International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.2, Issue.4, July-Aug. 2012 pp-2404-2408 ISSN: 2249-6645

# A Simulation Based Performance Analysis of AODV and DSDV Routing Protocols in MANETs

Biswaraj Sen[1], Sanku Sinha[2]
[1]Department of Computer Sc & Engineering, Sikkim Manipal Institute of Technology, India
[2] Department of Computer Sc & Engineering, Sikkim Manipal Institute of Technology, India

***ABSTRACT:*** *A Mobile Ad hoc Network (MANET) is an infrastructure less, decentralized multi-hop network where the mobile nodes are free to move randomly, thus making the network topology dynamic. Various routing protocols have been designed which aims at establishment of correct and efficient routes between a pair of mobile nodes. In this work, an attempt has been made to understand the characteristics/behavior of Ad hoc On Demand Distance Vector (AODV) and Destination Sequence Distance Vector (DSDV) routing protocols when operating in more challenging environment such as frequent change in network topology and node density. The performance differentials are analyzed using throughput, average end-to-end delay and normalized routing load which shall provide an insight about the sensitivity of the protocols under consideration when exposed in more challenging environment. Simulation based analysis of the protocols have been done using NS-2.*

***Keywords:*** *AODV, DSDV, MANET, NS-2.*

## 1. Introduction

A mobile Ad hoc network is a collection of wireless mobile nodes forming a temporary network without any centralized administration or fixed infrastructure, which makes any node in the network as a potential router [1, 13]. Since the nodes are highly mobile in nature, the changes in network topology are very frequent and the nodes are dynamically connected in an arbitrary manner. Further, the limitation imposed on the transmission range of the nodes have lead to the development of routing policy where packets are allowed to traverse through multiple nodes thus making each node act as terminal as well as router. Since the topology of Ad hoc network is dynamic in nature, design of suitable routing protocol is essential to adapt the dynamic behavior of the network.

Further, it is worth mentioning that node density and pause time will have significant effect in the performance of the any routing policy due to the fact that an increase in node density will tend to increase the hop count thus changing the topology significantly. Pause time indicates the mobility of the nodes in the network. Therefore, it is imperative to state that high pause time implies a stable network topology while low pause time indicates that the topology changes frequently. This paper makes an attempt to analyze the performance of two most popular Ad hoc routing protocols, viz. AODV and DSDV where both the above discussed factors i.e. Pause Time and Node Density vary considerably. Though both protocols use sequence number to prevent routing loops and to ensure freshness of routing information, the main mechanism of routing differs drastically in AODV and DSDV in the fact that they belong to two different routing families [3]. AODV is from reactive routing family where routes are only generated on demand, in order to reduce routing loads [5], while DSDV is from proactive routing family where routing tables are updated frequently regardless of need [2]. The rest of this paper is organized as follows: In the next section, brief overviews of both routing protocols have been discussed. Section 3 discusses the simulation environment in which both the protocols have been tested. Section 4 includes analysis of the performance of both the protocols under a varying node density environment and varying pause time with respect to performance metrics such as throughput, average end-to-end delay and packet delivery fraction. Section 5 provides conclusion, limitation and future work.

## II. Overview of the Protocol

### 1.1 Ad hoc On Demand Distance Vector (AODV):

Ad hoc On Demand Distance Vector Routing Protocol (AODV) is a reactive routing protocol designed for Ad hoc wireless network and it is capable of both unicast as well as multicast routing [3]. The Route Discovery process in this protocol is performed using control messages RouteRequest (RREQ) and RouteReply (RREP) whenever a node wishes to send packet to destination. Traditional routing tables is used, one entry per destination [2]. During a route discovery process, the source node broadcasts a RouteRequest packet to its neighbors. This control packet includes the last known sequence number for that destination. If any of the neighbors has a route to the destination, it replies to the query with RouteReply packet; otherwise, the neighbors rebroadcast the RouteRequest packet. Finally, some of these query control packets reach the destination, or nodes that have a route to the destination. At this point, a reply packet is generated and transmitted tracing back the route traversed by the query control packet. In the event when a valid route is not found or the query or reply packets are lost, the source node rebroadcasts the query packet if no reply is received by the source after a time-out.

In order to maintain freshness node list, AODV normally requires that each node periodically transmit a HELLO message, with a default rate of one per second [9]. When a node fails to receive three consecutive HELLO messages from its neighbor, the node takes is as an indication that the link to its neighbor is down. If the destination with this neighbor as the next hop is believed not to be far away (from the invalid routing entry), local repair mechanism may be launched to rebuild the route towards the destination; otherwise, a RouteError (RERR) packet is sent to the neighbors in the precursor list associated with the routing entry to inform them of the link failure [12].

### 1.2 Destination Sequenced Distance Vector (DSDV):

Destination-Sequenced Distance-Vector Routing (DSDV) [3] is a proactive routing protocol designed for Ad hoc mobile networks based on the Bellman-Ford algorithm [10]. The improvement made to the Bellman-Ford algorithm includes freedom from loops in routing tables by using sequence numbers. In mobile Ad hoc network, using of DSDV protocol assumes that each participating node as a router. Every node always maintains a routing table that consists of all the possible destinations. Each entry of the routing table contains the address identifier of a destination, the shortest known distance metric to that destination measured in hop counts and the address identifier of the node that is the first hop on the shortest path to the destination [11]. Each mobile node in the system maintains a routing table in which all the possible destinations and the number of hops to them in the network are recorded. Each route or path to the destination associated with a sequence number [4]. The route with the highest sequence number is always used and this sequence number helps to identify the stale routes from the new ones and thus it avoids the formation of loops. To minimize the traffic there are two types of packets in the system. One is known as “full dump” [5], which carries all the information about a change. However, when occasional movement occurs in the network, “incremental” [5] packet are used, which carries just the changes and this increases the overall efficiency of the system. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when there is no change in the network topology. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not scalable in Ad hoc networks, which have limited bandwidth and whose topologies are highly dynamic [1].

## III. Simulation Methodology

Simulation based study using Network Simulator NS-2 [6] has been used to compare two protocols viz. AODV and DSDV under varying node density and varying pause time, assuming that the size of network, maximum speed of nodes and transmission rate are fixed. Tables 1 and 2 summarize the parameters used in the communication and movement models for simulation.

### III.2 Communication Model

The simulator assumes constant bit rate (CBR) traffic with a transmission rate of 8 packets per second. The number of nodes varies from 25 to 100 in the denomination of 25, 50, 75 and 100. given on the last line.

Table 1. Parameters of Communication Model

| Parameter | Value |
|---|---|
| Traffic type | CBR |
| Number of nodes | 25, 50, 75, 100 |
| Transmission rate | 8 packets/second |

### IV.2 Movement Model

In line with the realistic mobility pattern of the mobile nodes, the simulation assumes a Random Waypoint Model [7], where a node is allowed to move in any direction arbitrarily. The nodes select any random destination in the 500 X 500 space and moves to that destination at a speed distributed uniformly between 1 and nodes maximum speed (assumed to be 20 meter per second). Upon reaching the destination, the node pauses for fixed time, selects another destination, and proceeds there as discussed above. After testing all possible connection for a specific scenario, pause time changes to test the next scenario. This behavior repeats throughout the duration of the simulation (500 seconds). Meanwhile, number of nodes and pause time has been varied to compare the performance of the protocols for low as well as high density environment and for low mobility of the nodes to high mobility. Table 2 lists the movement parameters of the simulations.

Table 2. Parameters of movement model

| Parameter | Value |
|---|---|
| Simulator | NS-2 |
| Simulation time | 500 seconds |
| Area of the network | 500 m x 500 m |
| Number of nodes | 25, 50, 100, 200 |
| Pause time | 10 seconds |
| Maximum speed of nodes | 20 meters per second |
| Mobility Model | Random waypoint |

### V.2 Performance Metrics

Three performance metrics has been measured for the protocols:

3.3.1 Throughput: Throughput is the number of packet that is passing through the channel in a particular unit of time [8]. This performance metric shows the total number of packets that have been successfully delivered from source node to destination node. Factors that affect throughput include frequent topology changes, unreliable communication, limited bandwidth and limited energy.

$$Throughput = \frac{Received\_Packet\_Size}{Time\_to\_Send} \quad (1)$$

**3.3.2 Average End-to-End Delay:** A specific packet is transmitting from source to destination node and calculates the difference between send times and received times. This metric describes the packet delivery time. Delays due to route discovery, queuing, propagation and transfer time are included metric [9].

$$Avg\_End\_to\_End\_Delay = \frac{\sum_1^n (CBR\_Sent\_Time - CBR\_Recv\_Time)}{\sum_i^n CBR\_Recv} \quad (2)$$

3.3.3 Normalized Routing Load: Normalized Routing Load is the ratio of total number of routing packet received and total number of data packets received [10].

$$Normalized\_Routing\_Load = \frac{Number\_of\_Routing\_Pkts\_Recvd}{Number\_of\_Data\_Pkts\_Recvd} \quad (3)$$

## 2. Simulation Result And Analysis

Figures 1, 2 and 3 represent the performance analysis in terms of throughput, average end-to-end delay and normalized routing load respectively. In all the cases the node density varies from 25 to 100 and pause time varies from 5 to 20 second.

### 4.1 Throughput:

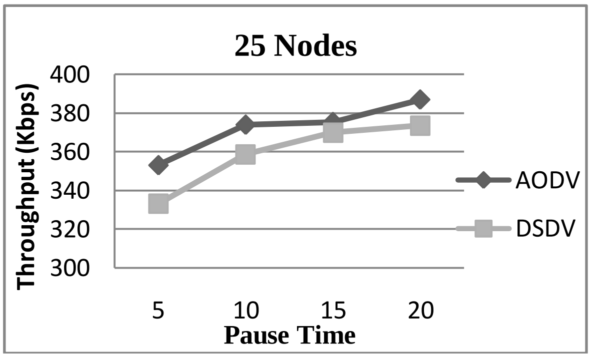


Figure 1 (a): Throughput for 25 nodes

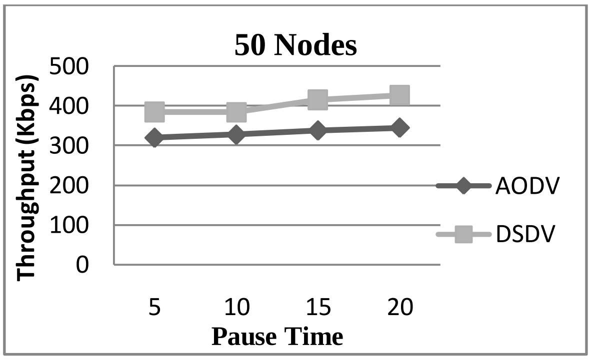


Figure 1 (b): Throughput for 50 nodes

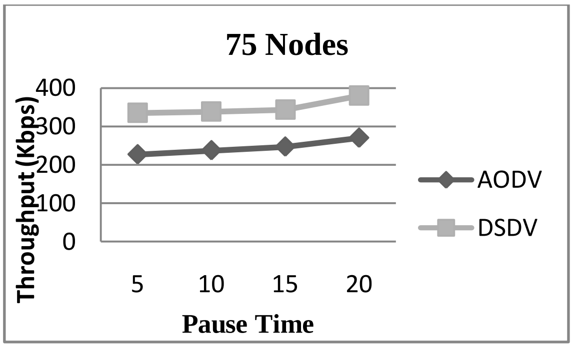


Figure 1 (c): Throughput for 75 nodes

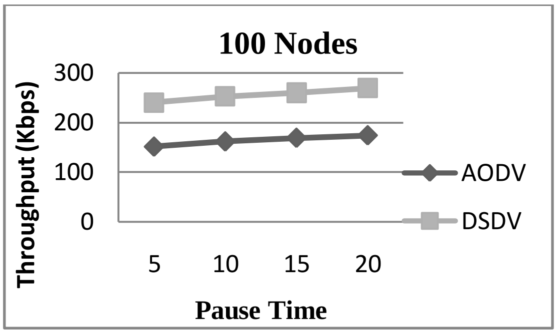


Figure 1 (d): Throughput for 100 nodes

Based on the result of simulation as indicated in Fig 1(a) it is evident that performance of AODV is better than DSDV in a low node density environment but with a rise in node density DSDV out performs AODV which is evident from Fig 1(b), 1(c) and 1(d). Another characteristic that has come to the notice is that pause time does not have significant bearing on the throughput whereas the performance is dictated only by the density of the network. The possible reason for the same is due to proactive nature of DSDV routing protocol, which causes less number of table update in a stable topology, thus producing better throughput.

### 4.2 Average End-to-End Delay:

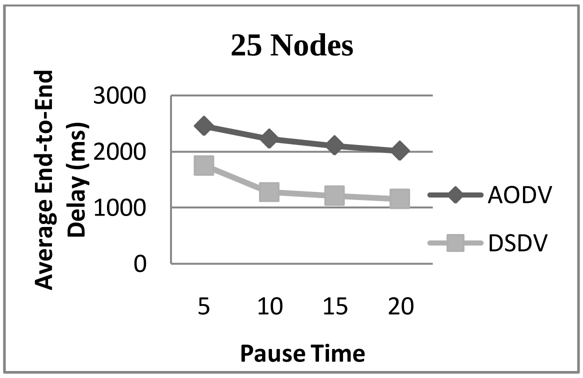


Figure 2 (a): Average End-to-End Delay for 25 nodes

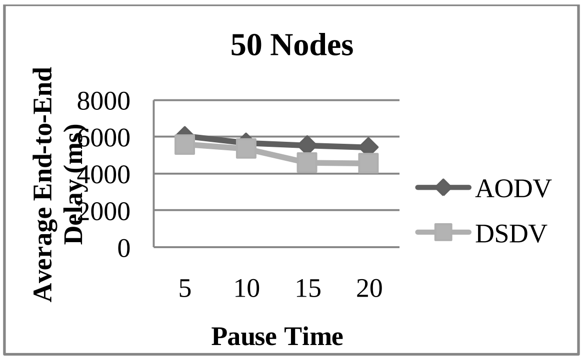


Figure 2 (b): Average End-to-End Delay for 50 nodes

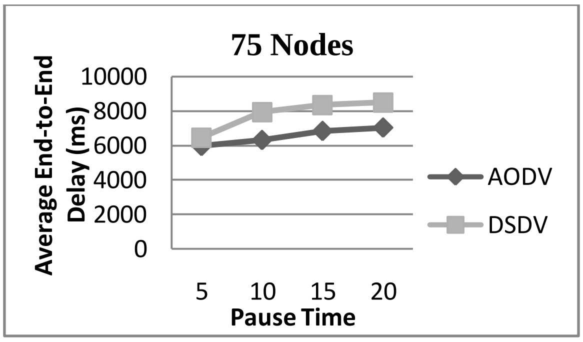


Figure 2 (c): Average End-to-End Delay for 75 nodes

www.ijmer.com Vol.2, Issue.4, July-Aug. 2012 pp-2404-2408 ISSN: 2249-6645

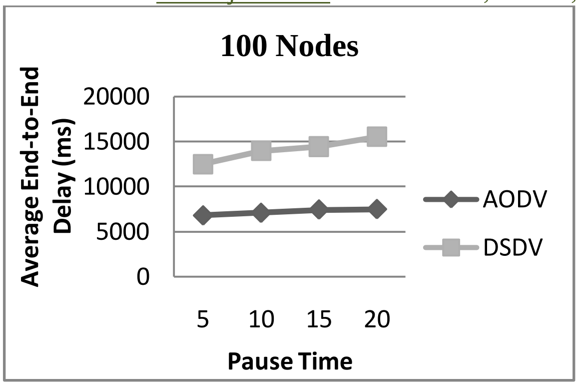


Figure 2(d): Average End-to-End Delay for 100 nodes

The simulation result as indicated in Fig 2(a) and 2 (b) shows that in case of low node density, the average end-to-end delay of AODV is higher than DSDV whereas Fig 2(c) and 2(d) indicates that with an increase in node density, AODV outperforms DSDV. It also has been observed that with an increase in pause time there is a decline in the average end-to-end for both the protocols under low node density environment (Fig 2a and 2b). However, this is not true when there is a rise in the network density. The possible reason for such behavior is the presence of more number of nodes between source and destination which effects in increase of hop count thus resulting in increased average end-to-end delay.

### 4.3 Normalized Routing Load:

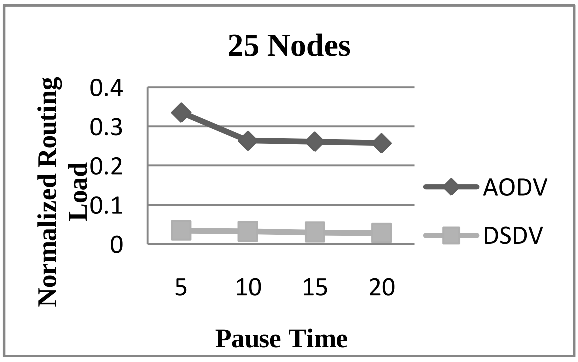


Figure 3(a): Normalized Routing Load for 25 nodes

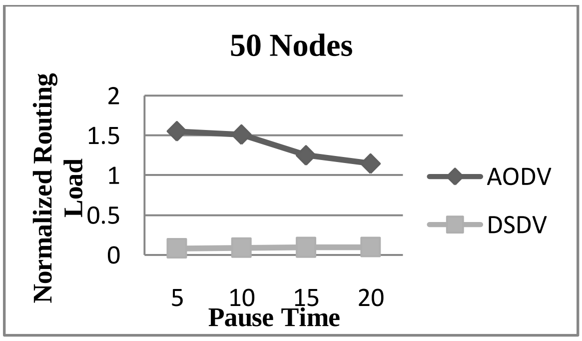


Figure 3(b): Normalized Routing Load for 50 nodes

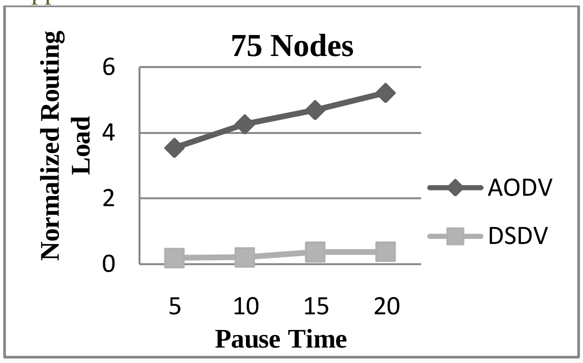


Figure 3 (c): Normalized Routing Load for 75 nodes

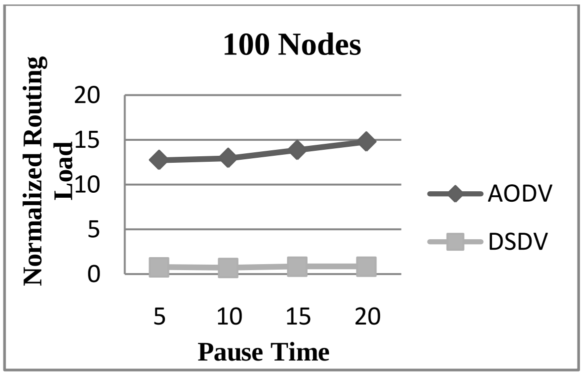


Figure 3 (d): Normalized Routing Load for 100 nodes

Fig 3(a), Fig 3(b), Fig 3(c) and Fig 3(d) indicates that normalized routing load of AODV is always higher than DSDV under any scenario. The performance of DSDV in terms of normalized routing load is not influenced in any way with respect to change in node density and pause time. The reactive nature of AODV routing protocol causes more number of control overhead than DSDV. Therefore, normalized routing load for AODV will always be higher than DSDV.

## CONCLUSION

The performance evaluation of two routing protocols, AODV and DSDV, has been done with respect to metrics viz. throughput, average end-to-end delay and normalized routing load under varying node density and varying pause time. From the result analysis, it has been observed that in high node density the performance of both protocols decreases significantly. The increase of node density in the network causes more number of control packets in the network for route establishment between a pair of source and destination nodes. This is the main reason of performance degradation of the routing protocols in high node density [14]. On other hand, increase of pause time indicates more stable network. Thus the performance of both routing protocols increases with the increment of pause time. It has been observed that in low node density the performance of AODV is better than DSDV in terms of throughput, whereas the performance of DSDV is better in high node density (upto 100 nodes). Another observation has been found from the result that increment of pause time does not affect much in the performance of DSDV where the performance of AODV varies significantly with the pause time. In Current work, only three performance metrics have been considered to analyze the performance of AODV and DSDV. Inclusion of other performance metrics will provide indepth comparison of these two protocols which may provide an insight on the realistic behavior of the protocols under more challenging environment. The current work has been limited with fixed simulation area (500x500m) with CBR traffic and node density is upto 100 nodes. From previous work [14], it has been observed that in higher node density (200 nodes) AODV performs better than DSDV. Varying simulation area and higher node density with different traffic will provide indepth performance analysis of these two protocols.

## REFERENCES


[1] C. Siva Ram Murthy and B.S. Manoj. *Ad Hoc Wireless Networks, Architecture and Protocols*, Pearson Education, 2004

[2] Charles E. Perkins, Elizabeth M. Royer, Samir R. Das and Mahesh K. Marina, *Performance Comparison of Two On-Demand Routing Protocols for Ad Hoc Networks*, IEEE Personal Communications, February 2001

[3] Charles E. Perkins. *Ad Hoc Networking*, Addison-Wesley, 2001

[4] Charles E. Perkins & P. Bhagwat, *Highly Dynamic Destination-Sequenced Distance Vector Routing (DSDV) for Mobile Computers*, Proceedings of ACM SIGCOMM'94, London, UK, Sep. 1994

[5] Mehran Abolhasan, Tadeusz Wysocki, Eryk Dutkiewicz. *A review of routing protocols for mobile ad hoc networks*, Telecommunication and Information Research Institute, University of Wollongong, Wollongong, NSW 2522, Australia, June 2003

[6] Kevin Fall, Kannan Varadhan, *The ns Manual*, November 2011

[7] Deepanshu Shukla and Prof. Sridhar Iyer, *Mobilty models in Ad Hoc Networks*, KReSIT-IIT Bombay, November 2001

[8] Sachin Kumar Gupta and R. K. Saket, *Performance Metric Comparison of AODV and DSDV Routing Protocols in MANETs Using NS-2*, IJRRAS, June 2011

[9] S H Manjula, C N Abhilash, Shaila K, K R Venugopal, and L M Patnaik, *Performance of AODV Routing Protocol using Group and Entity Models in Wireless Sensor Networks*, IMECS, Hong Kong, March 2008

[10] Comer and Douglas E., *Computer Networks and Internet*, Prentice Hall, 2008

[11] V. Ramesh, Dr. P. Subbaiah, N. Koteswar Rao and M. Janardhana Raju, *Performance Comparison and Analysis of DSDV and AODV for MANET*, International Journal on Computer Science and Engineering, 2010

[12] C. E. Perkins, E. M. Royar and S. Das, *Ad Hoc On Demand Distance Vector (AODV) Routing*, IETFInternet Draft, draft-ietf-manet-aodv-08.txt, March 2001

[13] David B. Johnson. P, *Routing in Ad Hoc Networks of Mobile Hosts*, Proceedings of the IEEE Workshop on Mobile Computing Systems and Applications (WMCSA'94), December 1994.

[14] Sanku Sinha and Biswaraj Sen. Performance Analysis of AODV And DSDV Routing Protocols in Mobile Ad Hoc Networks Under Varying Node Density, in the proceedings of international conference RTCMC-2012, OITM, Hissar, February 25-26, 2012 pp. 171-174