

Performance Comparison and Analysis of DSDV and AODV for MANET

V.Ramesh¹ Dr.P.Subbaiah² N. Koteswar Rao³ M.Janardhana Raju⁴

¹ Research scholar, Sathyabama University, Chennai. & Assoc.Prof, CMRCET, Hyderabad, AP, India..

² Principal, Veerabrahmendra Institute of Technology & Sciences, Badvel, Kadapa-Dt, AP, India.

³ Assoc.Professor, .Narayana Engineering College, Gudur, AP, India.

⁴ Research scholar, Sathyabama University, Chennai, TamilNadu, India.

Abstract—A Mobile Ad hoc NETWORK (MANET) is a kind of wireless ad-hoc network, and is a self configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which forms an arbitrary topology. The routers are free to move randomly and organize themselves arbitrarily, thus the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. There are various routing protocols available for MANETs. The most popular ones are DSR, AODV and DSDV. This paper examines two routing protocols for mobile ad hoc networks— the Destination Sequenced Distance Vector (DSDV), the table-driven protocol and the Ad hoc On-Demand Distance Vector routing (AODV), an On-Demand protocol and evaluates both protocols based on packet delivery fraction and average delay while varying number of sources and pause time.

Keywords—AODV, DSDV, Packet Delivery Fraction, MANET.

I. INTRODUCTION

A Mobile Ad hoc NETWORK (MANET) is a kind of wireless ad-hoc network, and is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which forms an arbitrary topology. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet.

Issues in MANETs: If there are only two nodes that want to communicate with each other and are located very closely to each other, then no specific routing protocols or routing decisions are necessary. On the other hand, if there are a number of mobile hosts wishing to communicate, then the routing protocols come into play because in this case, some critical decisions have to be made such as which is the optimal route from the source to the destination which is very important because often, the mobile nodes operate on some kind of battery power. Thus it becomes necessary to transfer the data with the minimal delay so as to waste less

power. There may also be some kind of compression involved which could be provided by the protocol so as to waste less bandwidth. Further, there is also a need of some type of encryption so as to protect the data from prying eyes. In addition to this, Quality of Service support is also needed so that the least packet drop can be obtained.

The other factors which need to be considered while choosing a protocol for MANETs are as follows:

i. **Multicasting:** This is the ability to send packets to multiple nodes at once. This is similar to broadcasting except the fact that the broadcasting is done to all the nodes in the network. This is important as it takes less time to transfer data to multiple nodes.

ii. **Loop Free:** A path taken by a packet never transits the same intermediate node twice before it arrives at the destination. To improve the overall, we want the routing protocol to guarantee that the routes supplied are loop-free. This avoids any waste of bandwidth or CPU consumption.

iii. **Multiple routes:** If one route gets broken due to some disaster, then the data could be sent through some other route. Thus the protocol should allow creating multiple routes.

iv. **Distributed Operation:** The protocol should of course be distributed. It should not be dependent on a centralized node.

v. **Reactive:** It means that the routes are discovered between a source and destination only when the need arises to send data. Some protocols are reactive while others are proactive which means that the route is discovered to various nodes without waiting for the need.

vi. **Unidirectional Link Support:** The radio environment can cause the formation of unidirectional links. Utilization of these links and not only the bi-directional links improves the routing protocol performance.

vii. **Power Conservation:** The nodes in an ad-hoc network can be laptops and thin clients, such as PDAs that are very limited in battery power and therefore use some sort of stand-by mode to save power. It is therefore

important that the routing protocol has support for these sleep-modes [1] [2].

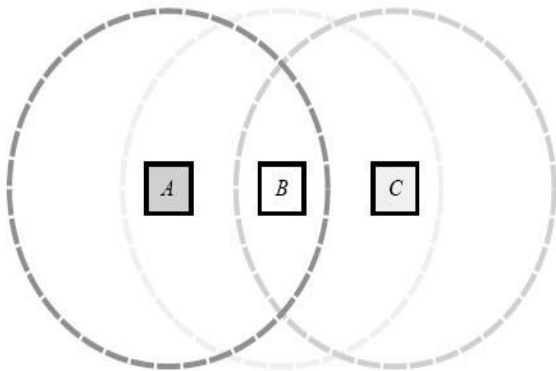


Fig 1: A Simple MANET

In figure 1, let's suppose that node A wants to send data to node C but node C is not in the range of node A. Then in this case, node A may use the services of node B to transfer data since node B's range overlaps with both the node A and node B. Indeed, the routing problem in a real ad hoc network may be more complicated than this example suggests, due to the inherent non uniform propagation characteristics of wireless transmissions and due to the possibility that any or all of the hosts involved may move at any time [5]. One of the main difficulties in MANET (Mobile Ad hoc Network) is the routing problem, which is aggravated by frequent topology changes due to node movement, radio interference and network partitions. Many Routing protocols have been proposed in past and reported in the literature. The proactive approaches attempts to maintain routing information for each node in the network at all times, where as the reactive approaches only find new routes when required and other approaches make use of geographical location information for routing

II. AODV

Ad-hoc On-demand distance vector (AODV) is another variant of classical distance vector routing algorithm, based on DSDV and DSR . It shares DSR's on-demand characteristics hence discovers routes whenever it is needed via a similar route discovery process. However, AODV adopts traditional routing tables; one entry per destination which is in contrast to DSR that maintains multiple route cache entries for each destination. The initial design of AODV is undertaken after the experience with DSDV routing algorithm. Like DSDV, AODV provides loop free routes while repairing link breakages but unlike DSDV, it doesn't require global periodic routing advertisements. Apart from reducing the number of broadcast resulting from a link break, AODV also has other significant features.

Whenever a route is available from source to destination, it does not add any overhead to the packets. However, route discovery process is only initiated when routes are not used and/or they expired and consequently discarded. This strategy reduces the effects of stale routes as well as the need for route maintenance for unused routes. Another distinguishing feature of AODV is the ability to provide unicast, multicast and broadcast communication. AODV uses a broadcast route discovery algorithm and then the unicast route reply message. The following sections explain these mechanisms in more detail. [5]

Route Discovery

When a node wants to send a packet to some destination node and does not locate a valid route in its routing table for that destination, it initiates a route discovery process. Source node broadcasts a route request (RREQ) packet to its neighbors, which then forwards the request to their neighbors and so on. Fig. 2 indicates the broadcast of RREQ across the network.

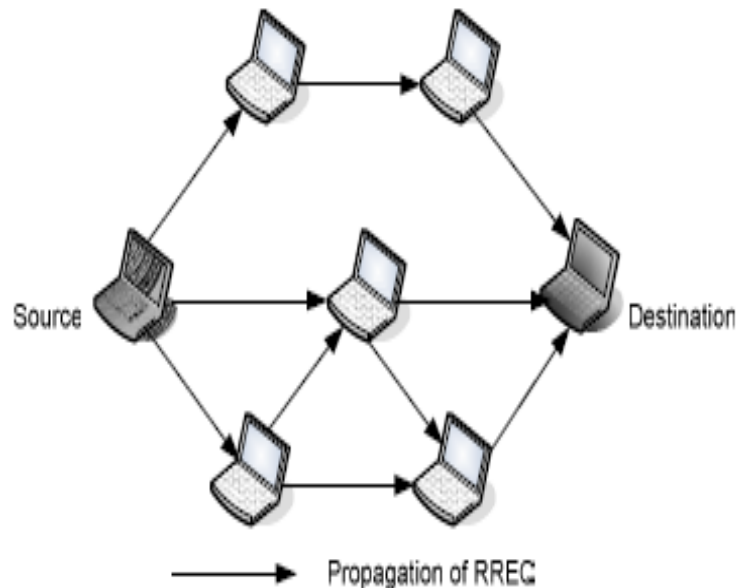


Fig 2: Propagation of RREQ Packet.

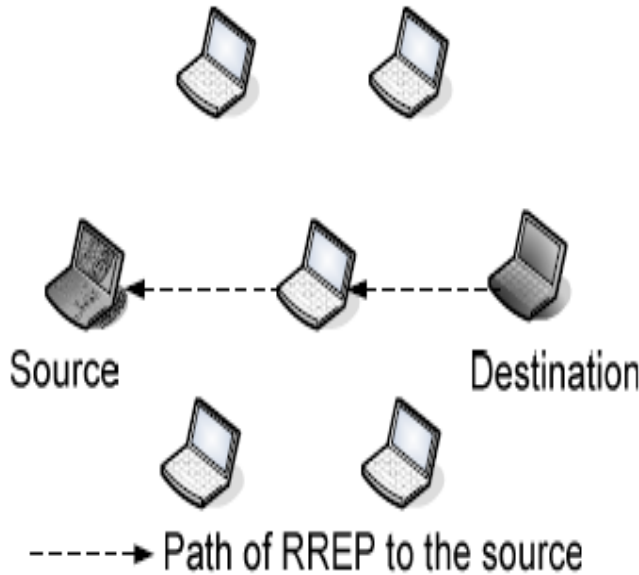


Fig 3: Route Reply through RREP Packet.

To control network-wide broadcasts of RREQ packets, the source node use an expanding ring search technique. In this technique, source node starts searching the destination using some initial time to live (TTL) value. If no reply is received within the discovery period, TTL value incremented by an increment value. This process will continue until the threshold value is reached. When an intermediate node forwards the RREQ, it records the address of the neighbor from which first packet of the broadcast is received, thereby establishing a reverse path. When the RREQ is received by a node that is either the destination node or an intermediate node with a fresh enough route to the destination, it replies by unicasting the route reply (RREP) towards the source node. As the RREP is routed back along the reverse path, intermediate nodes along this path set up forward path entries to the destination in its route table and when the RREP reaches the source node, a route from source to the destination established. Fig. 3 indicates the path of the RREP from the destination node to the source node.[5]

Route Maintenance

A route established between source and destination pair is maintained as long as needed by the source. If the source node moves during an active session, it can reinitiate route discovery to establish a new route to destination. However, if the destination or some intermediate node moves, the node upstream of the break remove the routing entry and send route error (RERR) message to the affected active upstream neighbors. These nodes in turn propagate the RERR to their precursor nodes, and so on until the source node is reached. The affected source node may then choose

to either stop sending data or reinitiate route discovery for that destination by sending out a new RREQ message.

III. DSDV

DSDV is one of the most well known table-driven routing algorithms for MANETs. It is a distance vector protocol. In distance vector protocols, every node i maintains for each destination x a set of distances $\{dij(x)\}$ for each node j that is a neighbor of i . Node i treats neighbor k as a next hop for a packet destined to x if $dik(x)$ equals $minj\{dij(x)\}$. The succession of next hops chosen in this manner leads to x along the shortest path. In order to keep the distance estimates up to date, each node monitors the cost of its outgoing links and periodically broadcasts to all of its neighbors its current estimate of the shortest distance to every other node in the network. The distance vector which is periodically broadcasted contains one entry for each node in the network which includes the distance from the advertising node to the destination. The distance vector algorithm described above is a classical Distributed Bellman-Ford (DBF) algorithm [4][7].

DSDV is a distance vector algorithm which uses sequence numbers originated and updated by the destination, to avoid the looping problem caused by stale routing information. In DSDV, each node maintains a routing table which is constantly and periodically updated (not on-demand) and advertised to each of the node's current neighbors. Each entry in the routing table has the last known destination sequence number. Each node periodically transmits updates, and it does so immediately when significant new information is available. The data broadcasted by each node will contain its new sequence number and the following information for each new route: the destination's address, the number of hops to reach the destination and the sequence number of the information received regarding that destination, as originally stamped by the destination. No assumptions about mobile hosts maintaining any sort of time synchronization or about the phase relationship of the update periods between the mobile nodes are made. Following the traditional distance-vector routing algorithms, these update packets contain information about which nodes are accessible from each node and the number of hops necessary to reach them. Routes with more recent sequence numbers are always the preferred basis for forwarding decisions. Of the paths with the same sequence number, those with the smallest metric (number of hops to the destination) will be used. The addresses stored in the route tables will correspond to the layer at which the DSDV protocol is operated. Operation at layer 3 will use network layer addresses for the next hop and destination addresses, and operation at layer 2 will use layer-2 MAC addresses [7].

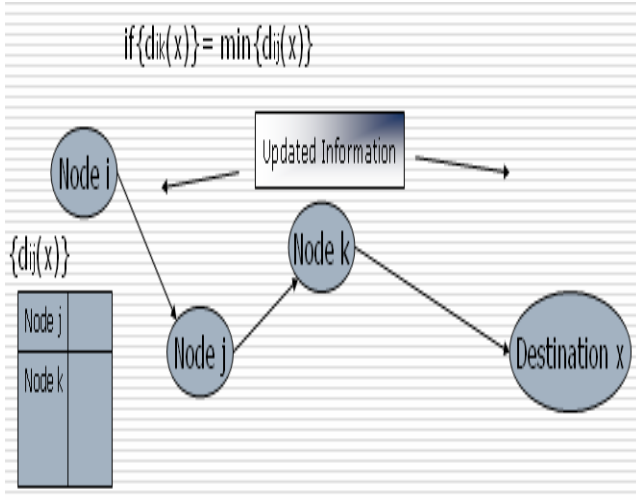


Fig 4: Illustration of DSDV

IV. SIMULATION ANALYSIS AND PERFORMANCE METRICS

In this section, The network simulation are implemented using the NS-2 simulation tool.[9]

Simulation Parameter	value
Simulator	NS-2
Node Movement Model	Random Waypoint
Speed	0-25m/s
Traffic Type	UDP
Bandwidth	2Mb/s
Transmission Range	250m

Table 1: List of Simulation parameters

While comparing two protocols, we focused on two performance measurements such as Average Delay, Packet Delivery Fraction.[8]

(i) Packet delivery fraction: The ratio of the number of data packets successfully delivered to the destinations to those generated by CBR sources. Packet delivery fraction = (Received packets/Sent packets)*100. Fig 5(a) & 5(b) shows a comparison between both the routing protocols on the basis of packet delivery fraction as a function of pause time and using different number of traffic sources.

(ii) Average End to end delay of data packets: The average time from the beginning of a packet transmission at a source node until packet delivery to a destination. This includes delays caused by buffering of data packets during route discovery, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times. Calculate the send(S) time (t) and receive (R) time (T) and average it.

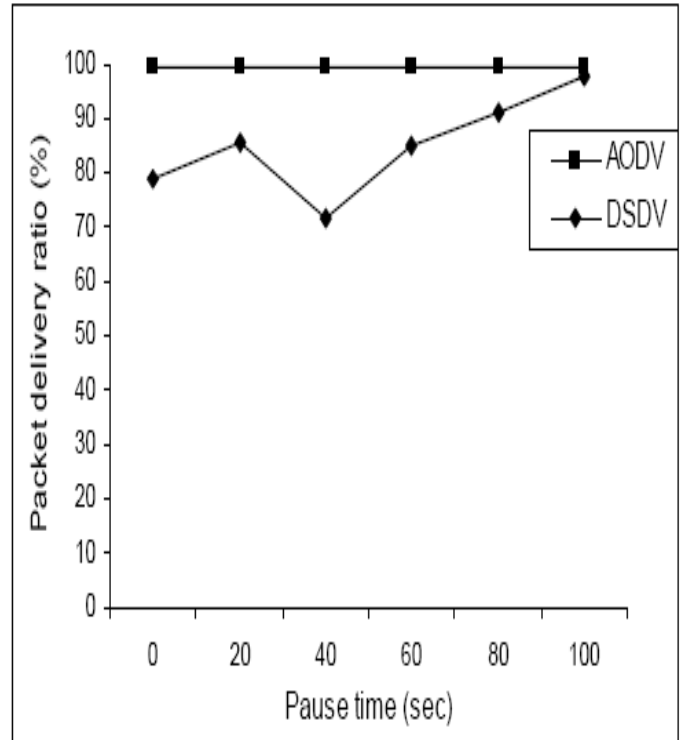


Fig 5(a) : Packet delivery fraction vs. Pause time for 50-node model with 15 sources.

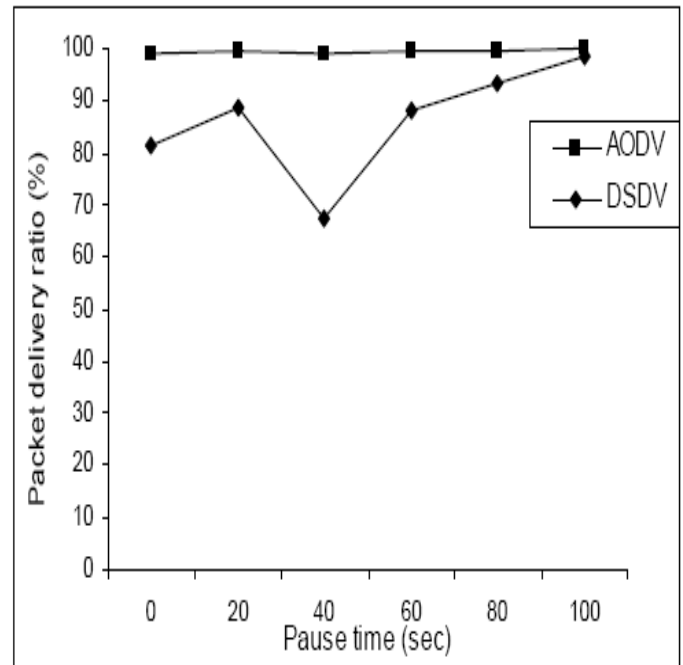


Fig 5(b) : Packet delivery fraction vs. Pause time for 50-node model with 30 sources

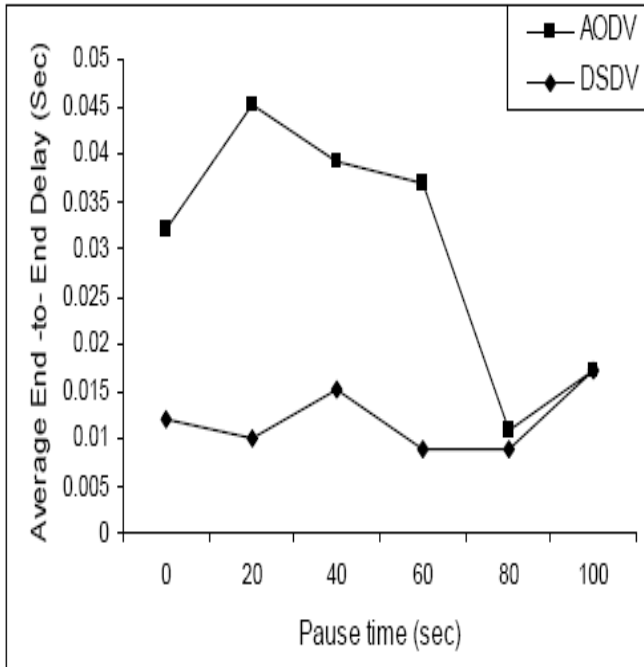


Fig 6(a) : Average End-to-End Delay vs. Pause time for the 50-node model with 15 sources.

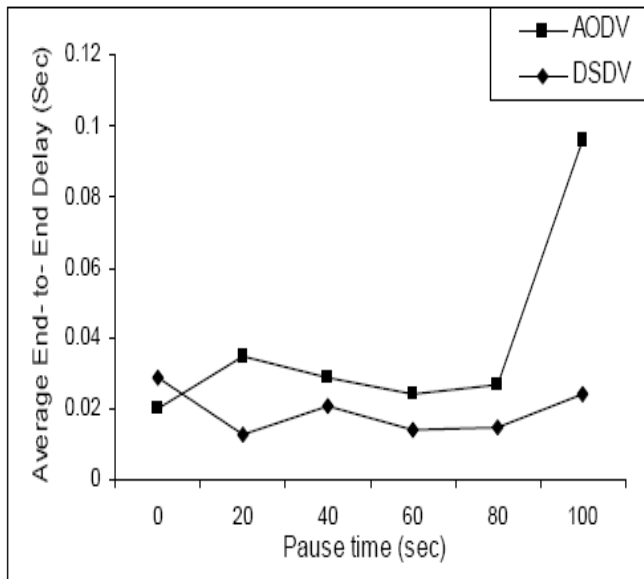


Fig 6(b) : Average End-to-End Delay vs. Pause time for the 50-node model with 30 sources

V. CONCLUSION

Simulation results show that both of the protocols deliver a greater percentage of the originated data packets when there is little node mobility, converging to 100% delivery ration when there is no node motion. The packet delivery of AODV is almost independent of the number of sources. AODV suffers

from end to end delays. DSDV packet delivery fraction is very low for high mobility scenarios. We Conclude that the AODV protocol is the ideal choice for communication when the communication has to happen under the UDP protocol as the base.

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AUTHORS PROFILE



1. Mr.V. Ramesh received his B.Tech from N.B.K.R.I.S.T, Vidyanagar, AP in Computer Science & Engineering and M.Tech in IT from Sathyabama University, Chennai. Presently he is working as Associate Professor at CMRCET, Hyderabad, AP. He has published several papers in various

International & National Conferences and Journals. Presently he is pursuing his Ph. D in the field of Ad-hoc networks at Sathyabama University. His research interests include Operating Systems, Mobile Ad-hoc Networks and Data Mining.



2. Dr P. Subbaiah received M.Tech(D.S.C) from JNTU and Ph. D from S.K University, Ananthapur in the area of fault tolerant systems. He has published several papers in international, national conferences and journals. He guided 6 research scholars. Presently he is working as Principal, Veerabrahmendra Institute of Tech & Science, Badvel, Kadapa, AP, India. His

research interests include Mobile ad-hoc networks, Digital image processing and VLSI design.



3. Mr N. Koteswar Rao received his B.Tach from Narayana Engineering College, Nellore and M.Tech from Sathyabama University, Chennai. Currently he is working as Assoc. Professor in the department of IT at Narayana Engineering College, Gudur, AP, India.

4. Mr.M.Janardhana Raju received M.Tech from Sathyabama University, Chennai and pursuing Ph.D at same University in the area of Mobile Computing. He is working as Assoc.Prof at AITS, Rajampeta, Kadapa, India.