Comparative Study of Unipath and Multipath Routing Protocols

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Abstract: ***An ad hoc wireless network can be described as collection of nodes that interact among themselves without any centralized authority. In an ad hoc network node movement results in dynamic topology and link failure. Thus, routing become a challenging task and many routing protocols have been proposed to overcome various challenges of routing in ad hoc networks. In this paper we compare AODV and AOMDV routing protocols. The AODV is a unipath routing protocol and AOMDV is a multipath version of AODV. In this article our objective is to analyze both the protocols under various scenarios and metrics with different parameters such as cbr rate, simulation time and packet size and show their effect on performance measures. Comparison between AODV and AOMDV is evaluated based on Packet Delivery Ratio, Throughput, Drop count and End-to-End Delay. All analysis is done using NS2 simulator.***

Keywords AODV, AOMDV, Routing

1. Introduction

Mobile ad hoc network (MANET), is an infrastructure less network and can configure itself on the fly. Because of its mobile nature MANETS nodes are allowed to move in any direction and are connected via wireless links. MANETs can be used in local area of wireless devices (such as a group of laptop computers), while others may be connected to the Internet. For example, VANET (Vehicular Ad Hoc Network) is a variation of MANET that allows vehicles to communicate with each other and also with on-road tools, for smart traffic management. Vehicles may not have a direct Internet connection, but the wireless on-road tools can be connected with the vehicle. The vehicle data may be used to analyze traffic conditions. Because of the dynamic nature of MANETs, they are not fully secure, so it is important to be cautious what data is sent over network. Further, MANETs are easily scalable due to which more stringent security measures are required.

This kind of network is useful in situation where ordinary wired networks are not feasible like battlefields, natural disasters etc. The nodes which are in the transmission range of one other may communicate directly or through intermediate nodes which are willing to forward packet hence these networks are also called as multi-hop networks.

MANET routing protocols fall into three categories that are reactive routing protocol, proactive routing protocols and hybrid routing protocol.

- **Pro-active Routing Protocol**- These routing protocols continuously control the traffic to set up the route. The route is maintained at all time in the network due to which the routes are available at every time.
- **Re-active Routing Protocol**- These routing protocols does not yield ingenuity for finding routes. They establish routes "on-demand" by flooding a query which may increase the network latency and results in initial delay in traffic.
- **Hybrid Routing Protocols**-These protocols are combination of both proactive and reactive routing protocol that were proposed to decrease the overhead caused by proactive routing protocols as well as reduce the latency caused by route discovery in reactive routing protocols.

A brief description of considered routing protocols is presented in section 2. Different scenarios, simulation parameters and simulation results are described in section 3. Results, discussions and analysis is given in section 4. Section 5 finally concludes the paper.

2. Routing Protocols

The following two routing protocols are considered in this paper:

Ad hoc On-demand Distance Vector (AODV)

Ad hoc On-Demand Distance Vector (Perkins & Royer 1999) is a reactive protocol which consists of two main phases i.e. route discovery and route maintenance.

Route Discovery

In AODV, a route is found between two nodes the route discovery process which is initiated when a node tries to communicate with another node and the required routing information is missing from its routing table. Firstly, a Route Request Packet (RREQ) is broadcasted to all the neighbors of the sender, then the RREQ is rebroadcasted by the receivers and repetition is avoided by discarding the any identical RREQs. The intermediate node generates a Route Reply (RREP) when a viable route to the destination is available, else the RREQ is rebroadcast. Corresponding copies of the RREQ packet received at any node are rejected. Finally, when the destination node receives a RREQ, it propagates a RREP, which eventually reaches the inventive sender through the reverse path links. The sender then proceeds with data transmission.

Route maintenance

A broken route is repaired using Route maintenance and also helps in finding a new one. The whole process is done using Route error (RERR) packets. When a link failure is detected (for example, by a link layer feedback), a RERR is sent back through separately maintained predecessor links to all sources using that failed link and also along its way routes are erased by the RER.

Ad hoc On-demand Multipath Distance Vector (AOMDV)
AOMDV is a multi-path extension of AODV, the representative multipath routing protocol which maintains a similar invariant as in AODV to eliminate any possibility of loops. Multipath routings provide load balancing by distributing traffic, fault tolerance between a set of disjoint paths and higher cumulative bandwidth

3. Parameters Used

In this paper, we consider following four performance metrics to compare AODV & AOMDV routing protocol

1) Throughput: The ratio of the total amount of information that a receiver receives from the sender to the time it takes for the receiver to receive the last packet.
2) Average end to end delay: this includes all possible delays caused by buffering during route discovery, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times[7].
3) Drop Count: Drop count occurs when one or more packets of data travelling across a computer network fail to reach their destination. Drop Count is typically caused by network congestion.
4) Packet Delivery Ratio: The packet delivery ratio or packet delivery fraction is the ratio of successfully delivered packets at the destination to the packets sent by the source[12].

Simulation Parameter Table
The simulation is done with the help pf NS-2 (V-2.35) network simulator. Here we used two different scenarios for our study. In the first case we changed the simulation time in second case we use different cbr rate and in third case we use variable packet size. The simulation parameters for all the cases are shown in the table below

Table 1: Simulation Parameters

Parameter	*Value*
MAC	802.11
Simulation time	60,80,100,120,150sec
Antenna	Omni antenna
Max connections	7
No: of nodes	100
Packet size	512,1024,2048,4096
Simulation area	1000*1000
Cbr rate	0.05,0.1,0.15,0.25,0.3,0.35,0.4

4. Results

Simulations were done by varying simulation time, cbr rate and with different packet size. In this number of the nodes are kept constant (100 nodes).

Table 2 (AODV and AOMDV)

	AODV
	AOMDV

I Throughput

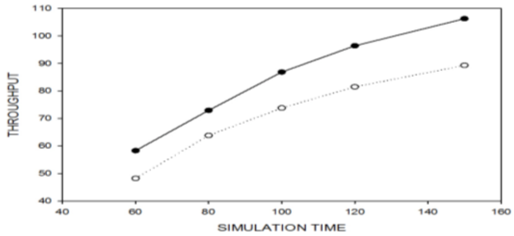

Figure 1: (Throughput Vs Sim. Time)

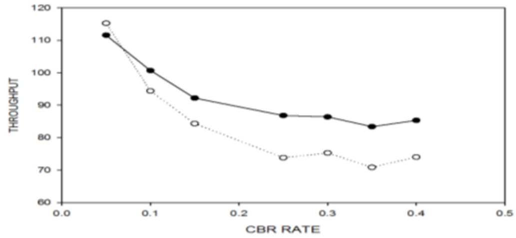

Figure 2: (Throughput Vs CBR)

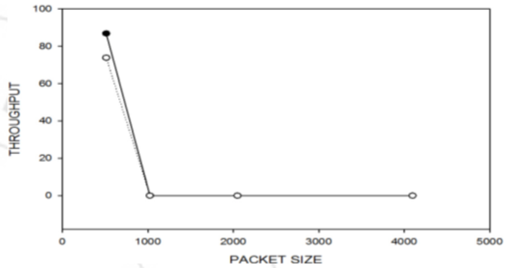

Figure 3: (Throughput Vs Packet size)

The graphs in Figure 1 to 3 shows variation in throughput of AODV and AOMDV routing protocols with different simulation time, cbr traffic and packet size. As shown clearly AODV performs better due to less congestion in the network. But when packet size is increased to 1024 and above the packet delivered in both AODV and AOMDV is zero

II Packet Delievery Fraction

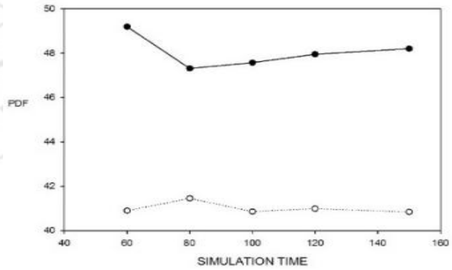

Figure 4: (PDF Vs Sim. Time)

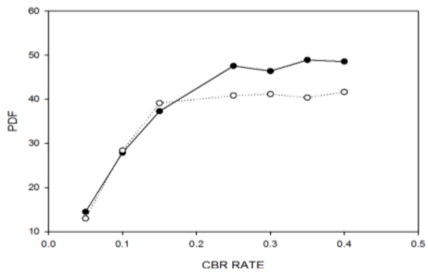

Figure 5: (PDF Vs CBR rate)

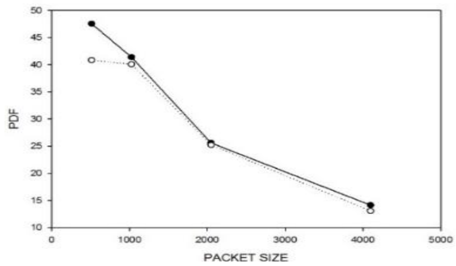

Figure 6: (PDF Vs Packet size)

Figure 4 to 6 shows the performance of AODV and AOMDV in terms of packet delivery fraction. Here, we can see that by performing the multiple paths between source and destination, the average packet loss of the network has been increased significantly compared to the conventional AODV routing protocol. This is because, when we are using multiple paths, the information's is transmitted to multiple paths between source and destination that leads to congestion and bottleneck. For instance at simulation time 120 the PDF for AODV is 47.095 and for AOMDV is 40.99.

III Delay

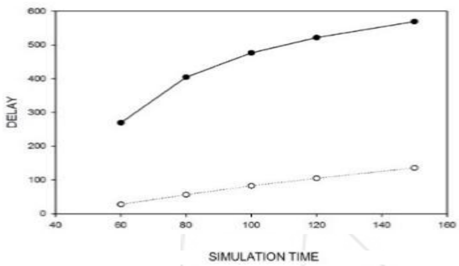

Figure 7: (Delay Vs Sim. Time)

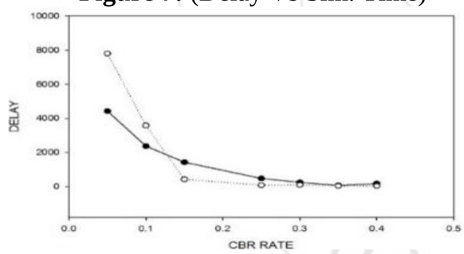

Figure 8: (Delay Vs CBR rate)

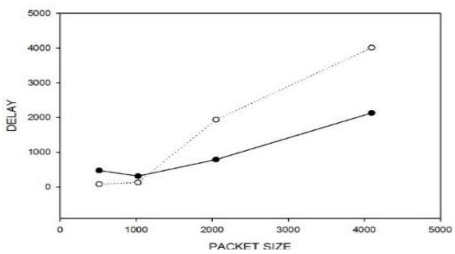

Figure 9: (Delay Vs Packet size)

Figure 7 to 9 shows delay, from the above graph in figure it is clearly visible that delay is high in AODV when simulation time is changed because of the multiple paths between source and destination. With variable cbr rate and packet size both AODV and AOMDV shows random behavior.

IV DROPCOUNT

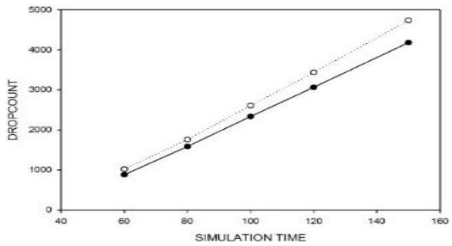

Figure 10: (Dropcount Vs Sim. Time)

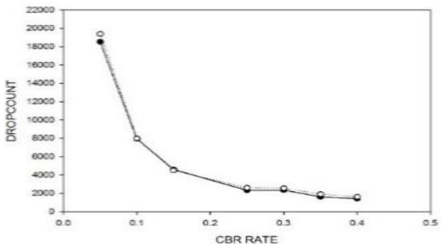

Figure 11:(Dropcount Vs CBR rate)

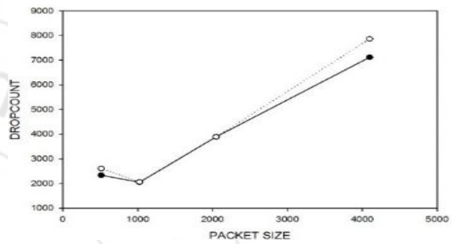

Figure 12: (Dropcount Vs Packet size)

Figure 10 to 12 shows the number of packets dropped in AODV are low in compared to AOMDV. With increasing pause time packets dropped for both protocols increases but AOMDV drops more packets than AODV. Congestion in AOMDV network attributes to less packet drop. So, dropcount of AOMDV is more than AODV.

5. Conclusion

In this paper, we examined the performance of AODV & AOMDV routing protocol for MANET under varying simulation time, cbr rate and packet size. We measured end to end delay, throughput, PDF and drop count. Simulation result shows that AODV is the better protocol in terms of throughput and PDR and Dropcount but AOMDV performs better in terms of delay under varying parameters.

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