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ANALYSING EFFICIENCY OF MULTIPATH ROUTING ON REACTIVE ROUTING PROTOCOLS IN MANET

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***Abstract*— The** mobility of the nodes is an important factor in Mobile Ad hoc Networks (MANETs). The reactive routing protocols are very useful to deal with the mobility of nodes. In the Reactive routing or On Demand protocol the transmission of data is always preceded by the process of finding the route. So these protocols can effectively deal with the stale routes arising due to the mobility of nodes. Examples of such protocols include Dynamic source routing protocol (DSR), Ad-hoc On demand Distance Vector Routing protocol (AODV) etc. The reactive protocols can further be categorized as Unipath and Multipath routing Protocols. The AODV is Unipath routing protocol whereas multipath variant of AODV is Ad hoc On demand Multipath Distance Vector Routing Protocol (AOMDV). Here the efficiency of both AODV and AOMDV has been tested using NS2 simulator for different number of nodes moving at different speeds with respect to different performance metrics.

***Keywords*—** MANET, Unipath, Multipath, Reactive Routing, Mobility, Stale routes, AODV, AOMDV.

I. INTRODUCTION

The MANETs [1] consist of a number of mobile nodes based on wireless communication for transmission of data. There are various constraints associated with nodes mobility in a wireless ad hoc network. The primary constraints include energy, mobility of nodes i.e. the stale routes arising due to the mobility and delays associated with network. Each mobile node has an associated initial energy. This energy depletes as the node enters into communication with the other nodes. The communication between two nodes in the MANETs may or may not involve the use of intermediate nodes depending upon the current topology. In unipath routing protocols, there is a single path from source to destination whereas multipath routing protocols may use multiple paths between different nodes. Further, stale routes may arise in the MANETs due to the movement of the nodes. The on demand protocols [2] [3] can effectively deal with this situation. In such protocols, a node searches the route each and every time the data packets are to be transmitted.

The performance of MANET protocol depends upon various factors such as number of nodes, their speeds, number of possible paths between the nodes. Although the speed of mobile nodes in MANETs cannot be too high but they can significantly affect the performance of a network in terms of low packet delivery ratio, high energy consumption and throughput. The multipath routing protocols by providing a number of different paths can prove to be vital in the Mobile Ad-hoc Networks. As in case of a failure along a path, the other path can be used for carrying out the transmission of the data.

In this paper the AODV [4] [5] has been compared to its multipath variant AOMDV [6] [7] based on various factors such as number of mobile nodes, speed of nodes, energy consumed, Packet delivery ratio, throughput and end to end delay. The paper has been divided into four sections. The Section II provides the conceptual details related to both the protocols and the performance metrics to be used for analyzing the protocols. The Section III presents the simulation of both the protocols using the NS2 simulator, the analysis of results obtained as a result of simulation and the scope of work that can be done in the field of multipath routing. Last section concludes the findings of work presented in the paper.

II. BASICS OF PERFORMANCE ANALYSIS IN MANET

A. Performance metrics

The qualitative analysis of MANETs can be done using following metrics [2] [8]:

a. ***Packet Delivery Ratio*: (*PDR*)** refers to the ratio of the number of data packets received at the destination node to the number of data packets sent by the source node.
b. ***Throughput:*** is the amount of data in bits received at the destination in a given period of time.

c. ***End to end delay:*** refers to the time elapsed between successful transmission of messages from source to destination.
d. ***Energy Consumption***: refers to the average energy consumed at a node.

B. Unipath and Multipath Reactive routing protocols for NS2 simulation

The AODV is an on demand protocol whereas the AOMDV is its multipath variant. The basic functioning of these two protocols is as follows:

1)AODV

AODV [4] [5] [8]works on hop-by-hop basis. The complete routing strategy can be divided into two processes i.e. the route discovery and maintenance. The route request and reply packets are used for the discovery of route whereas the route error messages are used for maintenance.

2)AOMDV

AOMDV [7] [9] is multipath variant of AODV for producing link disjoint paths. Multiple Loop-Free paths are received at each node. For each destination, a node maintains the maximum number of hops for all the paths. This is called advertised hop count. If a route advertisement with larger sequence number is received, then it is required to reset the value of the next-hop and advertised hop count.

III. SIMULATION OF AODV AND AOMDV USING NS2

The network simulator 2 provides various inbuilt models such as energy model and mobility model. Hence is a vital tool for simulating the complex scenarios of MANETs. This section provides the simulation results corresponding to the various performance metrics for varying number of node at different speeds. Based on the metric being tested, the complete simulation has been divided into four cases. The various simulation parameters are as follows:

Table 1: Simulation Parameters

Routing Protocol	AODV, AOMDV
Network topology	1000 * 1000
MAC Type	802.11
Max. Packet in IFQ	50
Number of Nodes	10,30,50
Max. Simulation time	50 s
Speeds	0.5 , 1.0, 1.5, 2.0 m/s
Pause time	.25 s
Traffic type	CBR

CASE I: Energy Consumption versus number of nodes for varying speeds

Both the protocols have been tested for average energy consumption during the complete simulation time for number of nodes equal to 10, 30 and 50 moving at different speeds i.e. 0.5, 1.0, 1.5, 2.0 m/s. The results so obtained are shown in the Figure 1. Being multipath routing protocol the average energy consumption is marginally more in case of AOMDV than the AODV.

However AODV may be preferred to AOMDV for lower speed and less number of nodes. As shown in Figure 1 corresponding to the speed of 0.5, 1.0 and 1.5 m/s energy consumption is more in case of AOMDV. Although at a speed of 2.0 m/s, both protocols are producing almost similar results for low number of nodes but more energy is getting consumed with increase in number of nodes. This also shows that energy consumption is an area that can be worked out to further improve the quality of multipath routing

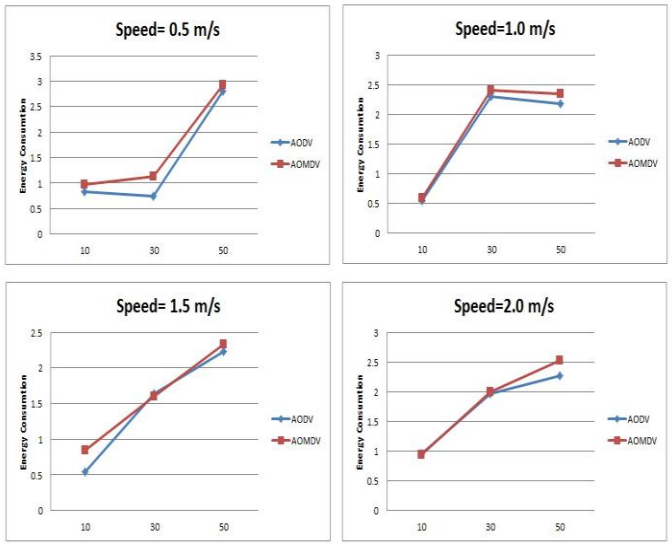

Figure 1: Energy Consumption versus number of nodes for varying speeds

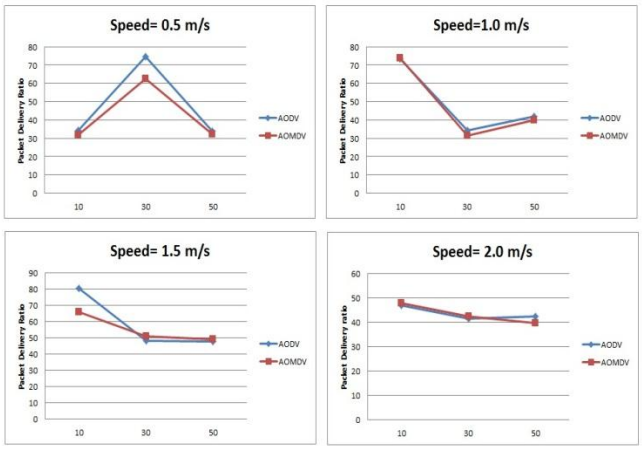

Figure 2: PDR versus number of nodes for varying speeds

CASE II: PDR versus number of nodes for varying speeds

In Figure 2 the PDR has been shown in terms of percentage. In multipath routing protocol, the overhead is generally higher than the unipath protocol. So it is expected to have lower PDR for AOMDV as compared to AODV. The Figure 2 also proves the same, as PDR of AOMDV is lower than AODV at lower speed i.e. at 0.5 m/s. However it can be noticed that as the speed of nodes is increased PDR is producing almost similar results in both the protocols.

CASE III: Throughput versus number of nodes for varying speeds

The Figure 3 shows the results of Throughput for different number of nodes at different speeds. The results clearly depict the benefit of multipath routing obtained in term of number of bits received per unit time due to availability of multiple paths. The throughput of AOMDV is much better as compared to AODV in every scenario. At all the speeds the throughput is almost same for less number of nodes i.e. 10 nodes.

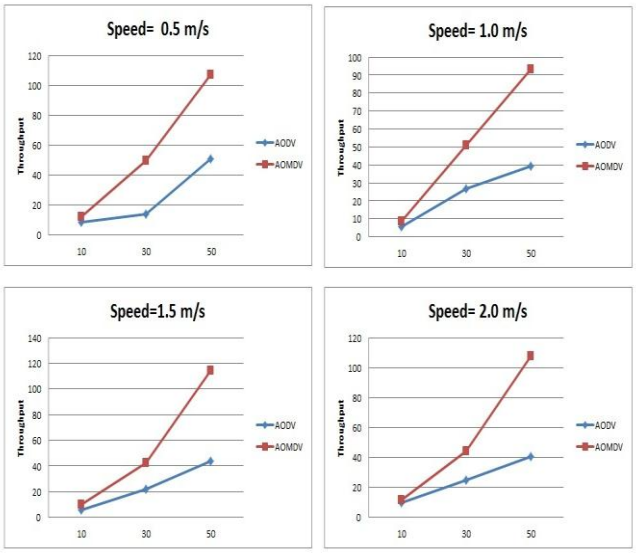

Figure 3: Throughput versus number of nodes for varying speeds

But with increase in the number of nodes, performance of AOMDV also gets better. It can be seen that the results of AOMDV are significantly better than AODV for larger number of nodes. This may be attributed to the availability of multiple paths.

CASE IV: End To End Delay versus number of nodes for varying speeds

The availability of multiple paths does provide the benefit of lower end to end delay. The results of Figure 4 prove the effectiveness of AOMDV as compared to AODV. For different number of nodes and at all the speeds the End To End delays are significantly less in case of AOMDV as compared to AODV.

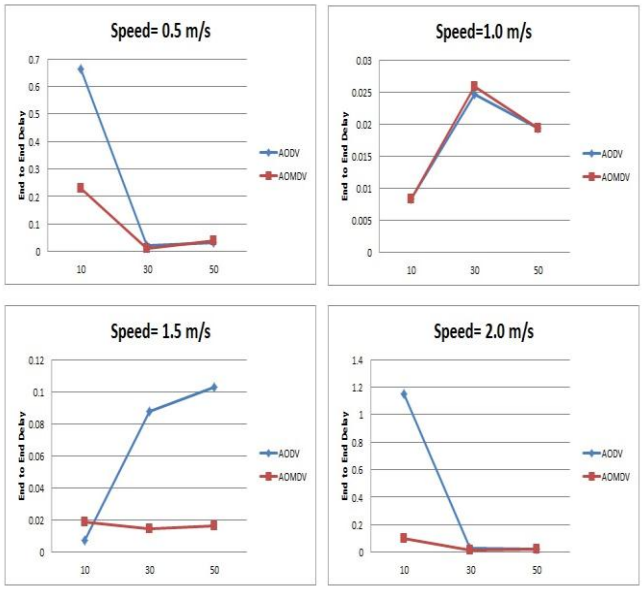

Figure 4: End To End Delay versus number of nodes for varying speeds

Considering all the cases, it can be analysed that AOMDV performs better than AODV in terms of End to End Delay and Throughput. But being multipath routing protocol AOMDV do suffer from its own limitations. This can be observed in the results of Packet delivery ratio and Energy Consumption. However, at higher speeds, AOMDV PDR is almost similar to AODV. Thus area requiring more focus is the conservation of energy when multiple paths are being used. As the average energy consumption can be controlled, the two possible solutions to work in this area are:

A. The average energy consumption of nodes can be decreased by setting a threshhold limit on the energy consumption of the node. This can disable the participation of the node in the transmission of packets after the limit is reached.

B. Distribute load proportionally among various possible paths. The load can be distributed in the proportion of remaining energy along all the paths, Such that a path with higher energy gets more packets. This load distribution may also decrease the average energy consumption.

IV. CONCLUSION

The paper presented the simulation of two On demand or Reactive routing protocols namely AODV and AOMDV. The AOMDV is a multipath variant of AODV. The effect of multipath routing has been analysed by the simulation of both the protocols using NS2. Both the protocols have been tested for different number of nodes at different speeds with respect

to Energy consumption, Packet Delivery Ratio, Throughput and End to End delay. The Benefits of using multipath routing can be seen in terms of higher throughput and lower end to end delays in AOMDV as compared to AODV. However the results in term of energy consumption are marginally better in AODV. This also shows that the multipath routing is an effective method for optimizing the performance of network but it can still be worked out for improvement in terms of energy consumption. Finally two directions have also been identified that can be worked upon in future along with the multipath routing to optimize the routing mechanism in MANETs.

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