wjert, 2021, Vol. 7, Issue 3, 101-110. *Review Article* ISSN 2454-695X

World Journal of Engineering Research and Technology

WJERT

www.wjert.org

SJIF Impact Factor: 5.924

AD HOC ON DEMAND MULTIPATH DISTANCE VECTOR ROUTING IN AD HOC NETWORKS

K. Divya[1]* and Dr. B. Srinivasan[2]

[1]Ph.D Research Scholar, Department of Computer Science, Gobi Arts & Science College, Gobichettipalayam, India.

[2]Associate Professor, Gobi Arts & Science College, Gobichettipalayam, India.

Article Received on 11/03/2021 **Article Revised on 01/04/2021** **Article Accepted on 22/04/2021**

***Corresponding Author**

K. Divya

Ph.D Research Scholar, Department of Computer Science, Gobi Arts & Science College, Gobichettipalayam, India.

ABSTRACT

In this paper, AOMDV (Ad hoc on-demand distance vector) routing protocol has been analysed based on different performance parameters in different network scenarios. Performance parameters like normalized routing load (NRL), throughput, dropped packets, receiving packets, average delay. At different values of network connections, pause times, simulation times, and speed rates, we compared performance of AOMDV with AODV(Ad hoc on-demand distance vector), DSDV(Destination-Sequenced Distance Vector), and DSR(Dynamic Source Routing) routing protocols.

KEYWORDS: *E2E delay, throughput, Dropped packets, Network connections, Pause time*

1. INTRODUCTION

Mobile ad-hoc networks (MANETs) are the popular networks that are frequently used ad-hoc networks because of ease of installation and low cost. Routing in such types of networks is a big challenge. Because of nodes changes their position frequently. Also performance of various routing protocols during connection establishment is a big task. To reduce the packet loss and end-to-delay, several routing protocols like AODV have been enhanced. Similar type of modified extended version of AODV is AOMDV routing protocol which is a multi-route, disjoint path, and loop free protocol. AODV, DSR, and DSDV are three main routing protocols that are used in Mobile adhoc networks. All these have some features that vary depends on network conditions. Extended versions of these routing protocols have been proposed by several researchers.

AOMDV is the extended version of AODV. AODV is single path routing protocol while AOMDV is multi path routing protocol. Performance of AOMDV is evaluated in different network scenarios with several performance parameters. Some researcher analysed AOMDV with network size and speeds while others evaluated with various traffic rates and pause times. We can classified routing protocols in MANET based on routing information update. First reactive routing protocols like AODV, AOMDV, and DSR. These are on demand routing protocols. They do not main topology. Other category is proactive routing protocols like DSDV.

They are table driven routing based protocols. AODV and AOMDV routing protocols both are reactive routing protocols. Routing table in AODV and AOMDV are same, the main difference is that instead hop count, in AOMDV use advertisement hop count. During route discovery phase in AOMDV, it maintains multiple paths from source to destination.

In AODV, when destination receives same copy of two route request protocols(RREQ) from source to destination, only first route request(RREQ) will be entrainment, while other coming after will be dropped. AOMDV having two components.

- Maintaining multiple loop free paths for source to destination.
- Maintaining multiple link disjoint paths

2. Related Work

Route consumption time and route reconstruction time were considered as performance parameters. Updating of standby routes is completed using SFM (Speed Field Message) and SFMR (Speed Field Message Reply) messages. It is observed form simulation results that ANS-AOMDV performs best better as compared to AOMDV and MP-AOMDV routing protocols at high speed network environment.

Route discovery, route maintenance of AODV, DSR and AOMDV is also elaborated in detail. For simulation results, network simulator was used. CBR and TCP type of traffic was applied with maximum 50 network connections. Packet delivery ratio and throughput for

AOMDV was declared as best. DSR performs better with respect to end-to-end delay as compared to AODV and AOMDV routing protocols.

Here, the AOMDV routing protocol is enhanced with minor changes. Routes are decided on the basis of hop count and queue length. Route requests may be rejected depends on the length of queue. Proposed enhanced protocol AOMDV-LB (AOMDV-Load Balancing) is evaluated and compared with AOMDV using three performance metrics (packet loss rate, end-to-end delay, load distribution). For each route request, threshold value is calculated. AOMDV routing protocol for CBR and TCP traffic at various data packet generation rates. Several issues and challenges are also discussed with respect the quality of services. Using network simulator, network environment was produced for TCP and CBR traffics. AOMDV was compared with AODV at various packet generation rates with respect to average delay, route discovery frequency, routing overhead, throughput. It was concluded that AOMDV is consistent with TCP traffic at various data packet generation rates. But, its performance degrades for CBR traffic at various data packet rates.

It is extension of AODV routing protocol having multipath routing capability. AODV was discussed with its features and drawbacks. After that enhancement of AODV referred as AOMDV is discussed with its routing algorithmic steps. Route discovery, route maintenance for AOMDV was elaborated in detail. Performance evaluation and comparison work was carried out with several metrics like packet loss, route discovery latency, average delay, mean node speed. It was concluded that AOMDV having better performance at higher mobility environment. To reduce the drawback and to enhance the performance of AOMDV, NS-AOMDV (Node State based AOMDV) routing protocol is proposed on the basis of node state, routing paths are decided. Node state factor is calculated on the basis of residual energy rate, idle rate of buffer queue, and node weight. On The basis of path weight (PW) value, routes are decided for forwarding the packets. By varying the mobility and pause times, performance of AN-AOMDV was evaluated. It was concluded on the basis of simulation results that AN-AOMDV produces best results in higher mobility and pause times network scenarios.

Several parameters like throughput, packet delivery ratio, packet dropped, normalized routing load, end-to-end delay were used for performance evaluation. Simulation work was performed on the platform of network simulator. This paper concluded that at higher pause times, throughput of AOMDV is higher than AODV routing protocol. Packet dropped rate for

AODV is higher at higher pause times. End-to-end delay for AOMDV is less at all levels of pause times.

3. Ad Hoc On Demand Multipath Distance Vector Routing

We assume that every node has a unique identifier (UID) (e.g., IP address), a typical assumption with ad hoc routing protocols. For simplicity, we also assume that all links are bidirectional, that is, a link exists between a node i to j if and only if there is a link from j to i. AOMDV can be applied even in the presence of unidirectional links with additional techniques to help discover bidirectional paths in such scenarios.

3.1 Protocol Overview

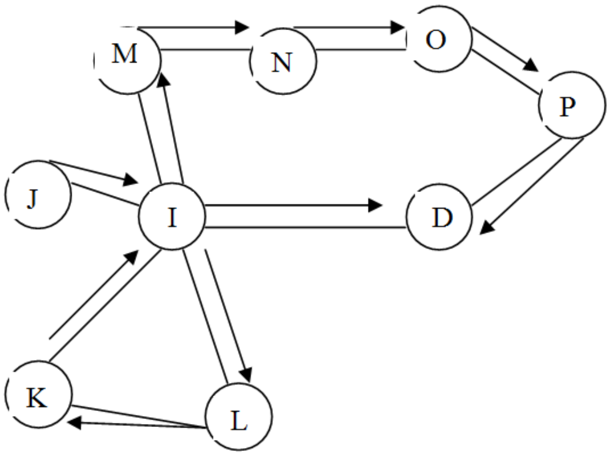
AOMDV shares several characteristics with AODV. It is based on the distance vector concept and uses hop-by-hop routing approach. Moreover, AOMDV also finds routes on demand using a route discovery procedure. The main difference lies in the number of routes found in each route discovery. In AOMDV, RREQ propagation from the source towards the destination establishes multiple reverse paths both at intermediate nodes as well as the destination. Multiple RREPs traverse these reverse paths back to form multiple forward paths to the destination at the source and intermediate nodes.

The core of the AOMDV protocol lies in ensuring that multiple paths discovered are loop-free and disjoint, and in efficiently finding such paths using a flood-based route discovery. AOMDV route update rules, applied locally at each node, play a key role in maintaining loop-freedom and disjointness properties. AOMDV relies as much as possible on the routing information already available in the underlying AODV protocol, thereby limiting the overhead incurred in discovering multiple paths. In particular, it does not employ any special control packets. In fact, extra RREPs and RERRs for multipath discovery and maintenance along with a few extra fields in routing control packets (i.e., RREQs, RREPs, and RERRs) constitute the only additional overhead in AOMDV relative to AODV.

3.1.1 Loop Freedom

AODV route update rules (Figure 1) limit a node to have at most one path per destination. Therefore, modifications to these route update rules are needed to have more than one path per destination at a node. These modifications, however, should be done in such a way that loop freedom is not compromised. Two issues arise when computing multiple loop-free paths at a node for a destination.

node D is the destination and node I has two paths to D—a five hop path via node M (I – M – N – O – P – D), and a direct one hop path (I – D). Suppose that I advertises the path I – M – N – O – P – D to node J and then the path I – D to node K. Then both J and K have a path to D through I, but each of them has a different hop count. Later, if I obtains a four hop path to D from L (L – K – I – D), I cannot determine whether L is upstream or downstream to itself, as only the hop count information is included in the route advertisements.



Examples of Potential routing loop scenarios with multiple paths.

3.1.2 Disjoint Paths

For our purpose of improving fault tolerance using multiple paths, disjoint paths are a natural choice for selecting an effective subset of alternate paths from a potentially large set because the likelihood of their correlated and simultaneous failure is smaller compared to overlapping alternate paths. We consider two types of disjoint paths: link disjoint and node disjoint. Link disjoint set of paths between a pair of nodes have no common links, whereas node disjointness additionally precludes common intermediate nodes.

In finding disjoint paths, we do not explicitly optimize either cardinality or length of alternate paths. In fact, while describing the detailed protocol operation, the number and quality of disjoint paths discovered by AOMDV is largely determined by the dynamics of the route discovery process; however, it is possible to control these attributes by placing a limit on number and length of alternate paths maintained at each node.

In distributed routing algorithms of the distance vector type, a node forms paths to a destination incrementally based on paths obtained from downstream neighbors towards the destination. So finding a set of link disjoint paths at a node can be seen as a two step process.

- Identifying a set of downstream neighbors having mutually link disjoint paths to the destination;
- Forming exactly one path via each of those downstream neighbors.

Note that the second step is trivial—the node simply needs to ensure that every path has a unique next hop, which is a purely local operation. However, performing the first step requires knowledge of some or all downstream nodes on each path. In a typical distance vector protocol (including AODV), a node only keeps track of the next hop and distance via the next hop for each path. This limited one hop information is insufficient for a node to ascertain whether two paths obtained from two distinct neighbors are indeed link disjoint. As one possibility, every node could maintain complete path information for every path as with source routing. In such a case, checking link disjointness becomes straightforward.

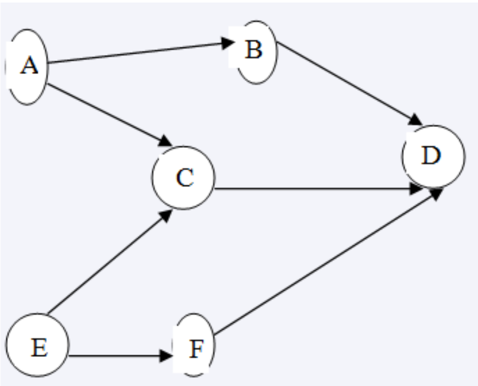


Figure 1: Disjoint Paths.

3.2 Performance Evaluation

Our main objective is to evaluate the effectiveness of AOMDV relative to AODV in the presence of mobility-related route failures. Other objectives include: understanding the effect of traffic pattern on the benefit of multiple paths, and evaluating the number of alternate disjoint paths that can be found using AOMDV.

3.2.1 Simulation Environment

The AODV model in our simulations is based on a recent protocol specification. We developed the AOMDV simulation model. In our simulations, we disable the expanding ring search when doing route discovery in both the protocols. This is done to simplify the analysis of simulation results. Note that the expanding ring search technique is complementary to the multipath technique we develop here, and so can be used with either protocol for containing the route discovery flood. Link breaks are detected using HELLO messages as well as the 802.11 link layer feedback mechanism, whichever detects the link break earlier. Failure to receive a HELLO message from a neighbor for some period of time signals loss the link to that neighbor. The 802.11 MAC layer reports a link failure when it fails to receive CTS after several RTS attempts, or to receive ACK after several retransmissions of data.

3.2.2 Performance Metrics

We primarily consider the following four performance metrics.

- Packet loss percentage—percentage of data packets dropped in the network either at the source or at intermediate nodes;
- Average end-to-end delay of data packets—this includes all possible delays caused by buffering during route discovery, queuing delay at the network interface, retransmission delays at the MAC, propagation and transfer times;
- Route discovery frequency—the aggregate number of route requests generated by all sources per second;
- Routing overhead—the total number of routing packets 'transmitted' per second. Each hop-wise transmission of a routing packet is counted as one transmission.

4 Simulation Results

4.1.1 Varying Mobility

AOMDV in the plots refers to the link disjoint version of the protocol. We also experimented with the node disjoint version, but the results look similar to the link disjoint version. We believe this is because of our decision to use alternate paths one at a time. When multiple paths are used simultaneously, these two variations may perform differently. We only show results for the link disjoint version in this paper unless mentioned otherwise. Furthermore, we restrict the number of paths per routing table entry to three and ignore alternate paths which are more than one hop longer than the shortest available path.

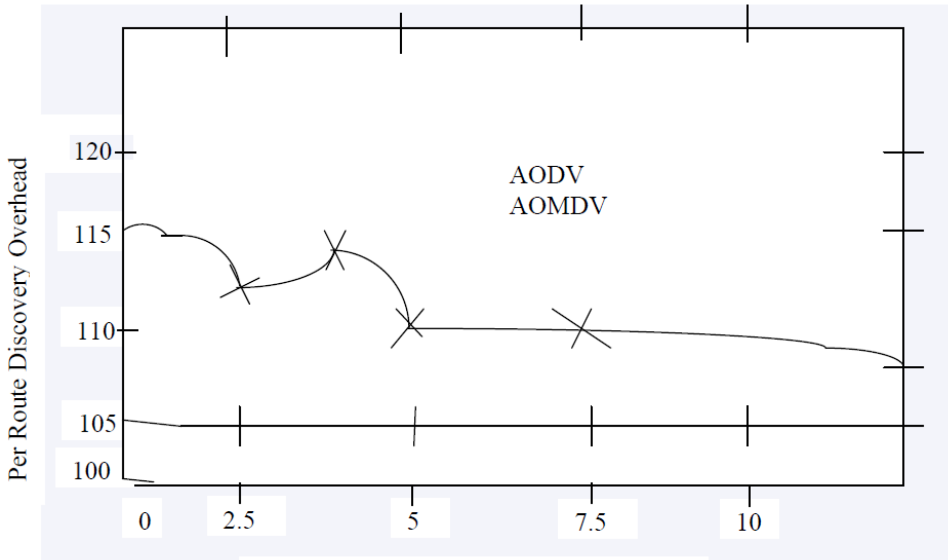


Figure 2: Mean Node Speed.

4.1.2 Varying Connections

For a constant rate of link failures (because of constant mean speed) and constant offered load, increasing the number of connections will spread the same amount of traffic among several connections. This requires a routing protocol to maintain routes between more number of source-destination pairs, thus stressing the protocol. Moreover, each route discovery will become more expensive because of the smaller amount of traffic over each connection. The performance of both protocols degrades with increasing number of connections. With smaller number of connections, the difference between AODV and AOMDV is not very noticeable. However, with increase in the number of connections, AOMDV tends to perform much better relatively.

4.1.3 Varying Packet rate

Performance degrades in both cases with increasing packet rate (offered load) and AOMDV always does better in comparison. With very low packet rates, a new route discovery is needed for almost every data packet that is generated because previously discovered routes will likely break by the time next data packet arrives at the source. This is evident from the higher route discovery frequency and routing overhead at the lowest packet rate (0.25 packets/s). AOMDV is not very effective in such scenarios because there are not enough packets to take advantage of alternate paths before they break.

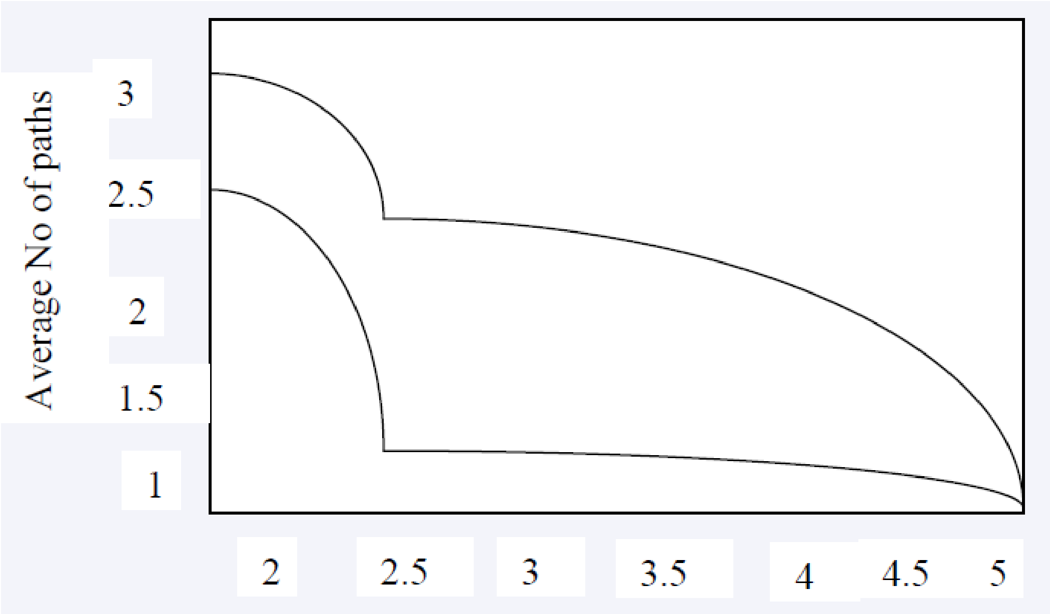


Figure 3: Shortest path length.

5. CONCLUSION

In this paper, we have proposed an on-demand multipath protocol called AOMDV that extends the single path AODV protocol to compute multiple paths. AOMDV ensures that the set of multiple paths are loop-free and the alternate paths at every node are disjoint. Other novel features of AOMDV include: low inter-nodal coordination overheads, ability to discover disjoint paths without using source routing, minimal additional overhead over AODV to obtain alternate paths.

Even though this work mainly concentrated on developing a multipath extension to the AODV protocol, some of the ideas in this paper can be readily applied to other ad hoc routing protocols. For instance, we can easily modify the DSDV protocol to maintain multiple loop-free paths using the advertised hop count concept. Several additional issues related to the design and evaluation of the AOMDV protocol require further investigation. First, the protocol can be improved to effectively deal with the route cutoff problem, and compute more disjoint paths when source-destination pairs are far apart. Second, we need to carefully study the interaction between timeout settings and AOMDV performance. Third, applying AOMDV for other purposes such as load balancing is another issue for future work. Lastly, we only evaluated AOMDV relative to AODV using random way point mobility model and CBR/UDP traffic. It is useful to see how improvements vary with other mobility models (more generally other failure models), other traffic types such as TCP and in comparison with other multipath protocols.

REFERENCES

1. Perkins CE, Royer EM, Das SR, Marina MK,(2001)" *Performance comparison of two on-demand routing protocols for ad hoc networks"*, IEEE Personal Communications.
2. Roy S, Saha D, Bandyopadhyay S, Ueda T, Tanaka S,(2003) " *A network-aware MAC and routing protocol for effective load balancing in ad hoc wireless networks",* In Proceedings of ACM MobiHoc.
3. Samar P, Wicker SB,(2004) "*On the behavior of communication links of a node in a multi*-hop *mobile environment*", In Proceedings of ACM MobiHoc.
4. B. Malany, A. Sarma, V.R. Dhulipala and R.M.Chandrasekaran, (2009) "*Throughput and Delay Comparison of MANET Routing Protocols*", International Journal of Open Problems Compt. Math, 2(3).
5. P. Arivubrakan and V.R Dhulipala, (2012) "*QoS Enhancement by varying Transmission Range in Wireless Ad- hoc Networks*", International Journal of Computer Applications (0975 – 8887), 37(9).
6. R.K. Gujral and M. Singh, (2011) "*Performance Analysis of Ad hoc Routing Protocols for Voice Communication Support over Hybrid MANETs*", International Journal of Computer Applications(IJCA), 22(3).
7. J. Gomez, (2002) "*Energy-Efficient Routing and Control Mechanisms for Wireless Ad Hoc Networks* ", Ph.D. Thesis, Columbia University, New York.
8. G. Rajagopal, K. Manikandan, and N. Sivakumar, (2011)"*QoS Routing using Energy Parameter in Mobile Ad Hoc Network*", International Journal of Computer Applications, (0975 – 8887) Volume 22 – No.4.
9. N. Humaira and D.S. Rao, (2011) "*Energy Aware QoS on-demand Routing Protocols for MANETs*", International Journal of Computer Applications (0975 – 8887), Volume 23 No.8.
10. Ye Z, Krishnamurthy SV, Tripathi SK,(2003)" *A framework for reliable routing in mobile ad hoc networks*", In Proceedings of IEEE Info com, 2003.