Comparing the Performance of AODV, DSR in Randomwaypoint and Randomwalk Mobility Models

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ABSTRACT
Wireless networking is a technology that permit users to move from one location to another and access information regardless of their geographical position. Mobile Ad-Hoc networks comprise of wireless mobile nodes highly dynamic in nature, with rapidly changing topologies in the absence of fixed infrastructure. Nodes of these networks function as a routers which discover and maintain the routes to other nodes in the network. In such networks, nodes are able to move and synchronize with their neighbors. The network connections can change dynamically due to mobility and nodes can be added and removed at any time. In this paper, we are going to compare mobile adhoc network routing protocols AODV and DSR using network simulator NS2 in Randomway point and Random Walk mobility models. The performance of two protocols have been compared together and individually with varying number of nodes . The performance metrics includes PDR (Packet Delivery Ratio), End to End Delay, Routing Load.

Keywords
Manet, AODV, DSR, Randomwaypoint, Random Walk, PDR, End to End Delay, Routing load.

1. INTRODUCTION
Mobile Ad-Hoc network [8][9][10] is a type of wireless and self configuring network of moving routers. The routers are free to move randomly and organize themselves arbitrarily, thus, the network's wireless topology extends rapid and unpredictable changes. Due to mobile routers MANET is an infrastructureless network managed by routing protocols. Main challenges to maintain the Mobile Ad-Hoc network are: No central controlling authority, limited power ability, continuously maintain the information required to properly route traffic. Routing algorithm is the part of network layer software which decides the output path through which an incoming packet should be transmitted on. Routing directs the passing of logically addressed packets from their source toward their ultimate destination through intermediary nodes. So routing protocol is the routing of packets based on the defined set of rules and regulations. Every routing protocol has its own algorithm on the basis of which it discovers and maintains the route. In all routing protocols, there is a datastructure which stores the information of route and also modifies the table as route maintenance is required. A routing metric is a value used by a routing algorithm to determine whether one route should perform better than another. Metrics can cover such information as delivery ratio, bandwidth, delay, hop count, packet loss rate, load, reliability. The routing table stores only the best possible routes while link-state or topological databases may store all other information as well. Mobile system is characterized by the movement of their constituents. The movement of nodes frequently changing in speed, direction and rate will be an effect on the protocols and system designed to support mobility. Mobility model is one of the key parameters that researchers have to consider when there is a need to analyze the performance of protocols in a simulation environment. The mobility model is designed to describe the movement pattern of mobile user, and how their location, velocity and acceleration change over time. Since mobility pattern may play a significant role in determining the protocol performance, it is desirable for mobility models to emulate the movement pattern of targeted the real life application in a reasonable way. The different selection of mobility models can have a major impact on the selection of a routing scheme and can thus influence performance[8][9][10].

2. ROUTING ALGORITHM

2.1 AODV
The Ad hoc On-Demand Distance Vector (AODV) [1][6][14] algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner. The operation of AODV is loop-free, and by avoiding the Bellman-Ford "counting to infinity" problem offers quick convergence when the adhoc network topology changes (typically, when a node moves in the network). When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. Route Requests (RREQs), Route Replies (RREPs) and Route Errors (RERRs) are message types defined by AODV. RREQ and RREP messages are used for route discovery. Route Error(RERR) messages and Hello messages are used for route maintenance[1][6][14].

2.2 DSR
The Dynamic Source Routing protocol (DSR) is an efficient reactive routing protocol for use in multihop networks. The network is self organizing and self configuring requiring no infrastructure. It is an ondemand routing protocol as the path finding process is executed only when there is path requirement by a node[3][5][15]. The DSR protocol is composed of two main phases that work together to allow the discovery and maintenance of source routes in the ad hoc

network [2].Route Discovery is the mechanism by which a node S1 wishing to send a packet to a destination node D1 obtains a source route to D1. Route Discovery is used only when S1 attempts to send a packet to D1 and does not already know a route to D1. Route Maintenance is the mechanism by which node S1 is able to detect, while using a source route to D1, if the network topology has changed such that it can no longer use its route to D1 because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S1 can attempt to use any other route it happens to know to D1, or it can invoke Route Discovery again to find a new route for subsequent packets to D1. Route Maintenance for this route is used only when S1 is actually sending packets to D1. In DSR Route Discovery and Route Maintenance each operate entirely"on demand"[3][5][15].

3. MOBILITY MODELS

The Random waypoint model is the most popular mobility model employed in research and is the basis for building other mobility models. In the Random waypoint mobility model a node moves from its existing location to another location by randomly choosing a direction and speed. The node stays in one location for a certain period of time (ie pause time) Fig[1]. Once this time expires, the MN chooses a random destination as well as a speed that is uniformly distributed between [0, maximumspeed]. It then travels towards the newly chosen destination at the selected speed. Upon arrival, the MN after a period starts the process again. We note that the movement pattern of an MN using the Random Waypoint Mobility Model is similar to the Random Walk Mobility Model if pause time is zero and [0, maximumspeed] = [speedmin, speedmax] Fig[2].This is a simple mobility model and is hence adopted by many authors in their simulation studies. The Random Walk Mobility Model as per Fig[2] has proven to be one of the most widely used mobility models because it describes individual movements relative to cells [7]. Specifically, in the Random Walk Mobility Model, a host moves from its current location to a new location by randomly choosing a direction and speed in which to travel. The new speed and direction are both chosen from pre-defined ranges, [speedmin, speedmax] and [0,2π] respectively. Each movement in the Random Walk Mobility Model occurs in a constant time interval *t*, at the end of which a new direction and speed are calculated[4][7][12].

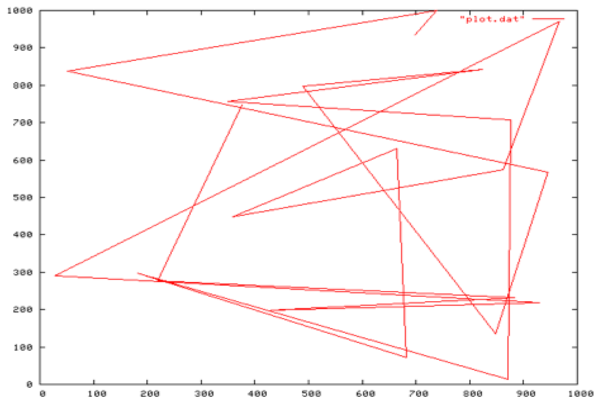

Fig 1 shows the travelling pattern of an MN using the Random Waypoint Mobility

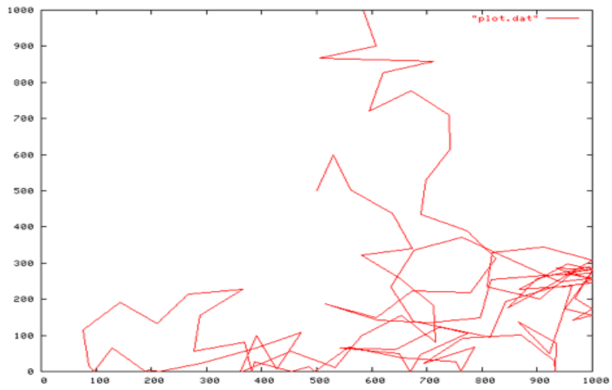

Fig 2 : Traveling pattern of an MN using the Random Walk Mobility Model

4. PERFORMANCE METRICS

Packet Delivery Ratio: It is the ratio of data packets delivered to the destination to those generated by sources. It is calculated by dividing the number of packet received by destination through the number of packets originated from the source.

End to End Delay: This is the delay caused by buffering during route discovery latency, queuing at the interface queue, retransmission delay at the MAC , propagation and transfer time. It is defined as the time taken for a data packet to be transmitted across a MANET from source to destination.

Routing Overhead: The number of routing packets transmitted for every data packet sent. Each hop of the routing packet is treated as a packet.. Normalized Routing load are used as the ratio of routing packets the data packets.

5. SIMULATION RESULTS

The simulation is held for ad hoc networks of 100,125,180,200 nodes. The nodes move with a velocity of 10m/s in an area whose dimension is 900*900m.The simulation lasts for 500 seconds for each experiment.The radio range is set to 250 m for all the nodes and the bandwidth is set to 2 Mb/s. The motion of the nodes within the network area is described using random-waypoint model and random walk mobility models. The routing protocols, AODV and DSR are compared in these two mobility modes.The size of data packets is set to 512 bytes. NS2 a simulator tool is used to simulate the results[11].

Table1- Simulation parameters

Parameter	**Value**
Simulation time	500 s
Number of nodes	100,125,180,200
Simulation area	900*900
RadioRange	250 m
Mobility Models	Randomwaypoint , Random Walk
Protocols	AODV,DSR

MAC	802.11
Speed	10ms
DataRate	512kbps

The performance of AODV,DSR routing protocols are analyzed in Randomway point, Random Walk mobility models for varying number of nodes based on different metrics like packet delivery ratio, end to end delay and routing load.

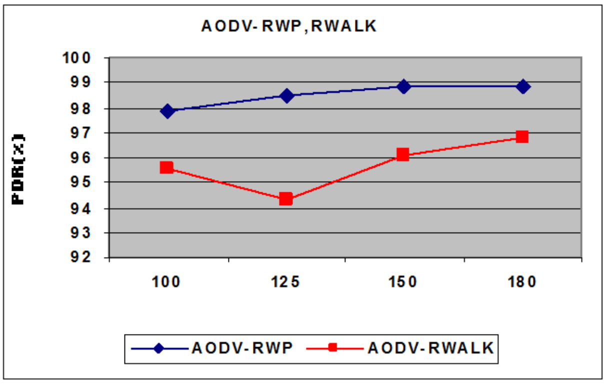

Fig 3 : Packet Delivery Ratio-AODV-RWP AND AODV-RW

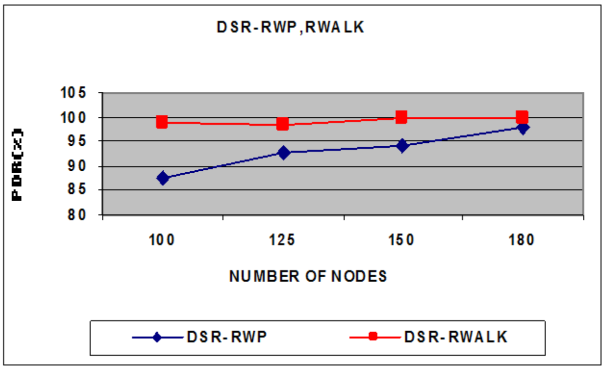

Fig 4 : Packet Delivery Ratio-DSR-RWP AND DSR-RW

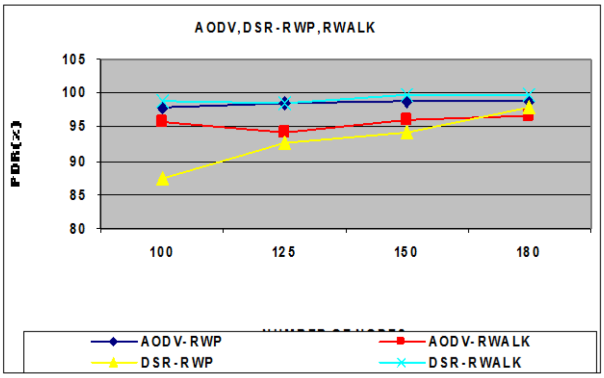

Fig5 : Packet Delivery Ratio-AODV,DSR-RWP AND AODV,DSR-RW

As in Fig3,The AODV Protocol has more of PDR in Randomwaypoint than in Randomwalk mobility model. The PDR is around 90% regardless of node density in both mobility models.The DSR protocol shows gradual increase in the packet delivery rate for increase in number of nodes in Randomwaypoint as with increase in number of nodes the load becomes less and the traffic is not heavy, whereas in the Random walk mobility model the the PDR is high regardless of node density(Fig4). As per Fig5 the AODV protocol produces more PDR above 95% in RWalk and Randomwaypoint.

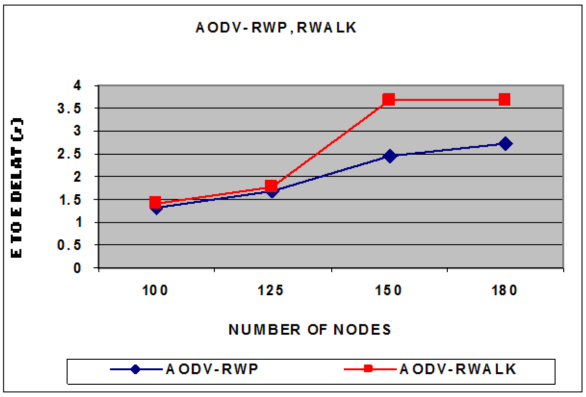

Fig 6 :End to End Delay-AODV-RWP AND AODV-RWalk

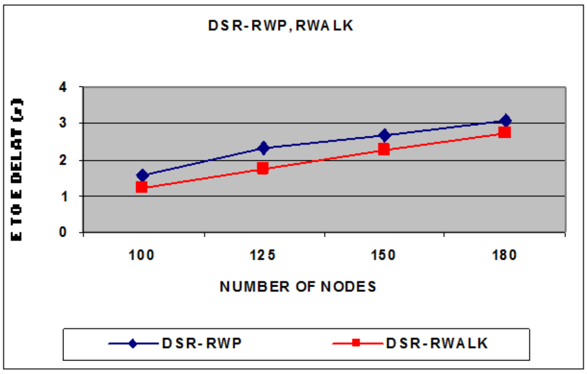

Fig7 : End to End Delay-DSR-RWP AND DSR-RWalk

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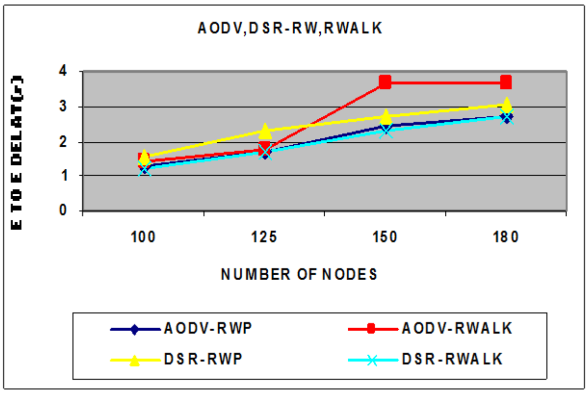

Fig8 : End to End Delay-AODV,DSR-RWP AND AODV,DSR-RWalk

AODV has less delay in Randomwaypoint than Randomwalk whereas DSR Protocol produces less end to end delay in Randomwalk than in Randomwaypoint Fig[8]. The delay increases in high density of nodes with AODV in both Randomwalk and Randomwaypoint as in Fig[6],but in DSR the delay converges to the almost to the same as the number of nodes increase as depicted in Fig[7]. The routing load is less with less density of nodes and gradually increases as the number of nodes increase. AODV in randomway point has less routing load than in Random Walk (Fig[9]). But in DSR routing load is only slightly less in Randomway point than in RWalk.[Fig10] regardless of node density.

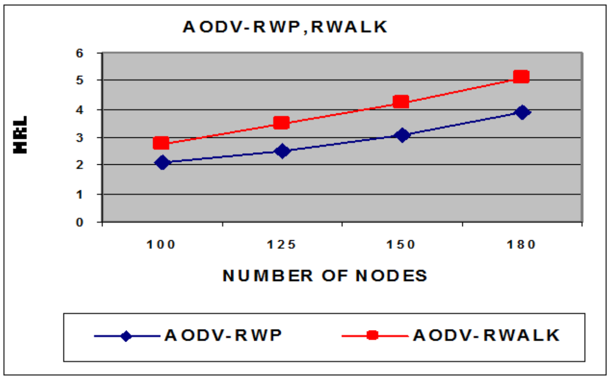

Fig 9 :Routing Load-AODV-RWP AND AODV-RWalk

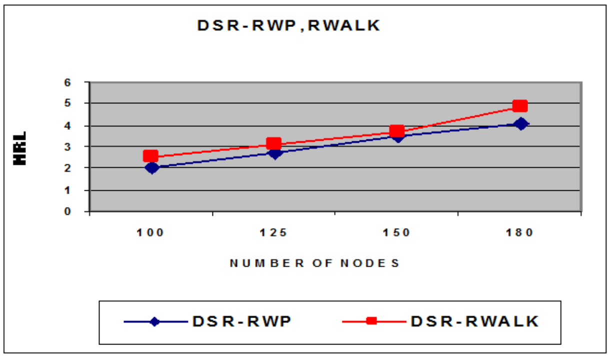

Fig10 :Routing Load-DSR-RWP AND DSR-RWalk

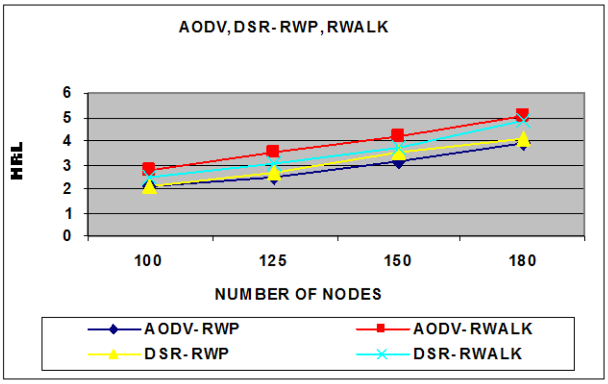

Fig11 :Routing Load-AODV,DSR-RWP AND AODV,DSR-RWalk

As per Fig[11] both protocols produce less routing load in Randomway point than in RandomWalk. In low density of nodes the routing load is less for AODV and DSR but increases when the concentration of nodes increase.

6. CONCLUSION

AODV and DSR protocolS produces less routing load in Randomwaypoint than in RandomWalk[Fig9,10,11]. As Randomwalk produces high routing load when changing the node direction and speed. But DSR has only slight variation in routing load for both mobility models(Fig[10]). The packet delivery rate is high for AODV in Randomwaypoint than in Rwalk but for DSR delivery rate is higher in Random walk than Randomwaypoint Fig[3,4,5]. Though for both Protocols the delay increases as the concentration of nodes increase, AODV produces lesser delay in Randomwaypoint than in Rwalk but DSR produces more delay with Randomwaypoint than with Rwalk. But in randomwaypoint mobility model the delay is less for AODV than DSR . But the delay is more in AODV than DSR in RandomWalk Fig[6,7,8]. AODV shows efficiency in routing and outperforms DSR in Randomwaypoint mobility model but in contrast DSR tends to perform better in Rwalk than AODV.

7. REFERENCES

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