

# Simulation and Comparison of AODV and AOMDV Routing Protocols in MANET

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**Abstract**— One of the main challenges of Mobile Ad Hoc Networks is the design of robust routing algorithms that adapt to the frequent and randomly changing network topology. MANET is a dynamic wireless network that need no pre-existing infrastructure in which each node acts as a router. Each node acts as an end system but also as a router to forward packets. These nodes are free to move and organizes themselves in the network and changes their positions frequently. The routing protocols are categorized as Proactive, Reactive and Hybrid protocols. Reactive routing approach is widely popular routing category for MANET. The design follows the idea that each node tries to reduce routing overhead by sending routing packets whenever a communication is needed. In this paper we compare AODV and AOMDV routing protocols for MANETs. The AODV is a unipath routing protocol and AOMDV is a multipath version of AODV. AOMDV was designed primarily for highly dynamic ad hoc network where link failures and route breaks occurs frequently. We analyze these routing protocols by extensive simulations in ns-2 simulator and show that how pause time affect their performance. Performance of AODV and AOMDV is evaluated based on Packet Delivery Ratio, throughput, packets dropped, normalized routing overhead, end to end delay and optimal path length.

**Keywords**—AODV,AOMDV,routing , MANET

## I. INTRODUCTION

A mobile ad hoc network [8] is a collection of digital data terminals equipped with wireless transceivers that can communicate with one another without using any fixed networking infrastructure. Communication is maintained by the transmission of data packets over a common wireless Channel. The absence of any fixed infrastructure, such as an array of base stations, makes ad hoc networks radically different from other wireless LANs.

The topology of the ad-hoc network depends on the transmission power of the nodes and the location of the mobile nodes, which may change from time to time. One of the main problems in ad-hoc networking is the efficient delivery of data packets to the mobile nodes where the topology is not pre-determined nor does the network have centralized control. Hence, due to the frequently changing topology, routing in ad-hoc networks can be viewed as a challenge.

In table-driven or proactive routing protocols, consistent and up-to-date routing information of the network topology of

all nodes is maintained at each node with respect to the time. Routes are built from each node to every other node before they are needed. Any changes occurring in topology is broadcasted through the network, notifying all the nodes of the changes. Proactive protocols hence maintain routing information about the available paths in the network even if these paths are not currently used. The major drawback of these approaches is that the maintenance of unused paths may occupy an important part of the available bandwidth if the topology changes frequently [17].

In on-demand or reactive routing protocols, the routes are created on requirement basis. To find a path from source to destination, it invokes the route discovery mechanisms. Only the routes that are currently in use are maintained, thereby maintaining low control overhead and reducing the network load since a small subset of all available routes is in use at any time. Reactive routing protocols have some inherent limitations. First, since routes are only maintained while in use, it is usually required to perform a route discovery before packets can be exchanged between communication peers. This leads to a delay for the first packet to be transmitted. Second, even though route maintenance for reactive algorithms is restricted to the routes currently in use, it may still generate an important amount of network traffic when the topology of the network changes frequently. Finally, packets to the destination are likely to be lost if the route to the destination changes [17].

Existing routing protocols in ad-hoc networks utilize the single route that is built for source and destination node pair. Due to node mobility, node failures and the dynamic characteristics of the radio channel, links in a route may become temporarily unavailable, making the route invalid [17]. The overhead of finding alternative routes mounts along with additional packet delivery delay. This problem can be solved by use of multiple paths between source and destination node pairs, where one route can be used as the primary route and the rest as backup. Performance can be adversely affected by high route discovery latency and frequent route discovery in dynamic networks. This can be reduced by computing multiple paths in a single route discovery attempt. Multiple paths can be formed for both traffic sources and intermediate nodes with new routes being discovered only when needed, reducing route discovery latency and routing overheads. Multiple paths can also balance network load by forwarding data packets on multiple paths at the same time.

In our paper we mainly concentrate on AODV and AOMDV routing protocols.

## II. BACKGROUND

### A. Ad hoc on demand distance vector (AODV) protocol

AODV is a destination based reactive protocol. This protocol inherits the feature of route discovery from DSR. However, AODV resolves the problem of large headers found in DSR. This problem can cause significant performance degradation especially when the actual data contents are small. AODV maintains routing tables on the nodes instead of including a header in the data packet. The source node initiates the route discovery process in the same way as in DSR. An intermediate node may reply with a route reply (RREP) only if it knows a more recent path than the one known by the sender node to the destination. A destination sequence number is used to indicate how recent the path is as follows. A new route request generated by the sender node is tagged with a higher sequence number and an intermediate node that knows the route to the destination with a smaller sequence number cannot send the RREP message. Forward links are setup when a RREP travels back along the path taken by RREQ. So the routing table entries are used to forward the data packet and the route is not included in the packet header. If an intermediate node is unable to forward the packet to the next hop or destination due to link failures, it generates the route error (RERR) message by tagging it with a higher destination sequence number. When the sender node receives the RERR message, it initiates a new route discovery for the destination node.

### B. Ad hoc on demand multipath distance vector (AOMDV)

Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV) [17] protocol is an extension to the AODV protocol for computing multiple loop-free and link disjoint paths [18]. The routing entries for each destination contain a list of the next-hops along with the corresponding hop counts. All the next hops have the same sequence number. This helps in keeping track of a route. For each destination, a node maintains the advertised hop count, which is defined as the maximum hop count for all the paths, which is used for sending route advertisements of the destination. Each duplicate route advertisement received by a node defines an alternate path to the destination. Loop freedom is assured for a node by accepting alternate paths to destination if it has a less hop count than the advertised hop count for that destination. Because the maximum hop count is used, the advertised hop count therefore does not change for the same sequence number [18]. When a route advertisement is received for a destination with a greater sequence number, the next-hop list and the advertised hop count are reinitialized. AOM DV can be used to find node-disjoint or link-disjoint routes. To find node-disjoint routes, each node does not immediately reject duplicate RREQs. Each RREQs arriving via a different neighbor of the source defines a node-disjoint path. This is because nodes cannot be broadcast duplicate RREQs, so any two RREQs arriving at an intermediate node via a different neighbor of the source could not have traversed the same node. In an attempt

to get multiple link-disjoint routes, the destination replies to duplicate RREQs, the destination only replies to RREQs arriving via unique neighbors. After the first hop, the RREPs follow the reverse paths, which are node disjoint and thus link-disjoint. The trajectories of each RREP may intersect at an intermediate node, but each takes a different reverse path to the source to ensure link disjointness. The advantage of using AOMDV is that it allows intermediate nodes to reply to RREQs, while still selecting disjoint paths. But, AOMDV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQs those results are in longer overhead

## III. METRICS FOR PERFORMANCE COMPARISON

The six important performance metrics are considered for evaluation of these routing protocols are as follows:

**Throughput** - Throughput is the measure of how fast we can actually send packets through network. The number of packets delivered to the receiver provides the throughput of the network. The throughput is defined as the total amount of data a receiver actually receives from the sender divided by the time it takes for receiver to get the last packet

**Packets Dropped** - Some of the packets generated by the source will get dropped in the network due to high mobility of the nodes, congestion of the network etc.

**3. Packet Delivery Ratio** - The ratio of the data packets delivered to the destinations to those generated by the CBR sources. It is the fraction of packets sent by the application that are received by the receivers

**4. Normalized Routing Overhead** - The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission. The routing overhead describes how many routing packets for route discovery and route maintenance need to be sent in order to propagate the data packets

**5. End-to-End Delay** - End-to-End delay indicates how long it took for a packet to travel from the source to the application layer of the destination i.e. the total time taken by each packet to reach the destination. Average End-to-End delay of data packets includes all possible delays caused by buffering during route discovery, queuing delay at the interface, retransmission delays at the MAC, propagation and transfer times.

**6. Optimal Path Length** - It is the ratio of total forwarding times (depends on number of hops) to the total number of received packets. Optimal path length increases as the number of hops on optimal path increases

## IV. SIMULATION RESULT AND ANALYSIS

As already mentioned we had taken two On-demand routing protocols namely Ad hoc On-demand Distance Vector (AODV) and Ad hoc On-demand Multipath Distance Vector

(AOMDV). The NS-2.34 simulation framework is used for simulation purposes. Our evaluations are based on the simulation of 50 wireless nodes forming an ad hoc network, moving about over a square (500m x 500m) flat space. The mobility model used is Random way point model because it models the effect of mobility of nodes on overall performance of network. In this paper various parameters such as throughput, packets dropped, packet delivery ratio, routing overhead, end to end delay and optimal path length are investigated on the basis of varying pause time. We ran the simulation environment for 200 seconds for the scenario of pause time varying from 0-100. Zero pause time resembles to high mobility of nodes and max pause time denotes low mobility of nodes. Table 1 illustrates the environment in which the simulation is carried out. Graphs from Fig 1 to Fig 6 shows the Effect of Mobility or varying pause time on AODV and AOMDV with respect to various performance metrics.

Table 1 Simulation parameters for varying pause time

S.No	Parameters	Value
1	Number of nodes	50
2	Simulation Time	200sec.
3	Area	500 *500m <sup>2</sup>
4	Max Speed	20 m/s
5	Traffic Source	CBR
6	Pause Time (sec)	0,20,30,40,100
7	Packet Size	512 Bytes
8	Packets Rate	4 Packets/s
9	Max. No. of connection	10,20,30,40
10	Bandwidth	10Mbps
11	Delay	10 ms
12	Mobility model used	Random way point

### 1) Throughput:

The pause time was increased (low mobility) and the throughput changes at every pause time during complete simulation period. AOMDV shows a better throughput than AODV at every pause time. At starting throughput of AODV decreases rapidly. When a link becomes over utilized and causes congestion, AOMDV can choose to divert through alternate paths and hence throughput increases.

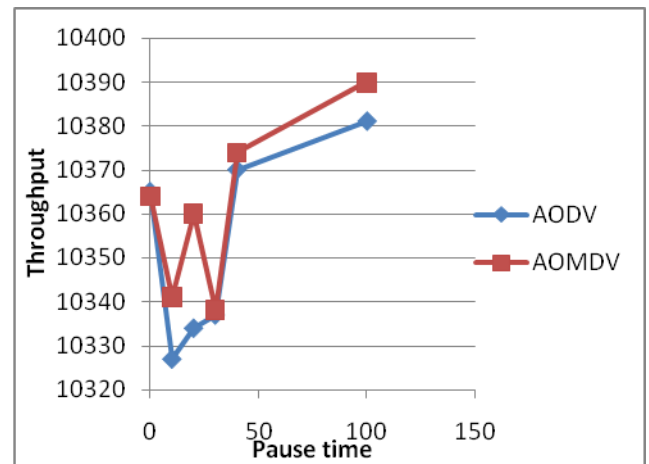


Fig. 1 Comparison between AODV and AOMDV on the basis of Throughput

### 2) Packets dropped:

The number of packets dropped in AOMDV are very low in compared to AODV. With increasing pause time packets dropped for both protocols increases but AOMDV drops less packets than AODV. Multipath nature of AOMDV attributes to less packet drop.

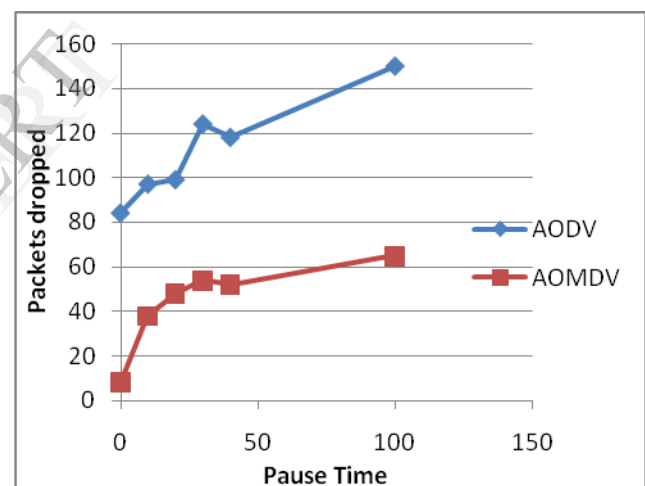


Fig. 2 Comparison between AODV and AOMDV on the basis of Packets dropped

### 3) Packet Delivery Ratio:

In order to calculate packet delivery ratio (PDR), the no of packets received by the destination will be divided by the no of packets originated. The better PDR implies the more accurate and suitable routing network. With increasing pause time the packet delivery ratio of AODV decreases rapidly but AOMDV follows a straight line. So a very little change in packet delivery ratio of AOMDV is observed. Thus AOMDV has better packet delivery ratio than AODV because of the availability of multiple paths.

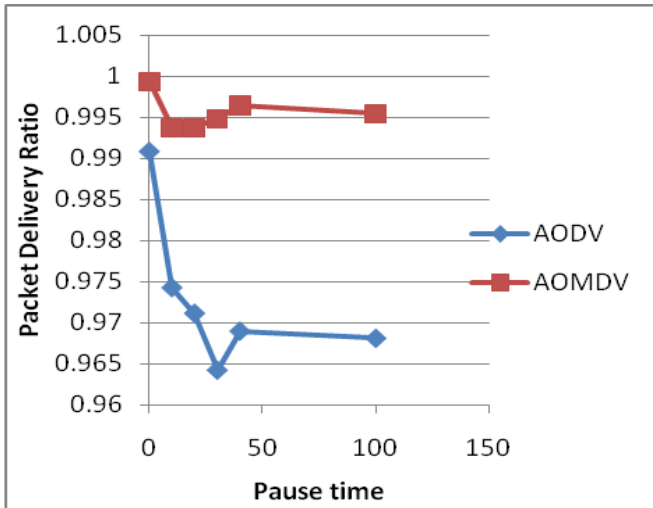


Fig. 3 Comparison between AODV and AOMDV on the basis of Packet Delivery Ratio

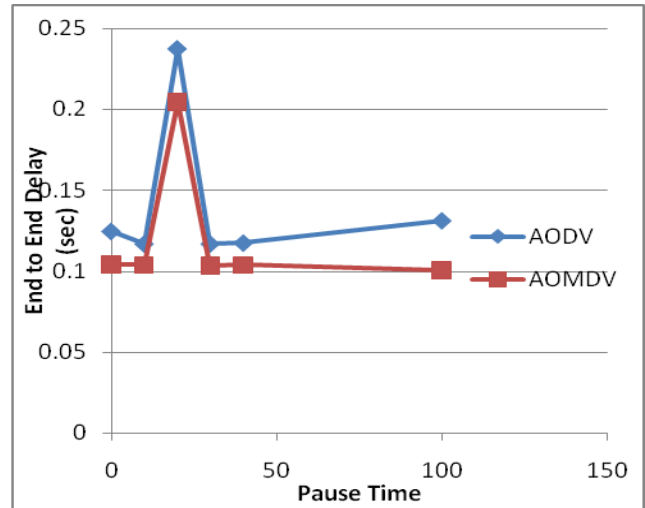


Fig. 5 Comparison between AODV and AOMDV on the basis of End to End Delay

4) Routing Overhead:

Pause time is varied again and results show that routing overhead decreases at lower pause time but increases at higher pause time for both protocols but AOMDV has low routing overhead at every pause time compared to AODV protocol.

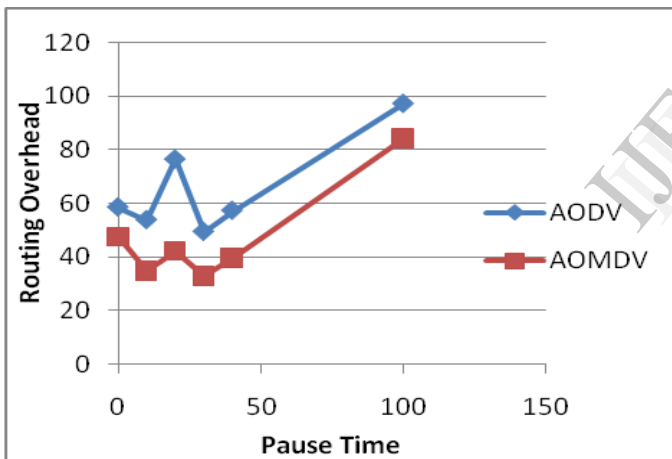


Fig.4 Comparison between AODV and AOMDV on the basis of Routing Overhead

5) End to End Delay:

With increasing pause time (from high mobility to low mobility) end to end delay increases for both protocols but still AOMDV has low end to end delay than AODV. At higher pause time end to end delay for AODV increases again but for AOMDV it decreases.

6) Optimal Path Length:

AOMDV has better optimal path length than AODV with increasing pause time. Because of multipath property AOMDV selects the best optimal path for routing. With increasing pause time Optimal path length for AOMDV is always smaller than of AODV.

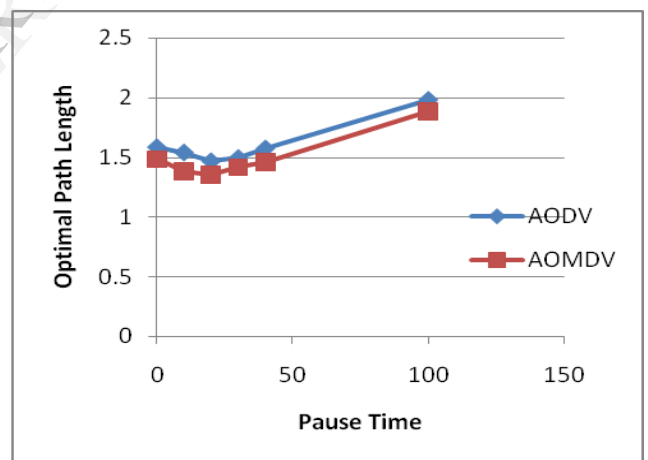


Fig. 6 Comparison between AODV and AOMDV on the basis of Optimal Path Length

CONCLUSION

This paper evaluated the performance of reactive protocols AODV and AOMDV using NS-2.34. Comparisons are based on the packet delivery ratio, packets dropped, throughput, normalizing routing overhead, end to end delay and optimal path length. Results shows that in every aspects AOMDV is has better performance than AODV though the difference is very low in every term. The simulation result reveals that the effect of mobility on the performance of AODV is higher as compared to AOMDV protocol, To compare both protocols more precisely we need to implement those protocols in more extreme conditions for better results, and performances of

these protocols can also be analyzed by varying number of nodes and transmission rate. So in conclusion we can say that AOMDV outperform AODV due to its ability to search alternate routes when a link breakdown occurs.

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