ISSN: 2319-5967
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 1, Issue 1, September 2012

Analysis of DHT Based Multi-Path Routing Protocol with Other Routing Protocols in MANETS

Avinash Giri, Jitendra Prithviraj, Ashok Verma
M.Tech. Student, Assistant Professor, Associate Professor
Gyan Ganga Institute of Tech. & Sc. Jabalpur, India
avinashgiri.20@gmail.com, J.prithviraj1@gmail.com, ashokverma@ggits.org

***Abstract:** A Mobile Ad-hoc Network (MANET) is a dynamic wireless network that can be formed without the need for any pre-existing infrastructure in which each node can act as a router. One of the main challenges of MANET is the design of robust routing algorithms that adapt to the frequent and randomly changing network topology. A variety of routing protocols have been proposed and several of them have been extensively simulated or implemented as well. In this paper, we compare and evaluate the performance of two types of On demand routing protocols- Ad-hoc On-demand Distance Vector (AODV) routing protocol, which is unipath and Adhoc On-demand Multipath Distance Vector (AOMDV) routing protocol and MDART (Multipath Dynamic Address Routing) which is a DHT (Distributed Hash Table)based multipath protocol. In this paper we note that on comparing the performance of AODV, AOMDV and MDART, MDART incurs a better efficiency when it comes to throughput, end to end delay, packet delivery, Packet Loss, Hop count.*

Keywords: MANET, Unipath, Multipath Routing, AOMDV, MDART, AODV, CBR, Scenario, Patterns, NS2.

I. INTRODUCTION

A mobile ad-hoc network or MANET is a collection of mobile nodes sharing a wireless channel without any centralized control or established communication backbone. They have no fixed routers with all nodes capable of movement and arbitrarily dynamic. These nodes can act as both end systems and routers at the same time. When acting as routers, they discover and maintain routes to other nodes in the network. 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 [1]. 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.

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

AODV is a reactive protocol that discovers routes on an as needed basis using a route discovery mechanism. It uses traditional routing tables with one entry per destination. Without using source routing, AODV relies on its routing table entries to propagate an RREP (Route Reply) back to the source and also to route data packets to the destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops [1]. All routing packets carry these sequence numbers. AODV maintains timer-based states in each node, for utilization of individual routing table entries, whereby older unused entries are removed from the table.

Predecessor node sets are maintained for each routing table entry, indicating the neighboring nodes sets which use that entry to route packets. These nodes are notified with RERR (Route Error) packets when the next-hop link breaks. This packet gets forwarded by each predecessor node to its predecessors, effectively erasing all routes using the broken link. Route error propagation in AODV can be visualized conceptually as a tree whose root is the node at the point of failure and all sources using the failed link as the leaves [1]. The advantages of AODV are that less memory space is required as information of only active routes are maintained, in turn increasing the performance, while the disadvantage is that this protocol is not scalable and in large networks it does not perform well and does not support asymmetric links.

B. Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV)

To eliminate the occurrence of frequent link failures and route breaks in highly dynamic ad hoc networks, AOMDV has been developed from a unipath path on Demand routing protocol AODV. The AOMDV [2,3] protocol finds multiple paths and this involves two stages which are as follows: i) A route update rule establishes and maintains multiple loop-free paths at each node, and ii) A distributed protocol finds link-disjoint paths. The AOMDV protocol finds node-disjoint or link-disjoint routes between source and destination. Link failures may occur because of node mobility, node failures, congestion in traffic, packet collisions, and so on. For finding node-disjoint routes, each node does not immediately reject duplicate RREQs. A node-disjoint path is obtained by each RREQ, arriving from different neighbor of the source because nodes cannot broadcast duplicate RREQs. Any two RREQs arriving at an intermediate node through a different neighbor of the source could not have traversed the same node. To get multiple link-disjoint routes, the destination sends RREP to duplicate RREQs regardless of their first hop. For ensuring link-disjointness in the first hop of the RREP, the destination only replies to RREQs arriving through unique neighbors. The RREPs follow the reverse paths, which are node-disjoint and thus link-disjoint after the first hop. Each RREP intersects at an intermediate node and also takes a different reverse path to the source to ensure link-disjointness.

C. Multipath Dynamic Address Routing (MDART)

The protocol, namely the multi-path dynamic address routing (M-DART), is based on a prominent DHT-based shortest-path routing protocol known as DART [4,5]. M-DART extends the DART protocol to discover multiple routes between the source and the destination. In such a way, M-DART is able to improve the tolerance of a tree-based address space against mobility as well as channel impairments. Moreover, the multi-path feature also improves the performances in case of static topologies thanks to the route diversity. M-DART has two novel aspects compared to other multi-path routing protocols [6--7]. First, the redundant routes discovered by M-DART are guaranteed to be communication-free and coordination-free, i.e., their discovering and announcing though the network does not require any additional communication or coordination overhead. Second, M-DART discovers all the available redundant paths between source and destination, not just a limited number.

II. OVERVIEW OF MULTIPATH PROTOCOLS IN TERMS OF DYNAMIC ADDRESSING AND DHT

Dynamic Addressing [8] separates the routing address and the identity of a node. The routing address of a node is dynamic and changes with movement of the node to reflect the node's location in the network topology.

A. MDART

1. Address Space

The network addresses are strings of l bits, thus the address space structure can be represented as a complete binary tree of l + 1 levels, that is a binary tree in which every vertex has zero or two children and all leaves are at the same level (Figure 1a). In the tree structure, each leaf is associated with a network address, and an inner vertex of level k, namely a level-k subtree, represents a set of leaves (that is a set of network addresses) sharing an address prefix of l – k bits. For example, with reference to Figure 1a, the vertex with the label 01X is a level-1 subtree and represents the leaves 010 and 011. Let us define level-k sibling of a leaf as the level-k subtree which shares the same parent with the level-k subtree the leaf belongs to. Therefore, each address has l siblings at all and each other address belongs to one and only one of these siblings. Referring to the previous example, the vertex with the label1XXis the level-2 sibling of the address 000 and the address 100 belongs only to this sibling. In Figure 1b, the address space is alternatively represented as an overlay network built upon the underlying physical topology. Its tree-based structure offers simple and manageable procedures for address allocation, avoiding to rely on inefficient mechanisms like flooding.

2. Route Discovery and Packet Forwarding

Each node maintains a routing table composed by l sections, one for each sibling, and the kth section stores the path toward a node belonging to the level-k sibling. Each section stores five fields: the sibling to which the entry refers to, the next hop, the cost needed to reach a node belonging to that sibling using the next hop as forwarder, the network id used for address validation, and the route log used by the loop avoidance mechanism.. The table has three sections: the first stores the best route, according to a certain metric, toward the node 001, the second toward a node belonging to the sibling 01X, and the last toward nodes belonging to the sibling 1XX.The routing state information maintained by each node is kept consistent through the network by means of periodic routing updates exchanged by neighbor nodes. Each routing update stores l entries, and each entry is composed by four fields: the sibling id, the network addresses. To route a packet, a node compares its network address with the destination one, one bit at a time starting with the most significant (left-side) bit, say the l th. If the I th bit is different, the node forwards the packet towards one the route stored in the I th section. With reference to the previous example, if the node 000 has to send a packet to the node with the address 101, then it will forward the packet to the next hop stored in the third section (i.e., the node 010).

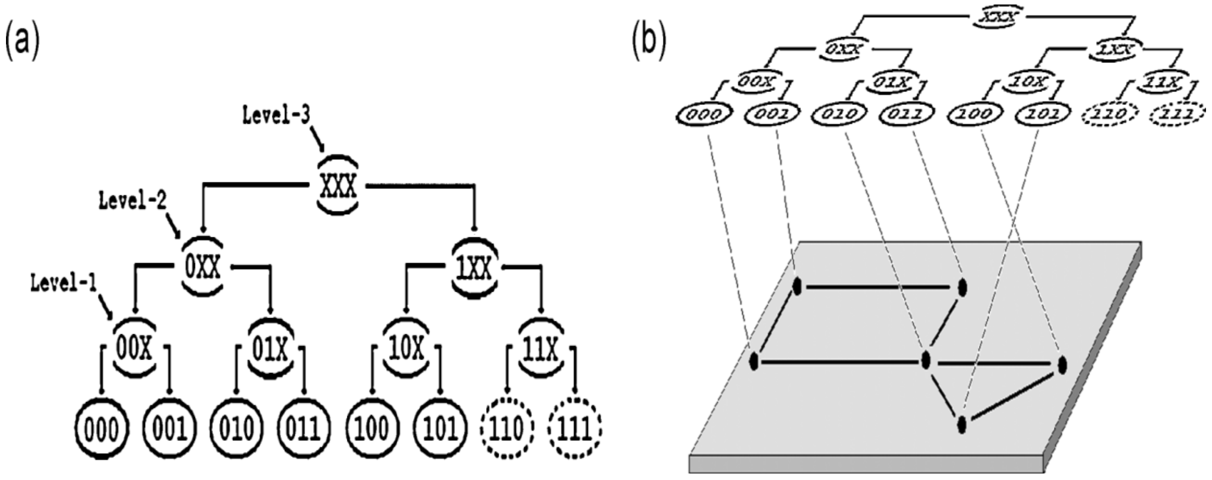
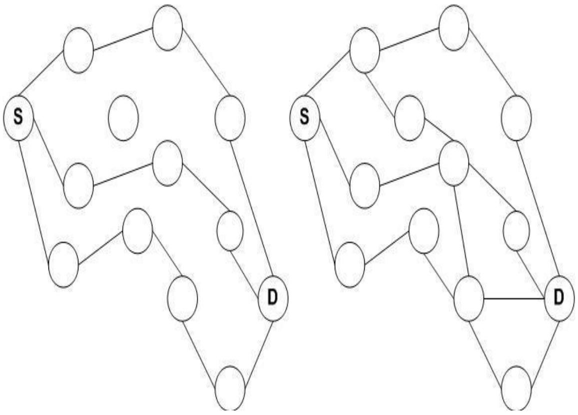


Fig 1. Relationship between the Address Space Overlay and the Physical Topology

B. AOMDV

AOMDV [2], [3] is a multi-path routing protocol. It is an extension to AODV and also provides two main services i.e. route discovery and maintenance. Unlike AODV, every RREP is being considered by the source node and thus multiple paths can be discovered in one route discovery. Being the hop-by-hop routing protocol, the intermediate node can maintain multiple path entries in their respective routing table.hop. To discover distinct paths, AOMDV suppresses duplicate route requests (RREQs) at intermediate nodes. Such suppression comes in two different variations, resulting in either node (illustrated in Fig. 2 (a)) or link (illustrated in Fig. 2(b)) disjoint. AOMDV can be configured to either discover the link (no common link between any given pair of nodes) or node (in addition to link disjoint, common intermediate nodes are also excluded between any given pair of nodes) disjoints paths.

Disjoint alternate paths are a good choice than overlapping alternate paths, as the probability of their interrelated and concurrent failure is smaller. This property can be helpful in an adversarial environment where malicious activity can also cause additional link failure. Finding a disjoint path is quite straightforward in source routing (as every node maintain complete path information for every path), but hop-by-hop routing i.e. AOMDV is considered more efficient in terms of creating less overhead Number of paths in any given source and destination is directly proportional to the number of nodes in entire network. AOMDV works more efficiently in dense and heavy networks.



(a) Node Disjoint **(b) Link Disjoint**

Fig. 2 AOMDV Multi-path

III. SIMULATION PARAMETERS

The table below presents the parameters used in the Simulations that we can observe the parameters that Suffered variations and that stayed fixed during the simulations. The obtaining of the communication patterns and movement felt through the use of scripts in the distribution of network simulator 2(version 2.34). The simulator uses these patterns to vary the movement of nodes and communication between them.

Table1 Simulation Parameters

Parameter	Value
Simulator	NS2.34
Area	1000m x1000m
Number of Nodes	10,30,50,100,150.
Routing Protocols	AODV,AOMDV, MDART
Traffic Type	CBR
Simulation Time	100 sec

A. Average Throughput

As shown in Figure 3, for small number of nodes (<100) , the throughput of M-DART is very slightly better than AOMDV and AODV up to 50 nodes, but it starts to behave better beyond 50 nodes.

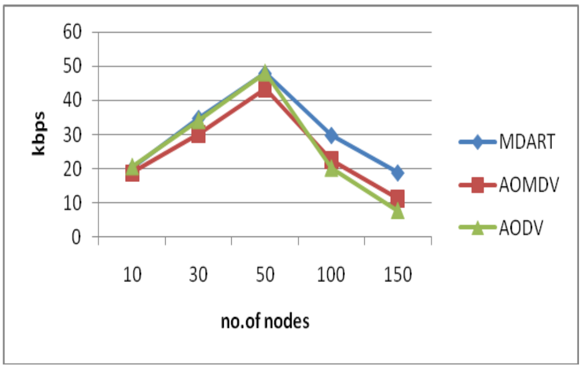


Fig.3 Throughput Vs Number Of Nodes

B. Packet Delivery Ratio (PDR)

Many protocols in MANETs use packet delivery ratio (PDR) as a metric to select the best route, transmission rate or power. As shown in Figure 4, M-DART has better throughput than both AOMDV and AODV as the number of nodes increases.

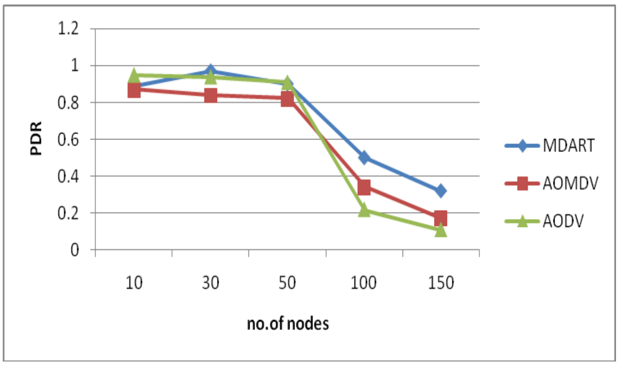


Fig. 4 PDR Vs Number Of Nodes

C. Average End to end delay

As shown in Figure 5, for small number of nodes, AOMDV and M-DART shows approximately same End to End Delay. As the number of nodes increases, End to End Delay of M-DART grows linearly, whereas AODV shows higher growth than both AOMDV and M-DART.

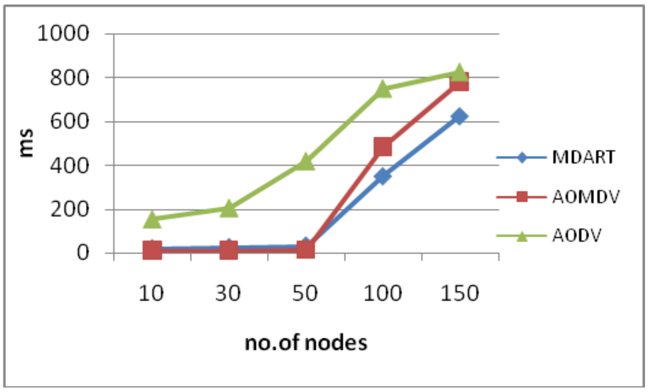


Fig.5 End To End Delay Vs Number Of Nodes

D. Packet Loss

Figure 6 shows the number of packet lost for MDART, AOMDV and AODV upto 150 nodes. We can see that for node >50 MDART has lesser number of packets lost as compared to AODV and AOMDV.

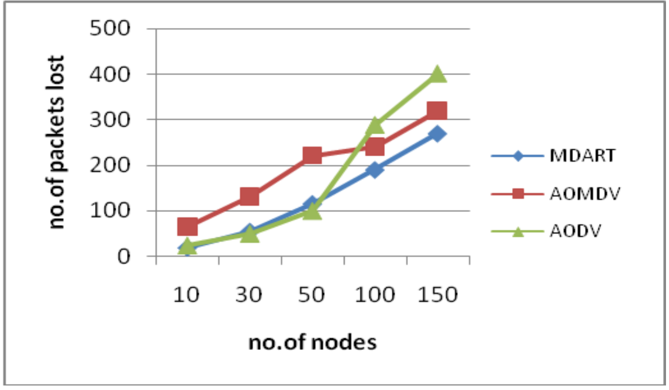


Fig.6 Packet Loss Vs Number Of Nodes

E. Average Hop count

From Fig. 7 we can analyze that the avg. hop count for MDART is lesser than AODV and AOMDV for nodes greater than 50.

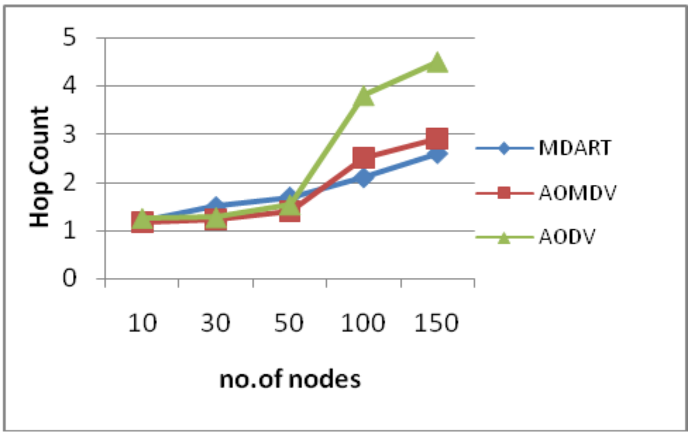


Fig. 7 Hop Count Vs Number of Nodes

V. CONCLUSION AND FUTURE WORK

From the above analysis we can conclude that Distributed Hash Table based multipath routing supports scalability in various wireless networks as M-DART is an efficient protocol which gives improved performance in large networks. We have also found that when number of nodes grows, the performance of other multipath and unipath routing protocols like AOMDV and AODV is not appropriate while M-DART is performing better in terms of Throughput, PDR, End to End Delay, Packet Loss and Hop Count. In future the work should be carried on some different traffic scenarios and others multipath protocols.

REFERENCES

[1] H.D.Trung,W.Benjapolakul,P.M.Duc,"Performance evaluation and comparison of different ad hoc routing protocols", Department of Electrical Engineering, Chulalongkorn University, Bangkok, Thailand, May 2007.

[2] V.C.Patil, Rajashree, V.Biradar, R.R. Mudholkar, S.R.Sawant, "On-Demand Multipath Routing Protocols for Mobile Ad Hoc Networks Issues and Comparison", International Journal of Wireless Communication and Simulation, 2010,Vol. 2(1), pp. 21-38.

[3] R.L.Lagendijik, J.F.C.M.de Jongh, "Multipath Routing in Mobile Ad Hoc Networks", Traineeship Report, Version 1.2, TU-Delft/TNO, 2003.

[4] Caleffi, M., Ferraiuolo, G., and Paura, L., "Augmented Tree based Routing Protocol for Scalable Ad Hoc Networks", in MHWMN '07: Proceedings of the Third IEEE International Workshop on Heterogeneous Multi-Hop Wireless and Mobile Networks, 2007.

[5] Eriksson J, Faloutsos, M, Krishnamurthy, S.Dart: dynamic address routing for scalable ad hoc and mesh networks. IEEE/ACM Transactions on Networking 2007; **15**(1): 119–132.

[6] Du S, Khan A, Pal Chaudhuri S, et al. Safari: a self organizing, hierarchical architecture for scalable adhoc networking. Ad Hoc Networks 2008; **6**(4): 485–507.

[7] Nasipuri A, Castaneda R, Das SR. Performance of multipath routing for on-demand protocols in mobile ad hoc networks. Mobile Networks and Applications 2001; **6**(4):339–349.

[8] J. Eriksson, M. Faloutsos and S. Krishnamurthy. "DART: Dynamic Address Routing for Scalable Ad Hoc and Mesh Networks". in IEEE- ACM Transactions on Networking, vol. 15, no. 1, April 2007, pp. 119-132.