ISSN No. 0976-5697
Volume 4, No. 3, March 2013 (Special Issue)
International Journal of Advanced Research in Computer Science
RESEARCH PAPER
Available Online at www.ijarcs.info

Performance Evaluation of AODV and AOMDV Routing Protocols in MANET

Ms. V. A. Parekh
Computer Engineering Department
C. U. Shah College of Engineering and Technology
Gujarat Technological University
Wadhwancity, India
viral_ccet@yahoo.co.in

Dr. K. H. Wandra
Principal
C. U. Shah College of Engineering and Technology
Gujarat Technological University
Wadhwancity, India
khwandra@rediffmail.com

Abstract: Mobile Ad Hoc Network is a collection of autonomous mobile nodes which communicate through wireless medium with each other. In MANET the mobile nodes are self configuring and self organizing in nature. As MANET is an infrastructure less multi hop wireless network without the aid of any centralized administration, plays an important role in military and civilian applications. In MANET each node works as a host as well as a router to forward the packets from source to destination. Routing in MANET is very complex task as the network topology changes continually as nodes are mobile. Reactive routing protocols for ad hoc networks discover and maintain only the needed routes to reduce routing overhead. This paper evaluates the performance of two on-demand routing protocols - Ad hoc On-demand Distance Vector (AODV) which is unipath and multipath version of AODV called Ad hoc On-demand Multi-path Distance Vector (AOMDV) routing protocols. AOMDV discovers multiple paths in a single route discovery. Simulation is done in Network Simulator tool NS-2 for various performance metrics.

Keywords: MANET, NS-2, AODV, DSR, DSDV, AOMDV, ZRP, TORA, throughput, PDR, End-to-end delay

I. INTRODUCTION

Mobile Ad-hoc networks (MANETs) are infrastructure less networks as there is no existing infrastructure available. Currently Ad hoc networks are enjoying extraordinary research interest, and are expected to provide opportunities for utilization of network applications in new scenario in which today's internet-based communication paradigms are no longer applicable. Ad-hoc networks are formed in a situation where no infrastructure is available and having no central administration. For MANET no predetermined subnet structure is known. Ad hoc networks are considered to be composed of mobile wireless devices, so the interconnection pathways between the devices can change rapidly.

As in MANET each device is free to move independently, links between the devices may change frequently. Routing is the process of forwarding the packets from source to the destination with efficient performance. As in MANET devices are moving frequently, routing is the most complex process. There are basically two types of traditional routing protocols: Link-State routing and Distance Vector routing protocols.

In either case, the routing protocols typically specify that each node makes periodic advertisements to supply current routing information to its neighbors. The neighbor is then able to determine routes to network nodes based on the received information. The node can also include the information it has received into its own advertisements, as essential according to the protocol. In the case of link-state protocols, the advertisements can have information about every known link between other routing agents in the network. On the other hand, Distance-vector protocols supply next-hop information about all destinations in the network. For Internet routing protocols, routing information is aggregated according to a well-defined subnet structure in order to reduce the size of the advertisements. Routes to all hosts on a particular subnet are represented by a single route entry to a routing prefix, and the addresses of all the hosts on the subnet are then required to use the routing prefix as the initial bits of their network-layer address. Subnets with longer prefixes (i.e., more specific addressing) are themselves typically aggregated into larger subnets with shorter prefixes. At the core (center) of the Internet, there is finally a requirement to advertise all of the routing prefixes with no further aggregation possible. The routers in the Internet (core and otherwise) are often considered to be the infrastructure of the Internet. Ad hoc network study has suggested that such periodic advertisements may be uneconomical because the presumptions about fixed relationships between hosts and subnets are not necessarily valid in these networks. There may not be any flat relationship between wireless, mobile devices and any distinguished routing node. There may not be any infrastructure, and hence ad hoc networks are often characterized to be infrastructure less networks. Since the communication medium of interest is often wireless, it is matter to capacity constraints, and is less appropriate for periodic advertisements containing volumes of routing data.

Two techniques for solving this problem are 1) to limit the amount of information advertised and 2) to establish routes only on demand so that periodic advertisements are no longer required. Though, such on-demand routing protocols have the disadvantage that routes are often unavailable at the time an application first needs them. This means that applications in networks using such routing protocols often experience initial delay during the time it takes to establish a route between the communication endpoints.

CONFERENCE PAPER
II International Conference on
"Advance Computing and Creating Entrepreneurs (ACCE2013)"
On 19-20 Feb 2013
Organized by
2nd SIG-WNs, Div IV & Udaipur Chapter , CSI , IEEE Computer Society Chapter India Council ,
IEEE Student Chapter Geetanjali Institute of Technical Studies, Udaipur, Rajasthan, India

II. ROUTING PROTOCOLS

Mainly there are three types of routing protocols:

a. Proactive (Table-Driven)
b. Reactive (On-Demand)
c. Hybrid

Proactive routing protocols find paths for all source-destination pairs in advance and stores in the routing tables. Each node periodically exchanges the routing information by broadcasting. The protocols are also known as table-driven routing protocol. Destination-Sequenced Distance-Vector Routing (DSDV) is a proactive routing protocol.

Reactive routing protocols discover a path when a packet needs to be transmitted and no known path exists between source and destination. So the protocol is known as on-demand routing protocol. In case of routing failure occurs the protocol discovers an alternate path. Dynamic Source Routing (DSR) and Ad-hoc On-demand Distance Vector (AODV) routing protocol are the most popular routing protocols.

Hybrid routing protocols are the combination of proactive and reactive routing protocols. Hybrid routing protocol use the proactive as well as reactive routing protocols for route finding. For the route finding between two networks hybrid protocols are used. To find a route in the network proactive routing protocols are used when to find a route between two different networks reactive routing protocols are used (i.e. for short distance proactive routing protocols are used and for long distance reactive routing protocols are used). Zone Routing Protocol (ZRP) is an example of hybrid routing protocol.

All the above mentioned protocols are unipath routing protocols. Another kind of routing protocol is multipath routing protocols. The goal behind the design of multipath routing protocols is to provide efficient fault tolerance in the sense of faster and efficient recovery from route failures in dynamic networks [4]. To achieve this goal, Ad-hoc on-demand multipath distance vector (AOMDV) computes “multiple loop-free and link-disjoint paths.” The paper evaluates the performance of AODV and AOMDV in MANET.

A. Ad-hoc On-Demand Distance-Vector:

Ad-hoc On-demand Distance Vector (AODV) [1] routing protocol is the most popular reactive unicast routing protocol, essentially combination of DSDV and DSR. AODV uses mechanism of route maintenance from DSDV and route discovery from DSR. AODV was first proposed in an Internet engineering task force (IETF) Internet draft in fall of 1997. AODV was designed to meet the following goals: [2]

a. Minimal control overhead.
b. Minimal processing overhead.
c. Multi-hop path routing capability.
d. Dynamic topology maintenance.
e. Loop prevention.

Route Requests (RREQs), Route Replies (RREPs), Route Errors (RERRs) and Route Reply Acknowledgement (RREP-ACK) are message types defined by AODV [3]. Due to simple AODV messages require little computations to minimize processing overhead. AODV allows mobile nodes to find routes quickly for new destination, and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to react to link breakages and changes in network topology in a timely manner. When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. The operation of AODV is loop-free, and by avoiding the Bellman-Ford "counting to infinity" problem offers quick convergence when the ad-hoc network topology changes (typically, when a node moves in the network).

B. Ad-hoc On-Demand Multi-path Distance Vector (AOMDV):

Ad hoc On-demand Multipath Distance Vector (AOMDV) [4] is an extension to the AODV protocol for computing multiple loop-free and link-disjoint paths. The routing entries for each destination contain a list of the next-hops along with the corresponding hop counts to keep track of multiple routes. All the next hops have the same sequence number. A node maintains the advertised hop count for each destination, which is defined as the maximum hop count for all the paths. This is the hop count used for sending route advertisements of the destination. Each duplicate route advertisement received by a node defines an alternate path to the destination. To ensure loop freedom, a node only accepts an alternate path to the 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. When a route advertisement is received for a destination with a greater sequence number, the next hop list and advertised hop count are reinitialized. AOMDV 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 RREQ arriving via a different neighbor of the source defines a node-disjoint path.

This is because nodes cannot 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.

III. COMPARISON OF AODV AND AOMDV

For the comparison the simulation tool used is NS-2[6] which is highly preferred by research community.

Table 1: Simulation Parameters

Serial No.	Parameters	Value
1	Number of nodes	50
2	Simulation Time	200sec.
3	Area	500*500m2
4	Max Speed	20 m/s
5	Traffic Source	CBR
6	Pause Time (sec)	0, 20, 10, 30 ,40, 100
7	Packet Size	512 Bytes
8	Packet Rate	4 Packets/s
9	Max. Number of connections	10,20,30,40
10	Bandwidth	10Mbps
11	Delay	10ms
12	Mobility model used	Random way point

The performance metrics that are taken into consideration for the comparison are:

a. Throughput (PDR)
b. Packets Dropped
c. Packet Delivery Ratio
d. End-to-end delay

A. Simulation Results : Effect of mobility:

The number of nodes is taken as 50 and the maximum number of connection as 20. For the analysis of the effect of mobility, pause time was varied from 0 seconds (high mobility) to 100 seconds (low mobility). Graphs shown in Fig (1-4) show the effect of Mobility for AODV and AOMDV protocols with respect to various performance metrics.

a. Pause Time Vs Throughput:

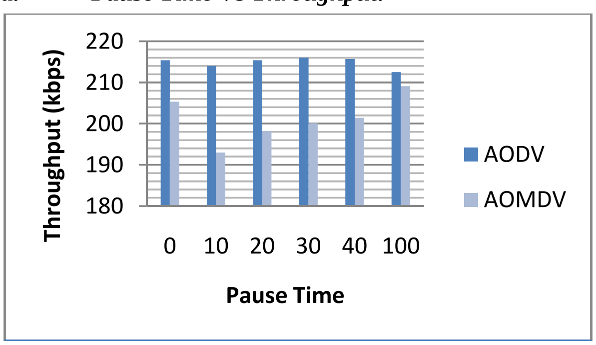

Figure. 1 Pause Time Vs Throughput

AODV provides better throughput than AOMDV at higher mobility. Due to high mobility in AOMDV fatal path entries may occur in routing table.

b. Pause Time Vs Packets Dropped:

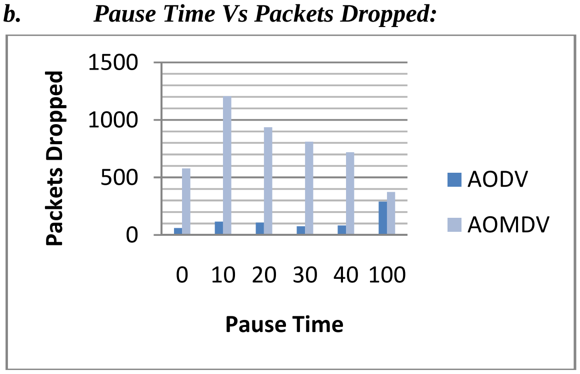

Figure. 2 Pause Time Vs Packets Dropped

In AOMDV more packets are dropped as compare to AODV.

c. Pause Time Vs Packet Delivery Ratio (PDR):

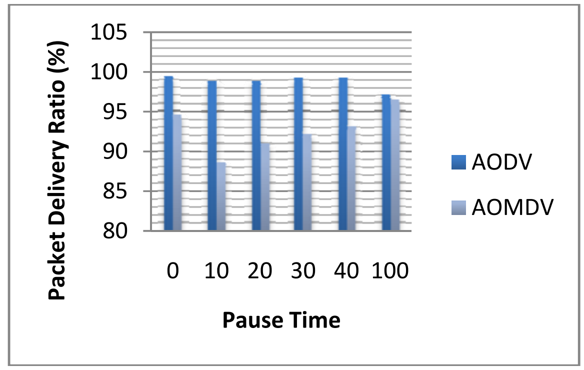

Figure. 3 Pause Time Vs PDR

Using AODV 99.38% PDR is obtained. The PDR of AOMDV is less as AOMDV incurs more routing overhead.

d. Pause Time Vs End-to-end Delay:

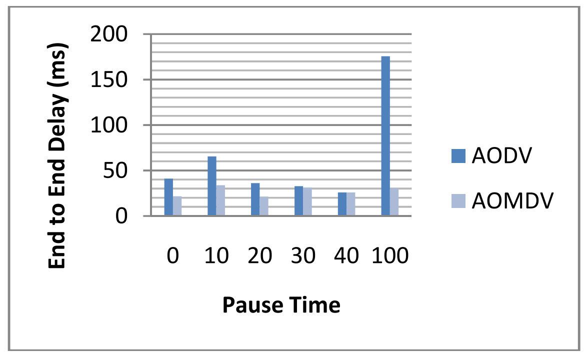

Figure. 4 Pause Time Vs End-to-end Delay

AOMDV protocol is designed to adopt multiple paths architecture of network, which is a step towards achieving a better QoS, and hence end to end delay involved in sending a data packets is less compared to AODV irrespective of variation in mobility.

B. Simulation Results: The effect of traffic load:

The network was simulated for high mobility scenario keeping the pause time 0 seconds. The number of connections was varied as 10, 20, 30 and 40 connections to study the effect of traffic load on the network. Graphs in Fig (5-8) show the effect Traffic Load for AODV and AOMDV protocols with respect to various performance metrics.

a. Max. Number of Connections Vs Throughput:

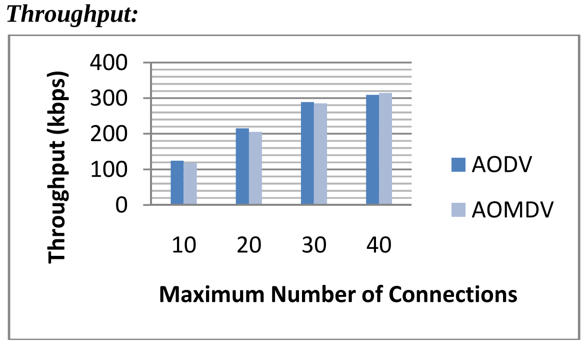

Figure. 5 Maximum Number of Connections Vs Throughput

When the traffic load increase AOMDV performs better than AODV. The reason is AOMDV always maintains multiple paths between source and destination; traffic gets distributed among the multiple paths to achieve load balancing and bandwidth aggregation.

b. Max. Number of Connections Vs Packets Dropped:

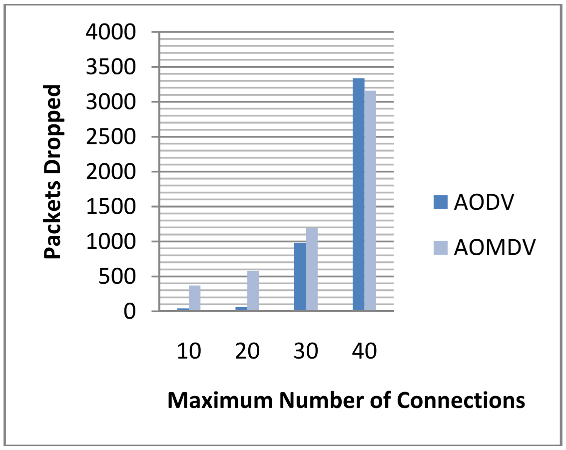

Figure. 6 Maximum Number of Connections Vs Packets Dropped

As the traffic load increases number of packets dropped in AOMDV is less. In AOMDV when one path fails, the data packets are sent by alternate path. If the traffic is too high, the data packets move in different paths for load balancing.

c. Max. Number of Connections Vs Packet Delivery Ratio (PDR):

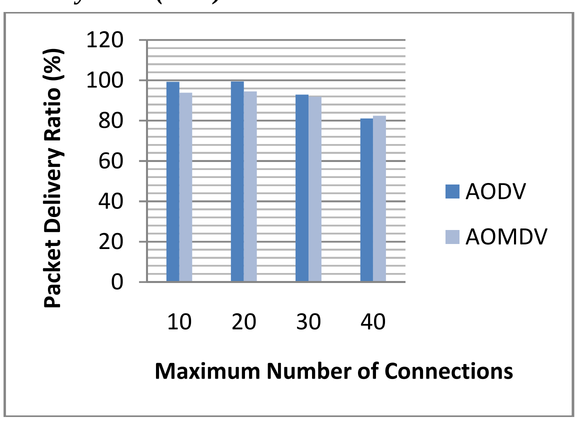

Figure. 7 Maximum Number of Connections Vs PDR

AOMDV delivers more packets at high traffic load compared to AODV. AOMDV supports load balancing and multiple paths to send a data packet to the destination. So AOMDV provides more packet delivery ratio compared to AODV at high traffic load.

d. Max. Number of Connections Vs End-to-end delay:

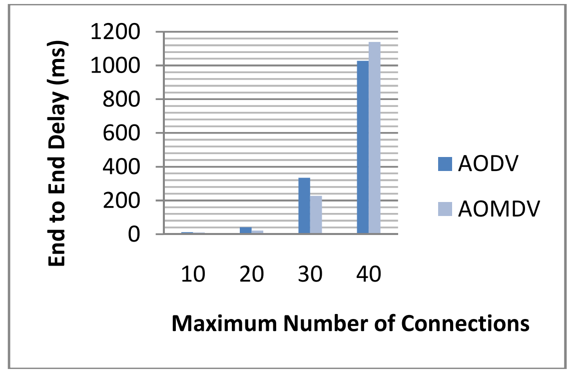

Figure. 8 Maximum Number of Connections Vs End-to-End Delay

IV. CONCLUSIONS AND FUTURE WORK

AOMDV stores multiple paths to the destination which provides better packet delivery ratio in case of high traffic load. AOMDV also supports load balancing in MANET by sending data to the destination through multiple paths. Delay for sending the data to the destination is also less in AOMDV. So AOMDV outperforms AODV routing protocol. So for the network with a better Quality of Service (QoS), AOMDV is the best choice. But for the network with less traffic AODV is the better choice. In future AOMDV can be modified to reduce routing overhead.

V. REFERENCES

[1]. Perkins, C. E. and Royer, E. M.; "Ad-hoc On-Demand Distance Vector Routing", Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications (WMCSA.99), New Orleans, LA, USA, February 1999, pages 90-100.

[2]. Elizabeth M. Belding-Royer, Charles E. Perkins, "Evolution and future directions of the ad hoc on-demand distance-vector routing protocol", 2003 Elsevier B.V, doi:10.1016/S1570-8705(03)00016-7.

[3]. "Mobile Ad Hoc Networking Working Group – AODV", http://www.ietf.org/rfc/rfc3561.txt

[4]. M.K. Marina and S.R. Das, "On-demand multipath distance vector routing in ad hoc networks", Proceedings of the 9th IEEE International Conference on Network Protocols (ICNP), 2001, pp.14–23.

[5]. Zygmunt J. Haas, Jing Deng, Ben Liang, Panagiotis Papadimitratos, and S. Sajama ,"Wireless Ad Hoc Networks" Cornell University School of Electrical and Computer Engineering.

[6]. Karthik sadasivam, "Tutorial for Simulation-based Performance Analysis of MANET Routing Protocols in ns-2"