An Experimental Comparison of AODV and DSDV Routing Protocols in MANET

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Abstract- Networks without any physical connections are known as wireless mobile ad hoc networks. Because the nodes in these networks move around, there is no set topology. In wireless networks, difficulties with path loss, multipath propagation, and interference also exist. Hence, these networks require a dynamic routing protocol to operate correctly. For doing this objective, numerous routing protocols have been devised. This paper goal is to learn about, comprehend, evaluate, and talk about the DSDV and AODV mobile ad-hoc routing protocols. Although AODV is a reactive protocol that finds a route to a destination whenever communication is required, DSDV One is a proactive protocol that relies on routing tables that are maintained at each node. When performance indicators for DSDV and AODV routing protocols are taken into account, such as End to End delay, throughput, and packet drop ratio, we get to the conclusion that DSDV is more suitable for smaller networks while AODV is better suited for large networks.

Index Terms- AODV, DSDV, MANET

I. INTRODUCTION

An ad-hoc network is nothing but collection of wireless hosts forming a temporary network without any centralized administration. While mobile ad-hoc network (MANET) is nothing but a self-organizing and self-configuring multihop wireless networks having dynamic nature due to mobile network[4]. Here nodes in wireless network not only act as hosts but also routers [3]. To facilitate information transmission between multiple MANET nodes, numerous routing protocols have been developed. Key elements of successful, dependable, and proficient communications are efficient routing protocols. Three categories are used to group these protocols. Routing protocols that are proactive or table-driven, Hybrid routing methods, which combine proactive and reactive routing, are reactive or on-demand protocols[3][12]. In a reactive routing strategy, a routing protocol waits to determine a route to a destination until it is necessary, which results in less control traffic overhead [12], for e.g AODV [16] and DSR [17]. Proactive protocols, on the other hand, are focused on timely exchange of control messages for route identification and maintenance and focus primarily on providing route immediately as and when needed. The majority of the network's bandwidth is used by proactive routing protocol to send regular topology updates. [3]. Examples of these protocols are OLSR [18], DSDV [17], and others. Table-driven and on-demand capabilities from both classes are combined in hybrid MANET protocols. These category protocols maintain a route to a particular destination constantly as a proactive feature and only find the route to a different destination when it is necessary as a reactive protocol feature. Examples of hybrid protocols include ZRP [12], GRP [12], and TORA. It is crucial to research and contrast various routing protocols from different categories in order to better understand and utilise the protocols.

II OVERVIEW OF ROUTING PROTOCOLS

1. Destination Sequenced Distance Vector Protocol(DSDV)
It is a pro-active protocol built on a modified version of the standard Bellman-Ford routing algorithm that adds a new attribute, like a sequence number. DSDV added the Sequence number attributes at each node for each route table. Each node maintains a routing table. This protocol was designed for the usage of data exchange via varying, arbitrary, and possible distant interconnection channels from base stations. Routing table updates that are sent periodically aid in topology maintenance. Updates are made instantly, or event-based, in the event of any new major changes to routing information. Each mobile node in the network must advertise its own routing table to its immediate neighbours in order to comply with the DSDV protocol. Either multicasting or broadcasting are used to deliver the advertisement.
Given that it is a distance vector protocol, the router simply sends the packet down the shortest path to the next-door host (or destination) and relies on the receiving router to continue the forwarding process from there [1].

Each node will get the new sequence number when it broadcast the data and contains the information like below -

Destination Address	Hop count	new sequence number, originally stamped by the destination

Operation of DSDV at Layer -2:

To avoid broadcast and save bandwidth which is required to find IP address for corresponding MAC address at layer-3, solution is to provide information of layer-3 at layer-2 itself [2].

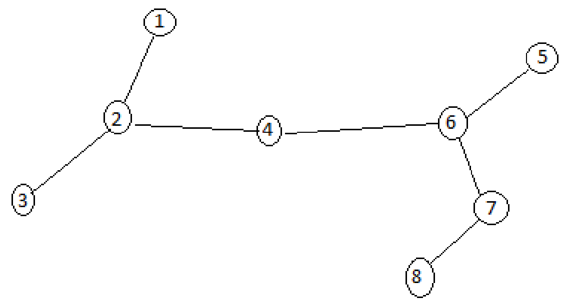


Figure 1: Movement of Mobile host in Adhoc Networks.

Take a look at figure 1, which shows a network with 8 hosts. We will have a look at the modifications to the Node4 routing table with regard to the movements of Node1. Since every node in the network initially broadcasts its routing information to every other node, Node4's routing table initially resembles Table-1.

Destination	**Next Hop**	**Metric**	**Sequence Number**	**Install**	**Stable Data**
Node1	Node2	2	S406 Node1	T001 Node4	Ptr1 Node1
Node2	Node2	1	S128 Node2	T001Node4	Ptr1 Node2
Node3	Node2	2	S564 Node3	T001 Node4	Ptr1 Node3
Node4	Node4	0	S710 Node4	T001 Node4	Ptr1 Node4
Node5	Node6	2	S392 Node5	T001 Node4	Ptr1 Node5
Node6	Node6	1	S076 Node6	T001 Node4	Ptr1 Node6
Node7	Node6	2	S128 Node7	T001 Node4	Ptr1 Node7
Node8	Node6	3	S050 Node8	T001 Node4	Ptr1 Node8

Table-1: Initially routing table at node-4

And the forwarding table at the Node4 would look like this Table-2:

Destination	**Metric**	**Sequence Number**
Node1	2	S406 Node1
Node2	1	S128Node2
Node3	2	S564 Node3
Node4	0	S710 Node4
Node5	2	S392 Node5
Node6	1	S076 Node6
Node7	2	S128 Node7
Node8	3	S050 Node8

Table-2: Forwarding table at the Node4.

Nevertheless, the link between Node2 and Node1 will be destroyed when the host Node1 moves its location as depicted in Figure 1 closer to Nodes 7 and 8. This will lead to the assignment of infinite metric at Node2 for Node1, and the routing table at Node2 will modify the sequence number to an odd number. This information will be updated on Node2's neighbouring hosts. Nodes 7 and 8 broadcast and update their information in the routing tables as a result of the addition of a new neighbour host. As of right now, Node4 will get its updated information from Node6, which will in turn get its updated information from Node1 with the same sequence number but a different metric after receiving two information packets from different neighbours. If the sequence number is the same, choosing the route will depend on fewer hops. The routing table now appears as Table-3.

Destination	Next Hop	Metric	Sequence Number	Install	Stable Data
Node1	Node6	3	S516 Node1	T001 Node4	Ptr1 Node1
Node2	Node2	1	S238 Node2	T001 Node4	Ptr1 Node2
Node3	Node2	2	S674 Node3	T001 Node4	Ptr1 Node3
Node4	Node4	0	S820 Node4	T001 Node4	Ptr1 Node4
Node5	Node6	2	S502 Node5	T001 Node4	Ptr1 Node5
Node6	Node6	1	S186 Node6	T001 Node4	Ptr1 Node6
Node7	Node6	2	S238 Node7	T001 Node4	Ptr1 Node7
Node8	Node6	3	S160 Node8	T001 Node4	Ptr1 Node8

Table-3: Routing Table of node4 after change in position of node1.

And the forwarding table will look like Table -4:

Destination	Metric	Sequence Number
Node1	3	S516 Node1
Node2	1	S238 Node2
Node3	2	S674 Node3
Node4	0	S820 Node4
Node5	2	S502 Node5
Node6	1	S186 Node6
Node7	2	S238 Node7
Node8	3	S160 Node8

Table-4: Forwarding Table after change in position of node1.

Benefits of DSDV:

- The protocol ensures loop-free pathways [6].
- Count to infinity problem is reduced in DSDV [6].
- By using incremental updates rather than full dump updates, we can save additional traffic.
- Path Selection: DSDV only keeps the optimal path, rather than keeping several pathways to each destination. As a result, the routing table takes up less space.

Limitations of DSDV –

- Bandwidth is wasted because routing information is advertised unnecessarily, even when there is no change in the network topology. [7]
- Multipath Routing is not supported by DSDV.
- It is challenging to estimate a delay for route advertising. [8]
- For bigger networks, it is challenging to keep the routing table's advertisement current. Every host on the network needs to keep a routing table updated for advertising. However, this would result in overhead for larger networks, consuming more bandwidth. [8] [14].

2) Ad-hoc On Demand Distance Vector (AODV)-

In distance vector, routers tell how far it thinks the destination is and also tell direction to reach there. When router receives this information if forms routing table with following entries.

Destination addresses	Next Node	Hop count	Sequence Number

Choose the quickest route to the destination based on the information above. By using a distance vector protocol, the router simply sends the packet down the shortest path to the next-door host (or destination) and relies on the receiving router to continue the forwarding process from there.

Although it is a development over DSDV, AODV is a reactive protocol. By generating routes that are in demand, it lowers the amount of broadcasts. The route request packet is broadcast by any source that wants to send packets to a particular destination (RREQ). Once a packet has reached its destination, surrounding nodes broadcast it to their neighbours in turn. The intermediary nodes from which the first copy of the packet is received are noted throughout this forwarding procedure. Their route tables contain this entry, which aids in building a reverse path. Any subsequent copies of the same RREQ that are received are discarded. Reverse route is used to send the replay. When a source node relocates, it can restart the route discovery process for route maintenance. Source node is alerted in the event of a link failure in the path and has the option to re-discover the route[15].

When a node (let's say source node "S") needs to interact with another (let's say destination node "D"), it broadcasts a route request packet ("RREQ") to its neighbours, increasing its broadcast-id and starting path discovery. the following fields are a part of the RREQ:

source-address	source-sequence# -to maintain freshness info	Broadcast-id-unique for each broadcast	destination-address	destination-sequence# - specifies how fresh a	hop-count

	about the route to the source.			route to the destination must be before it is accepted by the source.	

The (source-address, broadcast-id) pair is used to identify the RREQ uniquely. Then the dynamic route table entry establishment begins at all the nodes in the network that are on the path from S to D.

RREP has following format

source address	destination address-	destination sequence number-Time stamp generated by destination node	hop count	lifetime

Working of AODV at intermediate nodes:

The destination sequence number in the routing table of an intermediate node is compared to the RREQ if it contains a route entry for the desired destination. It rebroadcasts the RREQ to its neighbours if the destination sequence number in its routing table is lower than that in the RREQ. If the same request has not already been handled, it unicasts a route reply packet to its neighbour from where it received the RREQ (this is identified using the broadcast-id and source-address). After being created, the RREP follows the reverse path it established up before arriving at this node as it makes its way back to the source.. Each node along this chain sets a forward pointer to the node from which it is receiving the RREP as the RREP travels back to source and writes the most recent destination sequence number to the request destination. It's known as Forward Path Setup. An intermediate node update its routing database when it receives another RREP, it verifies its destination sequence number and propagates new RREP only if destination sequence number is bigger or if the new sequence number is same and hop count is modest, or If not, it simply skips the new RREP. This ensures that algorithm is loop-free and only the most effective route is used.
Suppose Node "A "wants to send data to Node "C" as shown in following figure-2 .

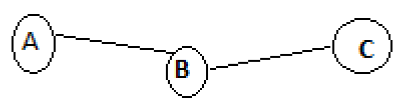


Figure-2

Step 1
Node A – generates RREQ packet <A,1,1,C, ,0> and broadcast to its neighbor nodes. Here hope count is zero since RREQ is generated by source node "A".

Step2
Node B- receives RREQ from Node "A", then Node "B" checks RREQ 's sequence number. If route is present in "B" routing table which has greater sequence number then node "B" generates RREP to its originator. Otherwise node "B" just increments hoop count in RREQ packet and broadcast to its neighbor <A,1,1,C, , 1> and also makes entry in its routing table

Routing table of Node"B"

Destination node	**Next node**	**Hop count**	**Sequence Number**
A	A	1	1

This step is repeated any number of intermediate nodes.

Step3
Same process takes place at node "C" as in step no.2. When node "C" receives RREQ packet from node "B", node "C" finds that it is request for him itself and node "C" generates RREP<C,A,140,0> .
Routing table of Node "C"

Destination node	**Next node**	**Hop count**	**Sequence Number**
A	B	2	1

In reverse path from C-B-A goes through following steps.
Step1
Node "C" broadcast RREP to its neighbor (i.e. "B")

Step 2
When node" receives RREP from node "C" ,it makes entry in its routing table with incremented hop count. And RREP <C, A, 140, 1> re-broadcast-ed. Records the latest destination sequence number to the request destination. This is called Forward Path Setup.
Routing table of Node"B"

Destination node	Next node	Hop count	Sequence Number
A	A	1	1
C	C	1	140

Step 3
When node "A" receives RREP and increments hop count and makes entry in its routing table.
Routing table of Node "A"

Destination node	Next node	Hop count	Sequence Number
C	B	2	140

Benefits of AODV:

- The reactive nature of AODV allows it to handle the highly dynamic behaviour of vehicle ad-hoc networks.
- Used for both unicasts and multicasts utilising the packet flag "J" (Join Multicast Group).

Disadvantages of AODV:
– Requirement on broadcast medium: The algorithm expects/requires that the nodes in the broadcast medium can detect each other's broadcasts.

III. SIMULATION PARAMETERS AND SETUP

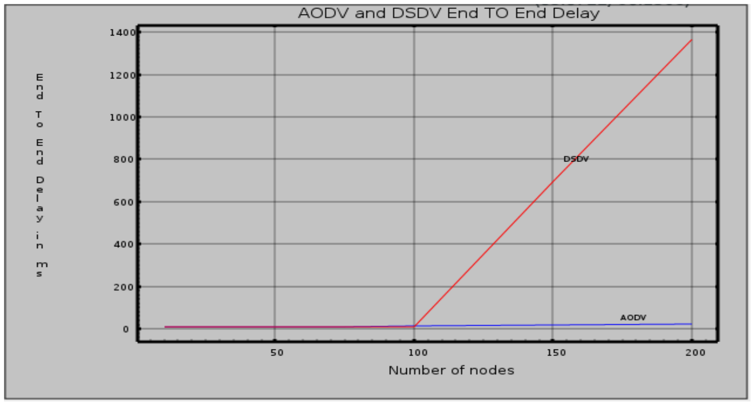
NS2.34 simulator is used to compare two protocols – DSDV and AODV. Simulation experiment of two protocols were conducted for varying number of nodes(10,20,30,50,75,100,150,200) on 500m X 500m simulation area[13]. At the time simulation queue length was considered as 100 and queue type had considered as Priority Queue . Other parameters of the simulation is mentioned in Table no. 5

Parameters	Values
Routing Protocol	AODV, DSDV
Simulation Area	500m X 500 m
Simulation Area	600 sec
Number of Nodes	10,20,30,50,75,100,150,200
Queue Length	100
Queue Type	Priority Queue
Mobility Models	Random WayPoint Mobility Model
Pause Time	10 sec
Speed	1.5 meter/sec
CBR Traffic	Agent -UDP, Packet Size-512 , Max packet Size-1000, Send rate-8 mbps, Maximum Connection-9
Mac_Protocol	802_11

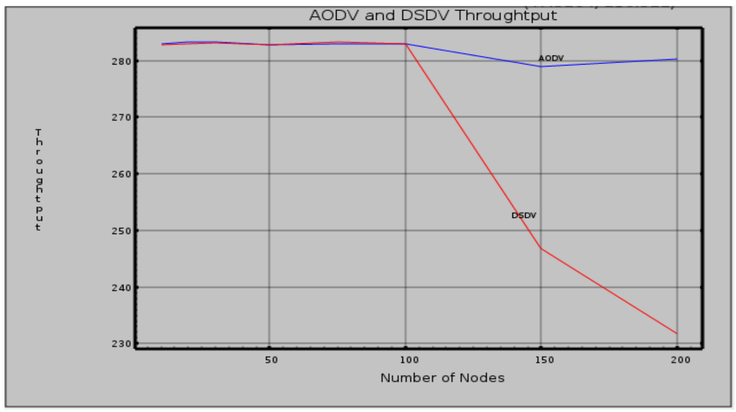
Table no. 5 Simulation parameters

IV. ANALYSIS AND DISCUSSION

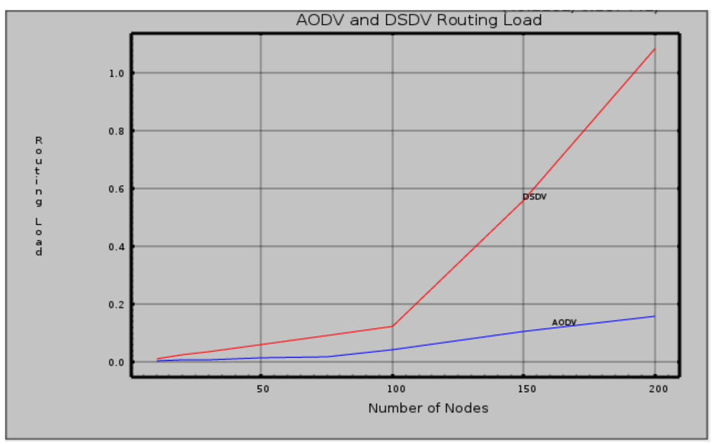
The performance of two MANET routing protocols DSDV and AODV are compared based on End to End Delay, throughput and routing load.



Graph-1: End to End Delay in AODV and DSDV Routing protocols



Graph-2: Throughput in AODV and DSDV Routing protocols



Graph-3: Routing Load in AODV and DSDV Routing protocols

Graph-1, Graph-2, Graph-3 reveals that, DSDV routing protocol consumes more bandwidth, because of the frequent broadcasting of routing updates. While the AODV is better than DSDV as it doesn't maintain any routing tables at nodes which results in less overhead and more bandwidth. It can be assumed that DSDV routing protocols works better for smaller networks but not for larger networks.

V. CONCLUSION

This paper discussed about two most widely used protocols – DSDV and AODV. NS2.34 simulator was used to compare two protocols – DSDV and AODV. Simulation experiment of two protocols were conducted for varying number of nodes(10,20,30,50,75,100,150,200) on 5Km X 5Km simulation area. At the time simulation queue length was considered as 100 and queue type had considered as Priority Queue. From the experiment, it is been observed that AODV routing protocol is best suited for general mobile ad-hoc networks as it consumes less bandwidth and lower overhead when compared with DSDV routing protocol.

Number of Nodes	End To End Delay	Throughput	Routing Load
Less than(>)100	Both AODV And DSDV routing protocol have same performance	Both AODV And DSDV routing protocol have same performance	Both AODV And DSDV routing protocol have same performance
Greater than(<)100	AODV routing protocol have far better performance	AODV routing protocol have far better performance	AODV routing protocol have far better performance

Application of DSDV

DSDV routing protocol is better to be used in small hotels and cafeteria area where rush is less.

Application of AODV

AODV routing protocol is better to be used in Shopping Mall and Airport area where rush of people is more.

REFERENCES

[1] Tasman Networks Inc. Routing basics: Protocol evolution in enterprise and service provider networks. Technical report, 2004.
[2] Perkins, C. E., & Bhagwat, P. (1994). Highly dynamic destination-sequenced distance-vector routing (DSDV) for mobile computers. ACM SIGCOMM computer communication review, 24(4), 234-244.
[3] Abolhasan, M., Wysocki, T., & Dutkiewicz, E. (2004). A review of routing protocols for mobile ad hoc networks. Ad hoc networks, 2(1), 1-22.
[4] Hong, X., Xu, K., & Gerla, M. (2002). Scalable routing protocols for mobile ad hoc networks. IEEE network, 16(4), 11-21.
[5] Schiller, J. H. (2003). Mobile communications. Pearson education.
[6] Roth, D. U. (1994, August). Highly dynamic destination-sequenced distance-vector routing. In Proceedings of ACM SIGCOMM (pp. 234-244).
[7] Patel, D. (2000). Energy in ad-hoc networking for the picoradio (Doctoral dissertation, Master's thesis, UC Berkeley).
[8] He, G. (2002). Destination-sequenced distance vector (DSDV) protocol. Networking Laboratory, Helsinki University of Technology, 135, 1-9.
[9] Tseng, Y. (2003). Mobile IP and ad hoc networks: An integration and implementation experience. IEEE Computer.
[10] Perkins, C. E. (2008). Ad hoc networking. Pearson Education India.
[11Perkins, C. E. (2000). Dsdv routing over a multihop wireless network of mobile computers. Ad hoc networking, 53-74.
[12] Avhankar, M. S., Pawar, D. J. A., Majalekar, S., & Kedari, S. (2022). Mobile Ad Hoc Network Routing Protocols Using OPNET Simulator. International Journal on Recent and Innovation Trends in Computing and Communication, 10(1), 1-7.
[13] Srilakshmi, U., Alghamdi, S. A., Vuyyuru, V. A., Veeraiah, N., & Alotaibi, Y. (2022). A secure optimization routing algorithm for mobile ad hoc networks. IEEE Access, 10, 14260-14269.
[14] Kafetzis, D., Vassilaras, S., Vardoulias, G., & Koutsopoulos, I. (2022). Software-defined networking meets software-defined radio in mobile ad hoc networks: State of the art and future directions. IEEE Access, 10, 9989-10014.
[15] Choudhary, S., Narayan, V., Faiz, M., & Pramanik, S. (2022). Fuzzy approach-based stable energy-efficient AODV routing protocol in mobile ad hoc networks. In Software Defined Networking for Ad Hoc Networks (pp. 125-139). Cham: Springer International Publishing.
[16] Perkins, C., Belding-Royer, E., & Das, S. (2003). Ad hoc on-demand distance vector (AODV) routing (No. RFC 3561).
[17] Johnson, D. B., & Maltz, D. A. (1996). Dynamic source routing in ad hoc wireless networks. In Mobile computing (pp. 153-181). Springer, Boston, MA.
[18] Jacquet, P., Muhlethaler, P., Clausen, T., Laouiti, A., Qayyum, A., & Viennot, L. (2001). Optimized link state routing protocol for ad hoc networks. In Multi Topic Conference, 2001. IEEE INMIC 2001 (pp. 62-68). IEEE.

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