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Comparative Evaluation of AODV, DSDV and AOMDV based on end-to-end delay and routing overhead using Network Simulator

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Abstract—MANET is a self-organizing and self-configurable network which has no infrastructure network. Mobile Ad-hoc Network (MANET) is a set of number of nodes, which provide an environment over a shared wireless medium to communicate with each other without any predefined infrastructure or a centralized control. It establishes a temporary connection where nodes can join or leave the network at any time. Here we have considered three different routing protocols of MANET i.e. AODV, DSDV and AOMDV. AODV and AOMDV are reactive routing protocols i.e. capability to discover a path towards destination dynamically by sending HELLO packets each time they want to perform routing. While DSDV is a proactive routing protocol which updates link connection periodically and it maintains table. We have compared the performance of these three protocols based on routing overhead and end-to-end delay under various conditions like number of nodes and pause time.

Keywords— MANET, routing overhead, end to end delay, AODV, DSDV, AOMDV

I. INTRODUCTION

Mobile Ad Hoc Network (MANET) is a collection of various multi-hop wireless mobile nodes that communicate with each other without centralized control or established infrastructure. The wireless links in this network are highly error prone and can go down frequently due to mobility of nodes, interference, less infrastructure and many other reasons. Therefore, routing in MANET is a critical task due to highly dynamic environment [1].

Recently, several routing protocols have been proposed for mobile ad hoc networks and prominent among them are AOMDV, AODV and DSDV. This research paper provides an overview of these protocols by presenting their characteristics, functionality, benefits and limitations and their comparative analysis so as to analyze their performance. The objective of this paper is to improve the performance of various routing protocols by observing the behavior under various scenarios.

Mobile Ad-hoc Networks can be characterized by:

1. Wireless Communication (i.e. single node can be either router or host)
2. No centralized controller and/or infrastructure required
3. Intrinsic mutual trust among nodes
4. Dynamic Network Topology
5. Frequent route updates

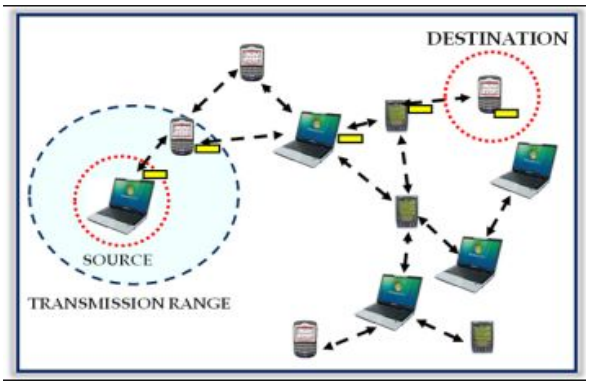

Fig. 1 Mobile AD-HOC Network (MANET)

II. ROUTING PROTOCOLS FOR MANET

A. Ad-hoc On Demand Distance Vector Routing (AODV)

AODV [2, 8] routing protocol is a variation of Destination-Sequenced Distance-Vector (DSDV) routing protocol which uses DSDV and DSR routing protocol as a base collectively. It aims to minimize the requirement of system-wide broadcasts to its extreme. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed by sending HELLO packets and are maintained only as long as they are required.

1) Route Discovery

When a node wants to send a data packet to a destination node, the entries in route table are checked to ensure whether there is a current route to that destination node or not. If it is there, the data packet is forwarded to the appropriate next hop toward the destination. If it is not there, the route discovery process is initiated. AODV initiates a route discovery process using Route Request (RREQ) and Route Reply (RREP). The RREQ packet has to be broadcasted by the source node to its neighbors which in turn forwards the same to their neighbors and so forth in order to find path towards destination. Especially, in case of large network, such broadcasts of RREQ lead to performance degradation so it required to be controlled and to control the same; the source node uses an expanding ring search technique. In this technique, the source node sets the Time to Live (TTL) value of the RREQ to an initial start value. If there is no reply within the discovery period, the next RREQ is broadcasted with a TTL value increased by

an increment value. The process of incrementing TTL value continues until a threshold value is reached, after which the RREQ is broadcasted across the entire network [1, 2]. When the intermediate node or destination node having a route to the destination receives the RREQ, it creates the RREP and unicast the same towards the source node using the node from which it received the RREQ as the next hop. When RREP is routed back along the reverse path and received by an intermediate node, it sets up a forward path entry to the destination in its routing table. When the RREP reaches the source node, it means a route from source to the destination has been established and the source node can begin the data transmission [3, 4].

2) Route Maintenance

A route discovered between a source node and destination node is maintained as long as needed by the source node. Since nodes movements are frequent in mobile ad hoc network, if the source node changes its location during an active session, it can reinitiate route discovery mechanism to establish a new route to destination. Conversely, if some intermediate node or the destination node moves, the break initiates for the upstream nodes [8].

3) Benefits and Limitations

The benefits of AODV protocol are that it favors the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement. It also responds very quickly to the topological changes that affects the active routes. AODV does not put any additional overheads on data packets as it does not make use of source routing. The limitation of AODV protocol is that it expects/requires that the nodes in the broadcast medium can detect each other's broadcasts.

B. **Destination Sequenced Distance Vector (DSDV)**

DSDV is characterized as table-driven routing algorithms for MANETs. The DSDV routing algorithm is based on the number of hops required to reach to the destination, and also sequence number of the classical [4]. Routing table is used to store data packets sent by nodes at each node in the network. The protocol has three main attributes: to avoid loops, to resolve the "count to infinity" problem, and to reduce high routing overhead. Each and every mobile node maintains a routing table with all available destinations along with some more information. DSDV is a table-driven routing protocol for ad hoc mobile networks which is based on the Bellman-Ford algorithm. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node.

1) Benefits and Limitations

DSDV was one of the early algorithms available. It is quite suitable for creating ad hoc networks with small number of nodes. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle [4]. Limitation is that whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks.

C. **Ad-hoc On Demand Multipath Distance Vector Routing (AOMDV)**

Ad-hoc On Demand Multipath Distance Vector Routing (AOMDV) is similar to AODV but has multipath whereas AODV has single path. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed by sending HELLO packets and are maintained only as long as they are required [5].

1) Benefits and Limitations

AOMDV is an on demand reactive routing protocol which discovers the route as and when required by sending HELLO packets to its neighbors. AOMDV selects the most optimum path from available paths between source node and destination node. The optimization criteria can be shortest and least congested path.

III. SIMULATION ENVIRONMENT

We have used network simulator (NS) for the evaluation of three routing protocols of MANET i.e. AODV, DSDV and AOMDV. In this research paper, simulation has been carried out by using various network environments. We have calculated end to end delay and routing overhead for all routing algorithm under various network parameters like pause time and number of nodes.

We have used following simulation parameter.

TABLE I
SIMULATION PARAMETERS

Channel	Wireless Channel
Propagation Model	Two Ray Ground
Network	Wireless Physical
Mac Type	802.11
Queue Type	DropTail / Priority Queue
Queue Length	50
Number of Nodes	50, 100, 150, 200
Terrain Area	500m × 500m
Traffic Type	CBR
Simulation Time	100 sec

Firstly, we have simulated AODV for different number of nodes and pause time and calculated routing overhead.

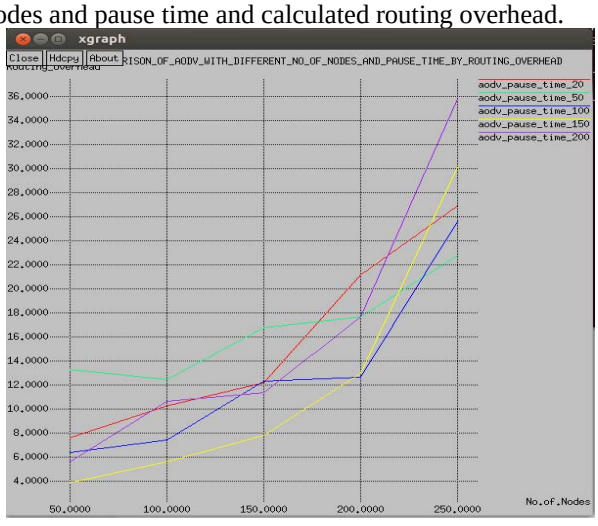

Fig. 2 routing overhead for AODV for different pause time and number of nodes

Then, we have simulated DSDV for different number of nodes and pause time and calculated routing overhead.

Fig. 3 routing overhead for DSDV for different pause time and number of nodes

Then, we have simulated AOMDV for different number of nodes and pause time and calculated routing overhead.

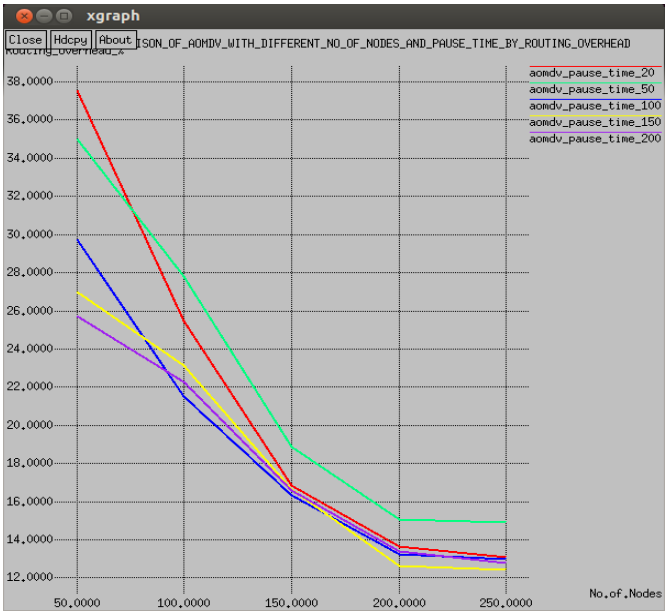

Fig. 4 routing overhead for AOMDV for different pause time and number of nodes

We have simulated routing protocols for above parameter for varying no. of nodes and pause time. In this scenario, we have observed that AODV's routing overhead increases with varying no. of nodes and pause time. This is because AODV is reactive protocol and due to increase in number of nodes more HELLO packets are send to discover routes. This leads to higher routing overhead. DSDV is proactive so it does not send HELLO packets every time. AOMDV chooses the most optimum path rather than shortest path.

Then, we have simulated AODV for different number of nodes and pause time and calculated end to end delay.

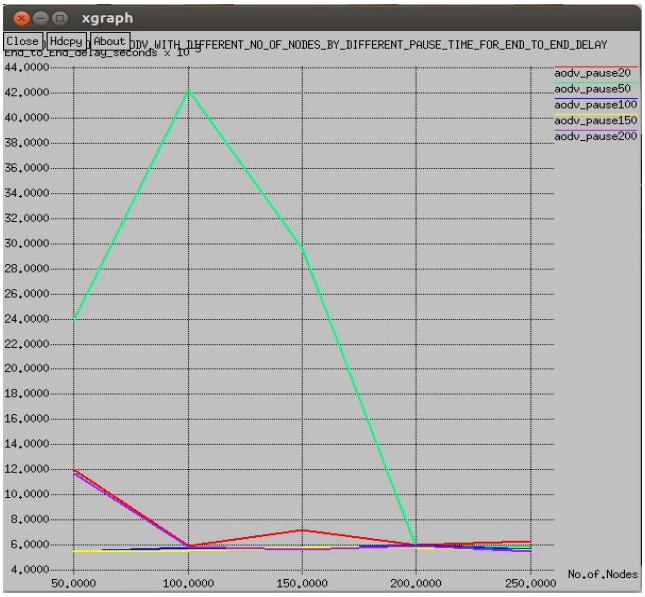

Fig. 5 End to end delay for AODV for different pause time and number of nodes

Then, we have simulated DSDV for different number of nodes and pause time and calculated end to end delay.

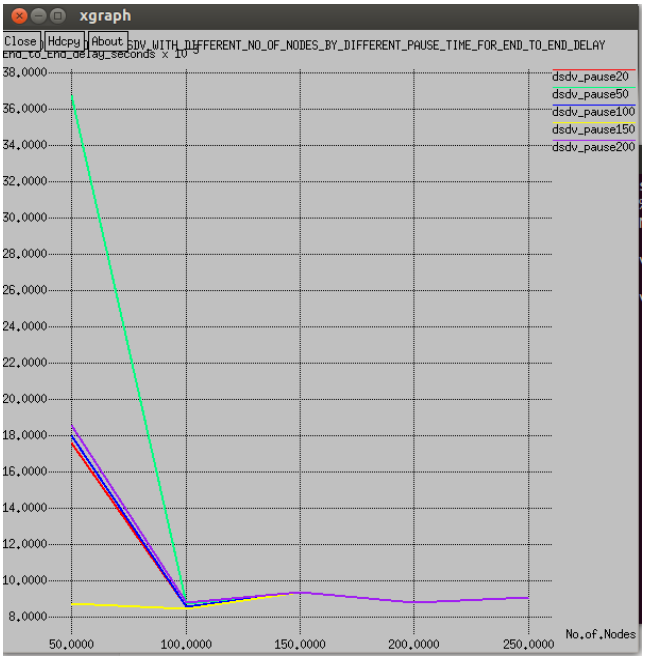

Fig. 6 End to end delay for DSDV for different pause time and number of nodes

Further, we have simulated DSDV for different number of nodes and pause time and calculated end to end delay.

Further, we have compared AODV, AOMDV and DSDV for different number of nodes and pause time and calculated end to end delay.

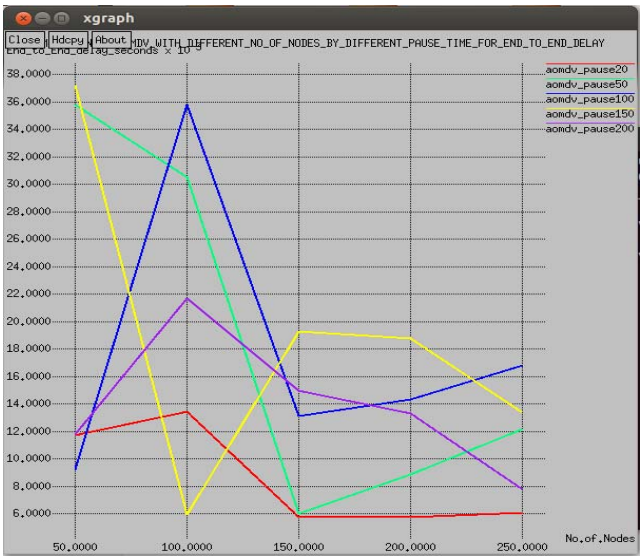

Fig. 7 End to end delay for AOMDV for different pause time and number of nodes.

We have simulated routing protocols for above parameter for varying no. of nodes and pause time and calculated end to end delay. In this scenario, we have observed that AODV's end to end delay first increases then decreases with varying no. of nodes and pause time. This is because AODV is reactive protocol and due to increase in number of nodes more HELLO packets are send to discover routes this leads to wastage of bandwidth but in DSDV HELLO packets are not send up to a specified interval this leads to loss of packets due to route failure. This leads to higher delay. AOMDV chooses the most optimum path rather than shortest path but this choosing takes time so its delay first increases and then after choosing the most optimum path its delay decreases.

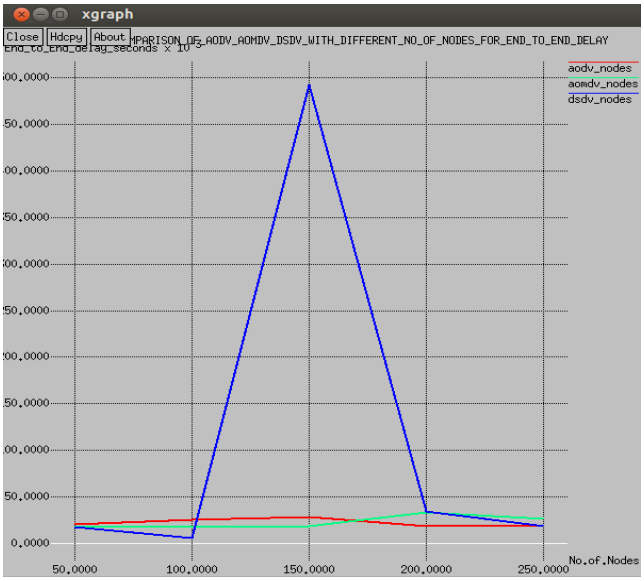

Fig. 8 End to end delay for AODV, DSDV and AOMDV for different number of nodes

IV. Conclusion

In this paper, we have seen performance analysis of AODV, DSDV and AOMDV under various conditions like with various pause time and number of nodes. The parameter which we checked for performance analysis is end to end delay and routing overhead. We noticed that DSDV shows higher end to end delay and routing overhead hence AODV and AOMDV shows better performance than DSDV. This is because of the fact that AODV and AOMDV are reactive therefore it sends HELLO packet every time to perform routing. DSDV does not send HELLO packet every time for a specified time period so even if the old route has expired it still sends packets through the old route. If the old route does not exist then the packet is lost. This leads to wastage of bandwidth and increase in delay therefore this reduces performance. Also this leads to duplicate packets which increase routing overhead. Therefore, AODV and AOMDV show better performance than DSDV.

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