AOMDV Routing Protocol: A New Paradigm of Performance Over AODV in area of Mobile Ad-hoc Network

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Abstract— A Mobile Ad hoc network (MANET) is a new paradigm in wireless communication thanks to its high significance in various sensitive and emergency operations. Major challenge of Mobile ad hok network is that it must adapt to the frequent and randomly changing network topology. Consequent upon comparison in terms of performance of protocols for MANET, this study found that Ad hoc On-demand Multipath Distance Vector (AOMDV) had generated increased packet delivery ratio and reduced average end to end delay in data transmission than that of Ad-hoc On-Demand Distance Vector (AODV) Routing Protocol. Meanwhile, AODV has a single path only to reach the destination. So, route discovery needs to be executed if the path is broken. AOMDV performs over AODV because it can search alternate routes when a current link breaks down under highly dynamic environments. In each route discovery, AOMDV finds multiple routes between source and destination. So, in case of route failure, it uses alternate routes when the main path is broken and discovers a new route only when all routes fail. The fewer number of route discoveries causes a reduction in delay and routing overhead. NS2 simulator tool has been used to compare the performance between AODV and AOMDV, it shows that although AOMDV protocol consumes more energy but maintain a good packet delivery ratio and reduce end to end delay. If network load balancing is not an issue, then AOMDV is better on-demand routing protocol than AODV.

Index Terms— Mobile Ad-hoc Network, Routing Protocol, AOMDV, AODV, Ad-hoc Network, Performance.

1 Introduction

Mobile ad hoc networks (MANETs) are always interesting areas of research. Due to the flexibility of dynamic structure, they are an attractive technology for different application. In this paper, two on-demand routing protocols AODV and AOMDV have been compared, AODV is the commonly used another one AOMDV is the enhanced and modified version of AODV which belongs reactive and on-demand routing protocol of ad-hoc wireless networks. The aim is to generate various paths between source and destination pair. But the energy required to maintain multiple routes by each node in a path is high compared to AODV. But this leads to low remaining energy and a lot of energy loss. For performance evaluation, NS2 simulator has been used which shows that AOMDV consumes more energy but can effectively reduce end to end delay and maintain a good packet delivery ratio.

2 Related Works

For extensive simulation and to analyze these routing protocols ns-2 simulator has been used which generate trace file from where all the required information can be extracted, and a NAM file show the animation of the protocol and Xgraph which show to pictorial presentation of the comparison of AOMDV and AODV performance. And the result show that how the number of nodes, pause time and traffic rate affect their performance. This paper compares AODV and AOMDV routing protocols for MANETs.

Routing in MANETs can be proactive, reactive and hybrid. AOMDV eliminate the occurrence of frequent link failures and route breaks in a highly dynamic ad hoc network. It adds some extra fields in routing tables and control packets and during a route discovery phase compute loop-free and link-disjoint multiple routes between a source and destination.

3 Proposed AOMDV Approach With AODV

Ad hoc On-demand Multipath Distance Vector (AOMDV) [1] [2] is the multipath extension to the AODV protocol, it belongs to on-demand and reactive routing protocol of ad-hoc wireless networks. The advantage of AOMDV over AODV is evaluated in terms of increased packet delivery ratio, throughput and reduced average end-to-end delay and normalized control overhead. In multiple routes, the destination contains a list of the next-hops along with the corresponding hop counts in routing table entries. The advertised hop count is defined as the maximum hop count for all the paths. Route advertisement sends to the destination by using this hop count value. If any duplicate route advertisement received by a node then it forwards the packet throw alternate path to the destination. The loop freedom is ensured by selecting the alternate path for a destination based on the hop count value of path is less than the advertised hop count for that destination. The best paths are selected, and data forwarded through these paths. AOMDV may follow node-disjoint or link- disjoint routes. In node-disjoint routes,

duplicate RREQs cannot immediately be rejected. The RREQ and RREP pair arrives through a different neighbor of the source in a node-disjoint path. During route discovery, the source node broadcasts a ROUTE REQUEST packet that is broadcasted throughout the network.

The on-demand protocols, multipath protocols have a relatively greater ability to reduce the route discovery frequency than single path protocols. On-demand multipath protocols discover multiple paths between the source and the destination in single route discovery. So, new route discovery is needed only when all these paths fail. Routing done by using the AOMDV routing protocol.

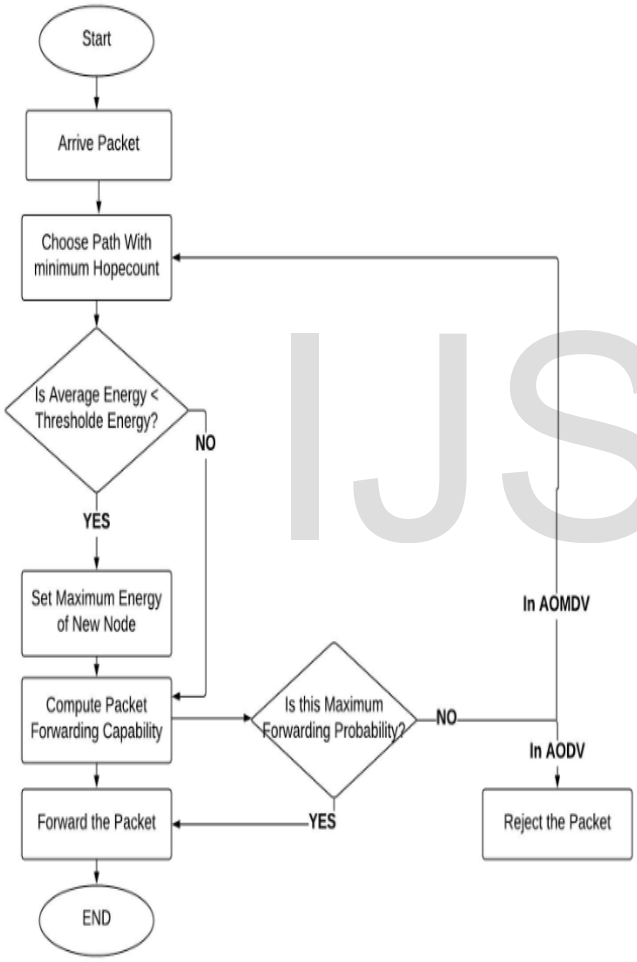

Figure 1: Comparative Performance Flowchart showing AOMDV Outperforms AODV

4 Simulation Model And Result

As real-world implementation of wireless ad-hoc networks hard so we preferred alternative is to use some simulation software which can mimic real-life scenarios. Though it is difficult to reproduce all the real-life factors such as air flow, humidity in the scenarios generated, most of the characteristics can be programmed into the scenario. This research make use of ns-2.34 which has support for simulating a multi-hop wireless ad-hoc environment completed with physical, data link layer models on ns-2.

4.1 Performance Evaluation and Movement Model

In the simulation, node movement is due to the random waypoint model. On the expiry of pause time, the node chooses a random destination in the 500m x 500m simulation space and moves there at a uniform speed. The source and destination pairs were spread randomly over the network. The results can then be analyzed using spreadsheets for plotting graphs. XGraph [3] or TraceGraph [4] are two possible tools that can be used to automate the data parsing but would require some technical proficiency to extract the data meaningfully.

Trace Files and Description

Snapshot and detailed discussion of a generated trace file for AOMDV are showing below:

```
s 1.000655000 _0_ MAC  --- 0 AOMDV 110 [0 ffffffff 0 800] ------- [0:255 -1:255 30 0] [0x2 0 1 [9 0] [0 4]] (REQUEST)
```

Figure 2: Snapshot of a row of AOMDV Trace File

Here, by analysis trace file row, required information has been extracted, the time required is 1.000655000, trace level is in MAC layer, AOMDV is the protocol type, 110 bytes is the byte size, source and destination address of MAC are 0 and ffffffff. IP trace information address is also here. 0 is IP source address and 255 is port number, 1 is destination address of IP and 255 is port number. By REQUEST in right that it is a route request address.

4.2 Results of Simulation

Simulation environments ran for 500sec with different scenarios and number of nodes varying in between 0 and 50. Packet delivery ratio, average end-to-end delay, energy consumed are calculated for AODV and AOMDV. The results found from simulation are sum up below with related graphs.

4.2.1 Packet Delivery Ratio

Packet delivery ratio is the ratio of delivery packets which is sent by the source node and received by the destination node. When the packet delivery ratio is high then performance is better.

Packet Delivery Ratio = (Total Received) * 100/ (Total Sent Packets)

From the following graph, it can be concluded that AOMDV has a better PDR as compared to AODV for each set of nodes.

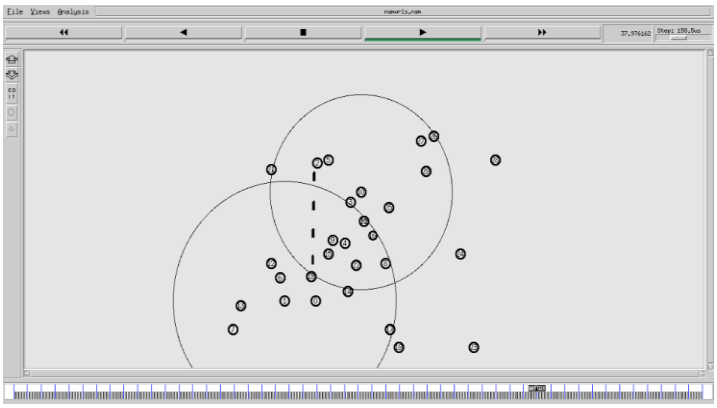

Figure 3: A snapshot of the simulation topology in NAM showing data received by node number 2 from node 18.

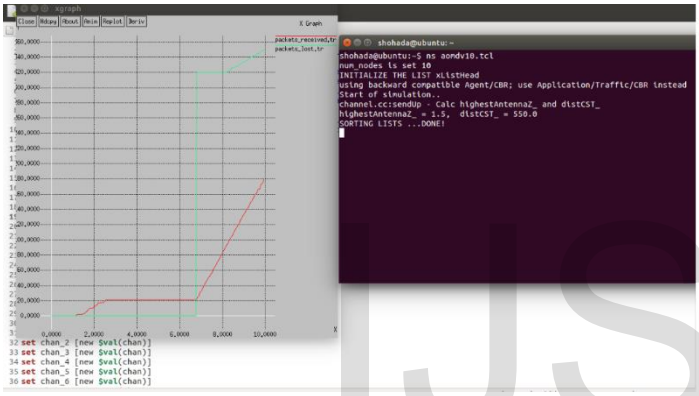

Figure 4: A Snapshot of running Xgraph for AOMDV Routing Protocol.

Here is a Xgraph for AOMDV routing protocol. Here two line graph of two color green and red showing packet received and packet lost in AOMDV routing protocol.

Avg. PDR / NO.Node	AOMDV	AODV
6 Nodes	48.78896	41.87954
10 Nodes	77.33809	62.14968
20 Nodes	87.56107	63.69324
30 Nodes	89.29508	65.06178
40 Nodes	92.69324	68.42639
50 Nodes	95.22234	71.42349

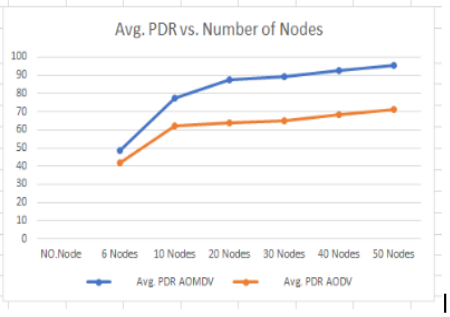

Figure 5: Comparison of AOMDV and AODV on basis of PDR Vs No. of Nodes

Here from the graph and table, it can be seen that average Packet delivery ratio is always higher for AOMDV than AODV whatever the number of nodes is. Different number of nodes have been considered there. 6, 10, 20, 30, 40, 50 nodes have been practically considered for simulation

A snapshot of 10 times simulation result for the packet delivery ratio of AODV and AOMDV is showing below:

PDR / NO.S	AOMDV	AODV
S1	84.30335	59.34744
S2	92.81961	66.54898
S3	92.6259	69.34629
S4	83.84477	63.91844
S5	79.94604	58.59031
S6	95.79982	70.22968
S7	91.28114	70.4163
S8	85.08535	63.19569
S9	75.54348	49.73357
S10	94.36123	65.60566
Average	87.56107	63.69324

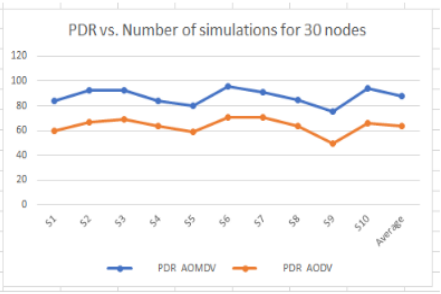

Figure 6: 10 times simulation result for packet delivery ratio of AODV and AOMDV

Here S1, S2, S3, S4, S5, S6, S7, S8, S9, S10 is the number of simulations. Blue color represents the packet delivery ratio for AOMDV, and orange color represent the packet delivery ratio for AODV protocol. Here for each simulation 30 nodes have been used. AOMDV has a better PDR value when compared to AODV for each set of connections. This is because in the time waiting at a node, AOMDV can find an alternate route if the current link has broken whereas AODV is rendered useless at that point.

4.2.2 Average End-to-End Delay of Data Packets

Time delay for data packets from the source node to the destination node is the End-to-end delay. When different number of nodes considered at different test and finally count the average then the average End-to-end delay can be found. It also includes all type of delay caused by the route discovery process and the queue in data packet transmission. Successfully delivered data packets to the destinations is only considered.

$$\sum (\text{arrive time} - \text{send time}) / \sum \text{Number of connections}$$

Better outcome of the protocol is considered when the end to end delay is lower. The simulation results are shown below in the form of graphs.

Delay / NO.Node	AOMDV	AODV
6 Nodes	0.1655186	1.7659693
10 Nodes	0.0802406	0.3505229
20 Nodes	0.051544	0.2157231
30 Nodes	0.0305228	0.1455185
40 Nodes	0.0123723	0.0932406
50 Nodes	0.0084515	0.062544

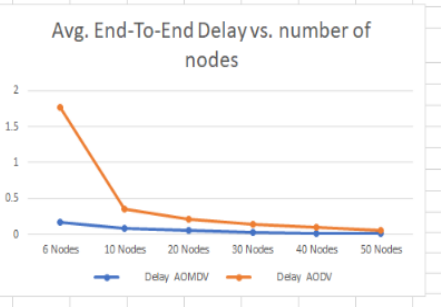

Figure 7: Comparison of AODV and AOMDV based on Average End-to-End delay of packets

Here from the graph and the table it can be seen that average

End-To-End delay is always higher for AOMDV than AODV whatever the number of nodes is. Different number of nodes have been considered there. 6, 10, 20, 30, 40, 50 nodes have been practically considered for simulation.

A snapshot of 10 times simulation result for End-to-End delay of AODV and AOMDV is showing below:

Delay / NO.S	AOMDV	AODV
S1	0.0534439	0.4152312
S2	0.0300265	0.0841574
S3	0.0346724	0.1993701
S4	0.0236965	0.1042744
S5	0.0768619	0.3994889
S6	0.0210313	0.0429777
S7	0.0247552	0.1164502
S8	0.0434733	0.3678275
S9	0.1607586	0.3314817
S10	0.0467206	0.095972
Average	0.051544	0.2157231

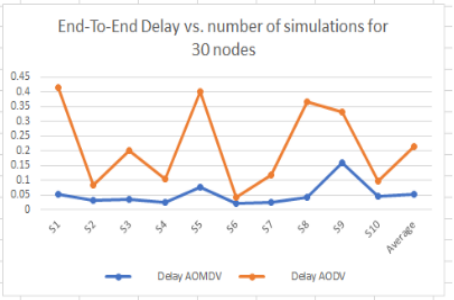

Figure 8: 10 times simulation result for End-to-End delay of AODV and AOMDV

Here S1, S2, S3, S4, S5, S6, S7, S8, S9, S10 is the number of simulations. Blue color represents the end to end delay for AOMDV and orange color represent the end to end delay for AODV protocol. Here for each simulation 30 nodes have been used.

4.2.3 Energy Consumed

The X-axis of the graph represents the number of connection and Y-axis represents the average delay. As the route discovery procedure of both the protocol id different since AODV is uni path routing protocol and AOMDV is multipath routing protocol. As AOMDV creates multiple paths and for this, it must maintain several tables to store route information thus AOMDV node uses more energy to find multiple paths between source and destination as compared to AODV.

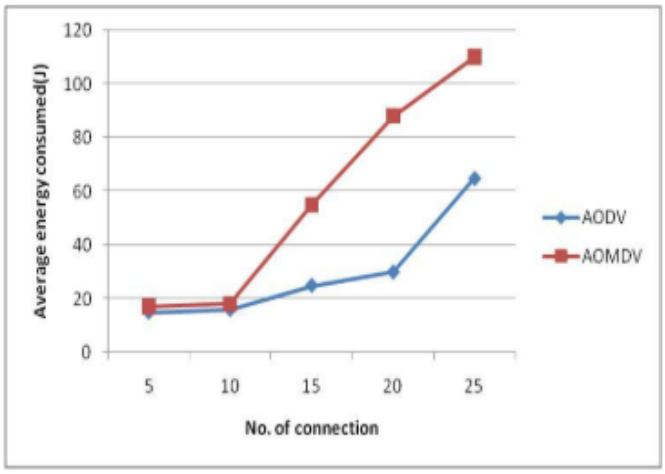

Figure 9: No. of connection vs Energy Consumed

5 Conclusion

This paper evaluated the performances of AODV and AOMDV using ns-2. For the simulation comparison feature considered are packet delivery ratio, average end-to-end delay and energy consumed, it can be concluded that AOMDV is better than AODV. For this analysis number of mobile nodes considered are 6, 10, 20, 30, 40, 50 mobile nodes, as as the number of the nodes increase, complexity also increases as well.

AOMDV performs better than AODV due to its ability to search for alternate paths when a current link breaks down. Though AOMDV incurs more routing overheads while flooding the network and packet delays due to its alternate route discovery mechanism, it is much more efficient when it comes to packet delivery for the same reason. Hence, in conclusion, we can say that when network load tolerance is of no consequence and energy consumed is not the concern, AOMDV is a better on-demand routing protocol than AODV since it provides better statistics for packet delivery and number of packets dropped.

References

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[2] Asis Nasipuri , Robert Castarida, Samir R. Das," Pe rformance of Multipath Routing for On- Demand Protocols in Mobile Ad Hoc Networks", Mobile Networks and App lications 6, 339–349, 2001 © 2001 Kluwer AcademicPublishers. Manufactured in The Netherlands.
[3] Hein, Carl, "XGRAPH General Purpose 2-D plotter", (2013).
[4] A4 50 pieces of Kokuyo S & T trace graph paper light-seasoned.