Analysis of Variations in Speed for Different Mobility Models in Ad Hoc Networking

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Abstract: Mobile Ad hoc network (MANET) is a group of mobile nodes which are capable of moving rapidly, changing and making a network without using a central infrastructure. In a mobile ad hoc network all nodes has intercommunication with each other. Every node in mobile ad hoc networks work as a router, so node forwards a packet to the neighbor node awaiting packet reaches to destination node. Because of mobility, connections in the network can change dynamically and nodes can be added and removed at any time. This paper focus to analyze the routing protocols AODV, DSDV and DSR on the basis of throughput, end to end delay, normalized routing load and packet delivery ration when speed of nodes varying. The simulation is carried out by using NS2 simulator, different simulations has been done by taking different mobility models.

Keywords: *MANET, AODV, DSR, DSDV, NS2, Different mobility models.*

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I. INTRODUCTION

In a mobile ad hoc network (MANET) nodes are connect themselves in a self-organized or decentralizes manner. Mobile ad hoc networks also can set up a multi hope routes, and it allows applications running on these wireless devices to share data of different types and characteristics. In a mobile ad hoc network if a source and destination nodes are not in transmission range of each other, then intermediate node is used as intermediate route among two nodes. In case, if mobile platform moves then it will communicate by using dynamically changing network. The topology of these networks is highly dynamic because every node in network moves freely. Due to this, routing is difficult in large networks because of many intermediate networks. To reduce this complexity it is divided into small domains and these small domains make it more manageable.

II. AN OVERVIEW OF PROTOCOLS

Routing protocols in ad hoc mobile network is divided into three classes as Proactive, Reactive and Hybrid routing protocols[1]. These proactive routing protocols are also known as table driven routing protocols. Every node maintains table which are consistent and up to date containing routing information for each node in the network. If any outsider node enters in a network or remove from network then control massages are send to neighboring nodes, after that they update their routing tables. Proactive routing protocols uses a link state routing algorithms, these are regularly flood the link information to the neighboring nodes. Proactive routing protocols are DSDV and OLSR[2]. Second type of routing protocols is reactive routing protocols. These are also known as on demand driven reactive protocols. These are mainly used to find the route between source and destination as required. When source demand, then routing protocol initiate routing discovery to find the route of destination. AODV is a reactive routing protocol[3]. Hybrid routing protocols is a combination of both reactive and Proactive routing protocols. Before some time, they behave like proactive routing protocols, because they have tables in starting phase and then start to find route there selves and hence works as reactive routing protocols. ZRP and TORA are hybrid routing protocols. Emergency services, Tactical networks, commercial environments, educational and entertainment are the applications of ad hoc mobile networks.

A. *DSDV*

Destination sequenced distance vector protocol is a table driven routing protocol and it is a modified version of Bellman-Ford algorithm. This algorithm provided a means of calculating a short path between source and destination nodes[4]. In DSDV, each node is required to transmit a sequence number, because the sequence number is used to discriminate stale routes from new ones and thus avoid the formation of loops. Update of rotes in both time-driven and event-driven. Routing table updates can be of two types- 'incremental' and 'full dump'. Full dump packets carry all available routing information and Incremental packets carry only information changed since the last full dump. When mobile nodes move place to place links are comes out of order, when a link to next hope is broken then any route through the next hop is quickly assigned infinity metric and updated sequence number. Sequence number assigned to by indicate origination nodes are even number and assigned to indicate infinity metrics are odd numbers. When a mobile node receives a new route update packet then it compare it to the table information already available in the table. Table is updated based on two points. First, if the received sequence number is greater than the last update, then the information in the table is replaced with the information in the update packet. Second, the table is update if the sequence numbers are same as last sequence number.

B. *AODV*

Ad hoc on demand distance vector routing protocol is a reactive routing protocol for mobile ad hoc networks. It discovers a route when needed, and is an improved over DSDV networks, the size of the network may increased depending on number of nodes in this network. AODV only needs to maintain the routing information of the active paths, as reactive routing protocols. In this protocol the routing information is maintained in the routing tables at each node. Each and every node has a next hop routing table[5-6]. A source node initiates a path discovery process to locate the other intermediate nodes and destination node, by broadcasting a route request (RREQ) to

neighbouring nodes. In AODV path discovery is accomplished by flooding a route request (RREQ) packet, when it reached to the destination node. Then destination node checks the sequence number which is specified in RREQ. After that route replay (RREP) packet is created and forwarded back to source only if the destination sequence number is equal to or greater than the RREQ. In AODV, symmetric links are used and RREP follows the reverse path of RREQ. After receiving a RREP packet, every intermediate node along the route updates next hop updated in table entries with respect to the target node. The main advantage of this protocol is low connection setup delay and the disadvantage in that more number of control overheads due to many route reply messages in a single route request.

C. *DSR*

Dynamic source routing protocol is a reactive unicast routing protocol that utilizes source routing algorithm [7]. It is totally self organizing and self configurable. The protocol is just combination of two mechanisms; one is route discovery and other route maintenance. This protocol frequently updates its route cache for the sake of new obtainable easy routes. In first mechanism, it has two messages Route Request (RREQ) and Route Reply (RREP). When node needs to send a message to specific node or destination, it floods a RREQ packet in network. The neighboring nodes in network range will receive this request massage they add their own address and rebroadcast in the network again. Destination receive a RREQ message with a full of information about the route. After that destination node send a Route Reply (RREP) packet to the sender with complete route information. This path considered the shortest path chosen by the RREQ packet. Now the source node has full information about the route in its route cache. Route maintenance uses a two kind of messages i.e. route error (RRER) and acknowledgement (ACK). If the message successfully received by the destination nodes, then they send an acknowledgement ACK to source node. if there is a some problem in the communication network a route error (RRER) message is transmitted to the sender, that there is some problem in the transmission[8].

III. MOBILITY MODELS

Different mobility models are designed in this paper by taking a wide range of mobility pattern for ad hoc networks applications. These different mobility models are chosen from different classes including entity based and group based mobility's.

A. *Random waypoint mobility model*

In all random based mobility models nodes are set free to move in any direction within the simulated area. In other words we can say that node is a free to set its destination, speed and direction independent of the neighborhood nodes. Random waypoint mobility mode is only the model that is widely implemented and analyzed in a simulation of routing protocols because of its simplicity and ease of availability[9]. In the starting of simulation every mobile node is waiting for the specific time known as a pause time and randomly select one location. Mobile nodes chose a new random direction after staying at its previous position for a time period. A mobile node travels across the area with random speed. This process of choosing the random destination is repeated again and again until the simulation is finish.

B. *Reference point group mobility model*

This model represents the random movement of the group of mobile nodes same as individual nodes in random mobility model. The path travelled by the logical center is followed by the group movements, which may be completely random or predefined. This mobility model is represented with a group motion vector. The center movement of group is completely characterizes the motion of its corresponding group of mobile nodes, as well as speed and direction. Other side, individual mobile nodes moves about their own predefined reference points, but their movement depends on the group movement. The individual references points are moves from t to t+1, and their locations are updated according to the logical center of group. Once the updated reference points, t+1 are calculated they are combining with a random motion vector to signify the random motion of each individual mobile node about its individual reference points. Example of reference point group mobility model is, military battle field communication where the commander and soldiers from the logical groups[10].

C. *Column Mobility Model*

This model is based on the group mobility model. It is mostly used for searching and scanning purposes. Number of mobile nodes form a line and moves uniformly in a particular direction. Every single mobile node follows on another. In a column mobility model individual mobile nodes are located in a single file line, then these mobile nodes moves about their initial positions. For the process new reference points are calculating by: new_ref_pos = old_ref_pos + advance_vector

Here, old_ref_pos is previous reference point, advance vector is predefined offset and new position of mobile nodes can be calculated as:

new_pos = new_ref_pos + random_vector

In this model, all mobile nodes moves around their relevant reference points, i.e. they follow a exacting reference point and start roaming according to the reference points[11].

IV. SIMULATION RESULTS

We are using a simulator NS2 for the simulation of the protocols. Here the simulation of different protocols has been done on the basis of different mobility models by increasing a speed of nodes. In this paper, simulation is carried out by using constant bit rate (CBR) within the 1000mx1000m area. Time for the simulation is 30sec by taking a fixed number of nodes with the increasing speed.

A. *Simulation Parameters*

TABLE I

Parameter	Value
Routing Protocol	AODV, DSR, DSDV
Simulation time	30 sec
Environmental size	1000x1000 m
Number of nodes	20
Traffic source	CBR
Maximum speed	20 m/s
Packet size	512 byte
Antenna	Omni directional
	Random waypoint mobility,

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Mobility models	Group mobility, Column mobility

B. *Performance Metrics*

To achieve different simulation results we have selected different number of performance metrics for routing protocols of ad hoc networking, which are explained below:

- *Throughput:* It is the number of bits transmitted between source and destination per unit time or how much data packet correctly delivered to the destination.
- *End to end delay:* It is the average time that a packet takes to transverse the network. It is a time from the generation of packet at sender up to destination by including all possible delays in transmission.

  ∑(arrive time-send time)/ ∑number of connections

- *Packet delivery ratio:* it is the ratio of the number of the data packets that delivers to the destination or it depicts the level of the delivered data to destination.

  ∑number of packet receive/ ∑number of packet sent

- *Normalized routing load:* The fraction part of all routing control packets that has been sent by every node over the number of received data packets at the destination nodes. In other words, it is the ratio between the total numbers of routing packets that are sent over the network to the total number of data packets received.

V. RESULTS AND DISCUSSION

In this section, we present our simulation results and discussion over them. In this paper results are compared between AODV, DSR and DSDV protocols by taking a three different mobility models.

A. *Throughput:* In this simulation throughput is evaluated for AODV, DSDV and DSR for three mobility models in time of 30 sec. when column mobility model is used in simulation, Fig. 1 shows that AODV has good throughput when speed is less but with the increasing of speed throughput fluctuating, when speed is at its peak then throughput is lesser then other protocols. On the other side, throughput is less affected by speed in DSDV protocol. DSR have extremely up and downs in throughput with changing speed. When reference point group mobility model is used as shown in Fig. 2, AODV perform better and DSDV has worse throughput performance. At last, when random waypoint mobility model is used shown in Fig. 3 to analyze the performance of throughput, steady throughput of protocols at different speeds. DSDV has excellent but DSR has poor performance.

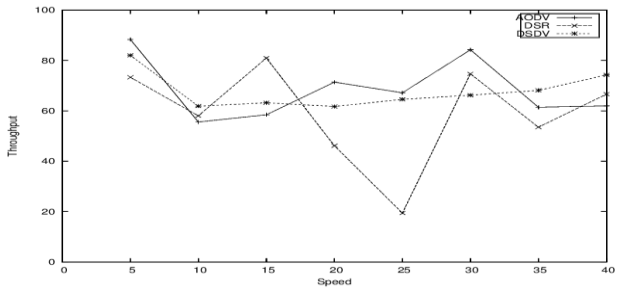

Fig. 1 Throughput vs speed in column mobility model

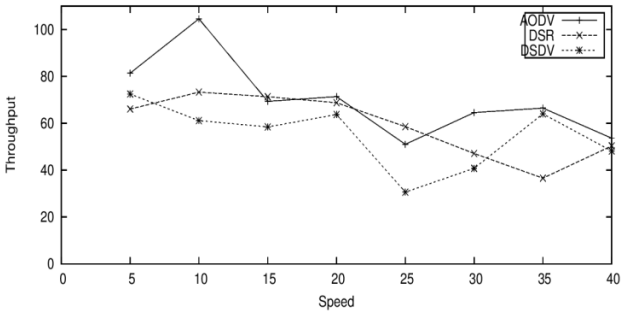

Fig. 2 Throughput vs speed in group mobility model

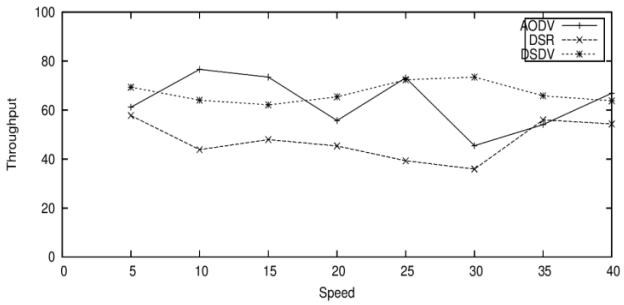

Fig .3 Throughput vs speed random way point mobility model

B. *Packet delivery ratio:* it is the ratio of the number of data packets that delivered at the destination. In Fig. 4 AODV have better but DSDV have bitter packet delivery ratio performance. Fig. 5 shows a graph when reference point group mobility is used, AODV perform better but DSR have fluctuating PDR with the increasing speed of nodes. As shown in Fig. 6 AODV, DSDV and DSR has better packet delivery ratio when random waypoint mobility is used.

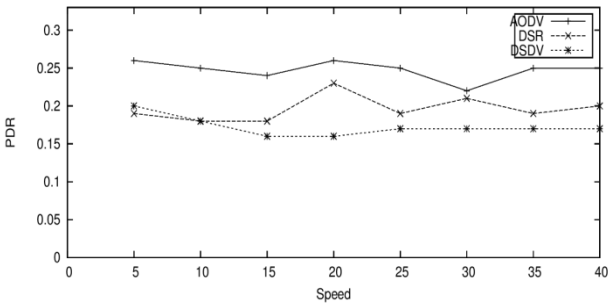

Fig .4 Packet delivery ratio vs speed in column mobility model

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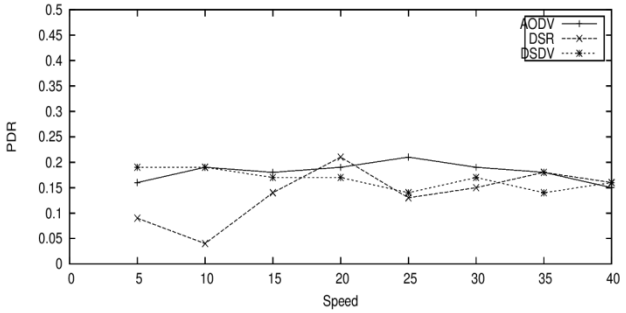

Fig. 5 Packet delivery ratio vs speed in group mobility model

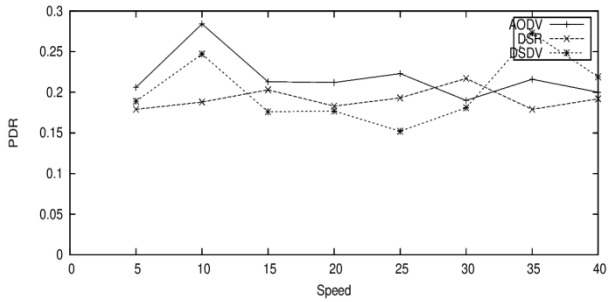

Fig. 6 Packet delivery ratio vs speed in random waypoint mobility model

C. *End to end delay:* it is the average time taken by packet to reach from sender to destination. In column mobility model DSDV perform worse because high end to end delay and DSR has lesser delay as in Fig. 7. Delay becomes more in AODV and less in DSDV when reference point group mobility model is used as shown in Fig. 8. If random waypoint mobility shown in Fig. 9, is used the AODV has least delay and DSDV has more end to end delay.

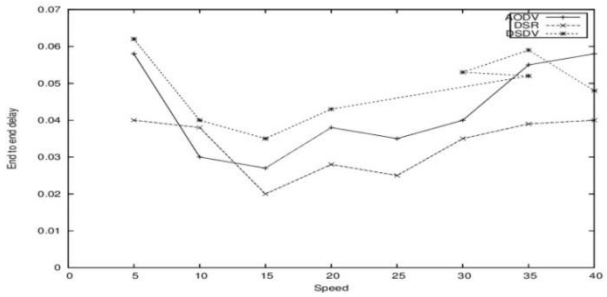

Fig. 7 End to end delay vs speed in column mobility model

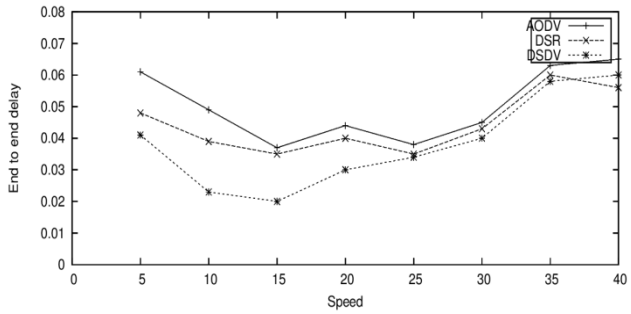

Fig. 8 End to end delay vs speed in group mobility model

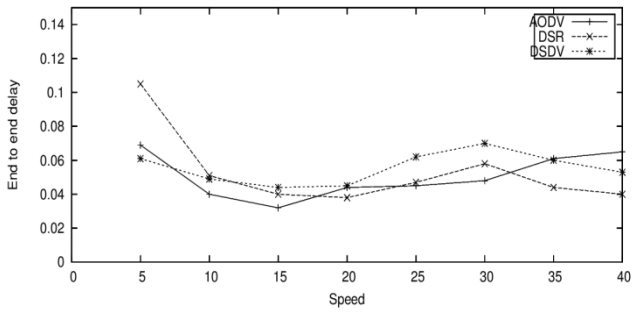

Fig. 9 End to end delay vs speed in random way point mobility model

D. *Normalized routing load*: is used for the evaluation of the efficiency of routing protocols. DSDV has a less NLR and almost same value with the changing of nodes speed. DSR has higher value of NLR, and it is on its peak value at speed of 15m/s in Fig. 10.

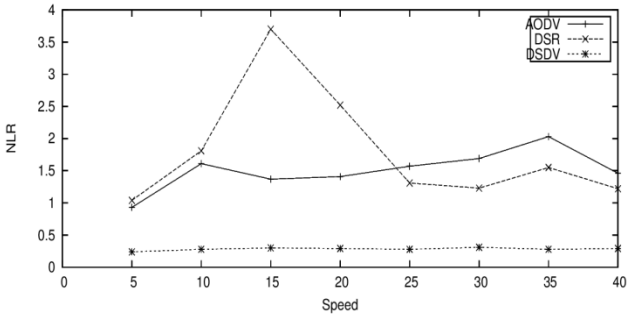

Fig. 10 Normalized routing load vs speed in column mobility model

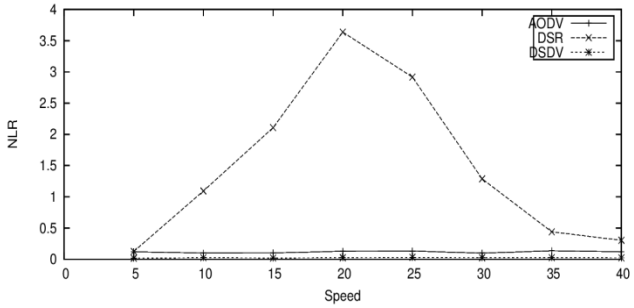

Fig. 11 Normalized routing load vs speed in group mobility model

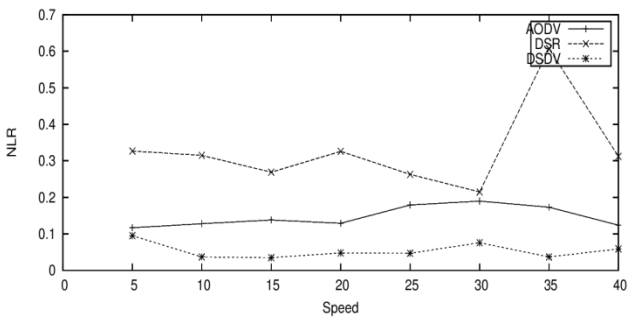

Fig. 12 Normalized routing load vs speed in random way point mobility model

When reference point mobility model is used shown in Fig. 11, NLR is lesser in DSDV and AODV but DSR have higher value. At last, Fig. 12 random waypoint mobility model is used the values of NLR of AODV and DSDV increased then other models. DSR have higher NLR at the speed of nodes 35m/s.

VI. CONCLUSION

It is observed that, AODV have a better throughput than other protocols and performance is good when random waypoint model is used i.e. AODV is more scalable. Packet delivery ratio is satisfactory high for AODV protocol when random movement of mobile nodes is used. Delay to send the packets from source to destination is less in DSDV when group mobility model is used, but when column mobility model is used the least delay in DSR. AODV also have lesser delay when model is random waypoint. Normalized routing load is high for DSR in both column and group mobility model but less in random waypoint mobility model. DSDV has least value of normalized routing load in each model that is used in this paper.

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