattan model and random direction model generated less routing overhead than random waypoint model.

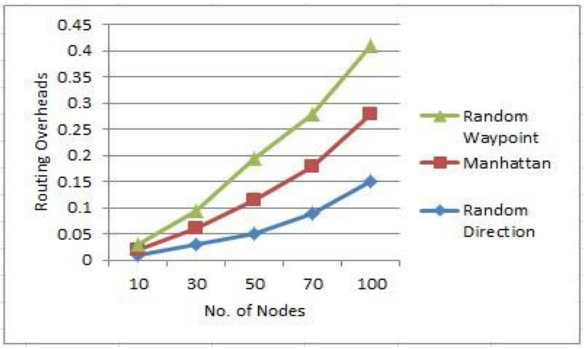

Fig. 13: Routing Overhead Vs No. of Mobile Nodes

4.2.3 Throughput Comparison

Throughput refers to the amount of data delivered in a unit of time averaged over the number of nodes. It is measured in bits per second (bps). Fig. 14 shows the Throughput of DSDV with various mobility models and varying number of mobile nodes (10-100), which is indicated on x-axis. In this it is observed that Manhattan Grid model outperformed the other two models in terms of throughput. Random Direction model performed the worst.

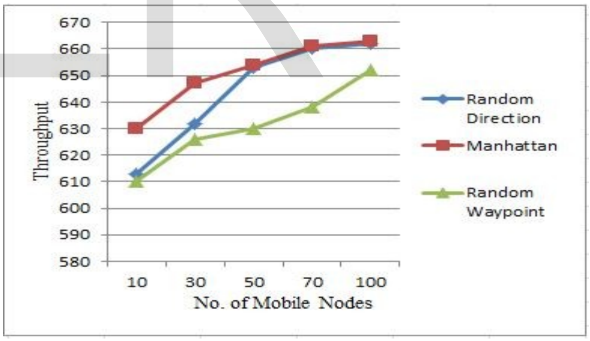

Fig. 14: Throughput Vs No. of Mobile Nodes

$$\text{Throughput} = TRP/TST \text{ (Kbits/Sec)}$$

Where TRP is total received packets & TST is the total simulation time

4.2.4 Packet Delivery Ratio

Packet Delivery Ratio is measured as the ratio of no. of packet reached at destination and the no. of data packets sent by sender. Fig. 15 shows the Packet Delivery Ratio of DSDV with various mobility models and varying number of mobile nodes (10-100), which is indicated on x-axis. In this it is observed that the packet delivery ratio dropped with the increase in number of nodes. Like in case of throughput, obviously, Manhattan grid model gave the best performance. The formula for Packet Delivery Ratio is:

PDF = (PR /PS)*100

Where PR is total Packet received & PS is the total Packet sent.

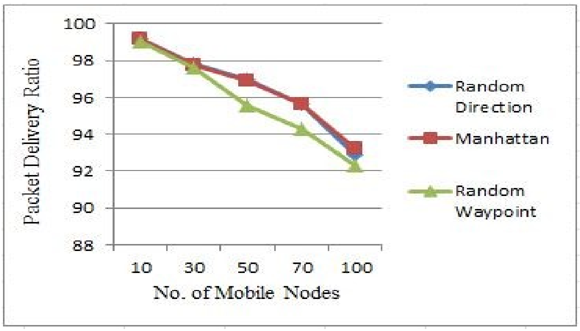

Fig. 15: Packet Delivery Ratio Vs No. of Mobile Nodes

5. Conclusions

Routing is a main subject when it comes to the performance of mobile ad hoc networks. In this paper, the focus on the study of the choice of the mobility models to evaluate the performance by using DSDV protocol. Results show that Manhattan Grid model gives better throughput and packet delivery ratio and exhibits lesser average end to end delay & routing overhead than by using Random Waypoint and Random Direction model. Random Direction Model performed well in terms of Average End-to-End delay and routing overhead. Therefore it has been concluded through this study that DSDV protocol gives best overall performance with Manhattan Grid mobility model over the other two models under the chosen simulation environment. However, it has been observed that the packet delivery ratio and hence the throughput declines with the increase in the number of nodes. In this paper three Random mobility models had been compared using DSDV protocol. This work can be extended on the following aspects:

i) Research of different MANET mobility models using different protocols under different types of traffic like CBR.

ii) Distinct number of nodes and different node speeds.

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