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Comparative Analysis of Unipath and Multipath Reactive Routing Protocols in Mobile Ad hoc Network

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Abstract-

The Mobile Ad hoc NETwork (MANET) is a collection of wireless mobile nodes and each of these nodes can be considered as an individual portable devices. Current unipath routing protocols result in performance degradation in mobile networks due to the unreliability of wireless infrastructure and mobility of nodes. Multipath routing protocol is an attractive alternative that distributes the traffic among several good paths instead of routing all the traffic along a single best path for highly error prone and resource depleted network environments. Frequent link failures are common in MANET due to node's mobility and use of unreliable wireless channels for data transmission. Due to this, multipath routing protocol becomes an important research issue. Among the reactive protocols, AODV is a reactive routing protocol .Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV) protocol is an enhancement part of the AODV protocol for computing multiple loop-free and link disjoint paths. Due to the frequently changing topology, routing in ad-hoc networks can be viewed as a challenging issue.

Keywords- MANET, AODV, AOMDV, Unipath, Multipath

I. INTRODUCTION

A mobile Ad hoc network is a set of wireless devices called wireless nodes, which dynamically connect and transfer information. Figure 1 illustrates what MANET is. In MANET, a wireless node can be the source, the destination or an intermediate node of data transmission. When a wireless node plays the role of an intermediate node, it serves as a router that can receive and forward data packets to its neighbor closer to the destination node [1].

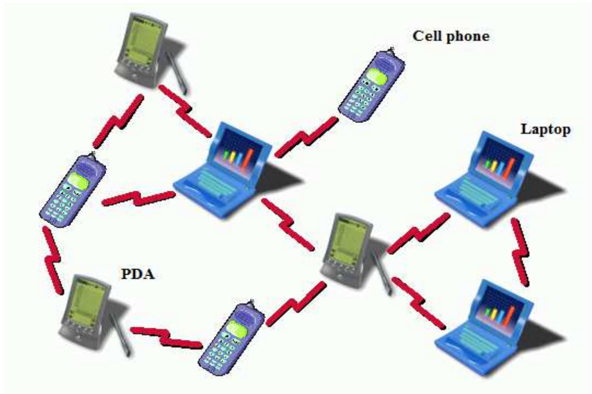

Figure 1: Mobile Ad-hoc Network [3]

Efficient routing in MANET is a challenging task due to its varying physical channel characteristics, dynamic topology and distributed communication.

This paper presents a performance comparison of two prominent routing protocols in MANET based on results analysis obtained by running simulations with different scenarios in Network Simulator version 2 (NS-2).Scenarios differ in the number of connections in the network, number of nodes, and maximum movement speed. Parameters based on which the comparison is performed are Packet Delivery Ratio (PDR), average throughput and average end to end delay.

A description of considered routing protocols is given in Section II. Scenarios and simulation parameters Simulation results are described in Section III. Result discussion and analysis are presented in Section IV. Section V concludes this paper.

II. ROUTING PROTOCOLS

The following two routing protocols are considered in this paper:

Adhoc On-demand Distance Vector (AODV)

Ad hoc On-Demand Distance Vector (Perkins & Royer 1999)[13] is a reactive protocol. Therefore it consists of two main phases: route discovery and route maintenance.

Route Discovery

In AODV, route discovery is the process to find a route between two nodes. It is initiated only when a node wants to communicate with another node and does not have the required routing information in its routing table. A sender first broadcasts a Route Request Packet (RREQ) to all its neighbors. All neighbors that receive the RREQ rebroadcast it. Any node that has already processed this RREQ discards any duplicate RREQs. If a valid route to the destination is available, then the intermediate node generates a RREP, else the RREQ is rebroadcast. Duplicate copies of the RREQ packet received at any node are discarded. Finally, when the destination node receives a RREQ, it sends a RREP, which eventually reaches the original sender through the reverse path links. The sender then proceeds with data transmission.

Route maintenance

Route maintenance consists of repairing a broken route or finding a new one, and is initiated when a route failure occurs. Route maintenance is done using route error (RERR) packets. When a link failure is detected (by a link layer feedback, for example), a RERR is sent back via separately maintained predecessor links to all sources using that failed link. Routes are erased by the RERR along its way.

Ad hoc On-demand Multipath Distance Vector (AOMDV)

AOMDV is a multi-path extension of AODV.AOMDV is the representative multipath routing protocol which maintains a similar invariant as in AODV in order to eliminate any possibility of loops. Multipath routings provide load balancing by distributing traffic, fault tolerance among a set of disjoint paths and higher aggregate bandwidth[15][16].

III. Simulation Process

In our evaluation of AODV and AOMDV protocols performance, NS-2.35 is used as a simulation tool under Linux environment.

In the simulation environment, the number of mobile nodes is 100 with randomly distributed in a 1000m X 1000m region, nodes move according to the widely used random waypoint Model. The traffic is initially generated by 5 CBR sources. Then the number of connections is varied with 10, 15, 20 and 25 different CBR connections.

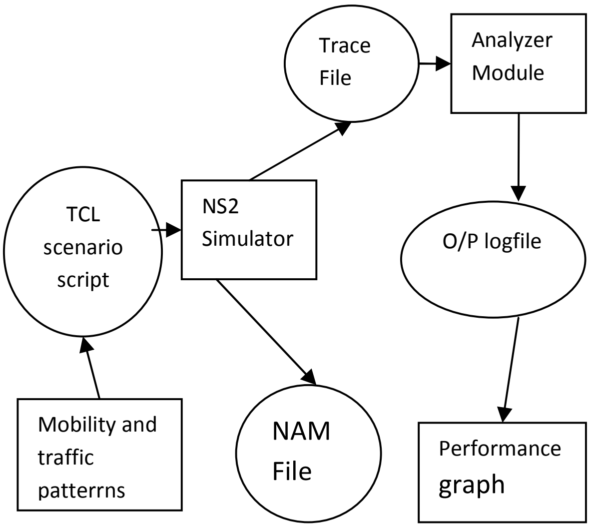

Figure 2: Simulation Process.

Similarly, the second simulation environment is created in a network of 100 nodes with 20 connections and node speed is varied from 1 to 5m/s in unit interval. Third simulation scenario is run in the environment of TCP transport protocol with varying the number of nodes 30, 40, 60, 80 and 100.

Scenario 1

In this scenario some parameters with specific value are considered. Those are as shown in table:

Parameter	**Value**
Simulation Time	900 s
Simulation Area	1000X1000 m2
Number of Nodes	100
Routing Protocols	AODV, AOMDV
Mobility Model	Random Waypoint
No. of Connections	5, 10, 15, 20, 25
Traffic type	CBR (Constant Bit Rate)
Transport Protocol	UDP (User Datagram Protocol)
Queue type	Drop tail
Propagation model	Two ray ground
Queue length	50

Table 1: Simulation parameters for scenario 1.

IV. Results and Analysis

Simulation Result

Simulation environments were run for 900 seconds on five different scenarios with number of connections varying 5, 10, 15, 20 and 25. The simulation results are shown in the figures.

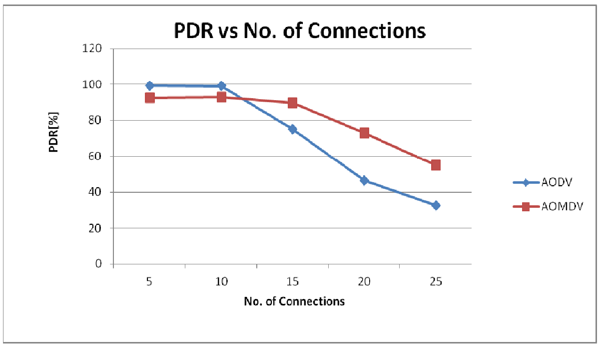

Figure 3: Packet Delivery Ratio measurement result

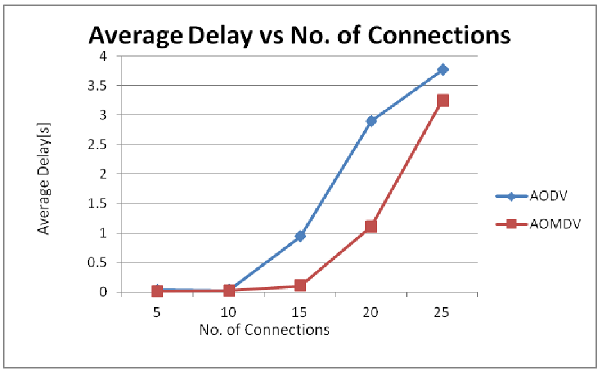

Figure 4: Average Delay measurement result

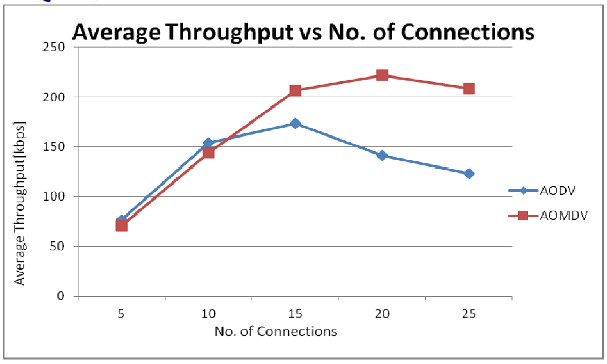

Figure 5: Average Throughput Measurement Result

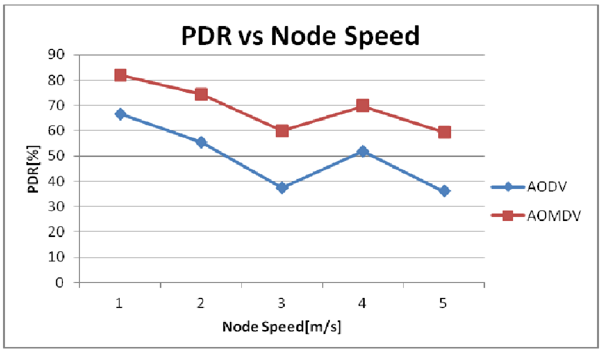

Figure 6: Packet Delivery Ratio measurement result

Scenario 2

In this scenario some parameters with specific value are considered. Those are as shown in table:

Parameter	Value
Simulation Time	900 s
Simulation Area	1000X1000 m2
Number of Nodes	100
Routing Protocols	AODV, AOMDV
Mobility Model	Random Waypoint
Node Speed	1, 2, 3, 4, 5 m/s
No. of Connections	20
Traffic type	CBR (Constant Bit Rate)
Transport Protocol	UDP (User Datagram Protocol)
Queue type	Drop tail
Propagation model	Two ray ground
Queue length	50

Table 2: Simulation parameters for scenario 2

Simulation Result

Similarly simulation environments were run for 900 seconds on five different scenarios with varying node speed of 1, 2, 3, 4 and 5 m/s. The simulation results are in the form of line graphs

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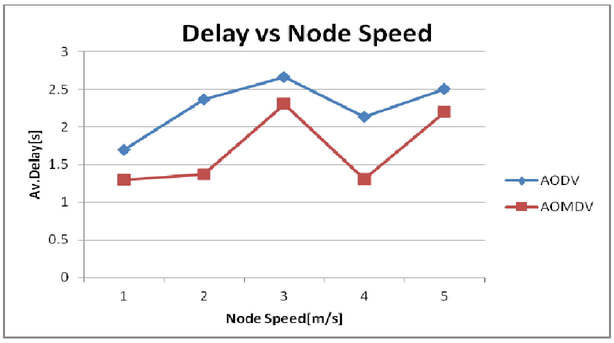

Figure 7: Average Delay Measurement Result

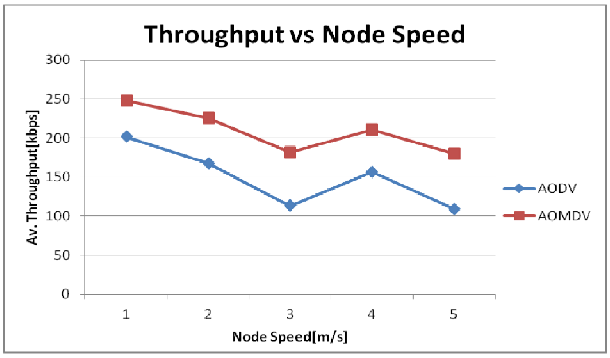

Figure 8: Average Throughput Measurement Result

Scenario 3

In this scenario some parameters with specific value are considered. Those are as shown in table:

Parameter	Value
Simulation Time	900 s
Simulation Area	1000X1000 m2
Number of Nodes	30, 40, 60, 80, 100

Routing Protocols	AODV, AOMDV
Mobility Model	Random Waypoint
Node Speed	5 m/s
No. of Connections	25
Traffic type	FTP
Transport Protocol	TCP
Queue type	Drop tail
Propagation model	Two ray ground
Queue length	50

Table 3: Simulation parameters for scenario 3

Simulation Result

Similarly simulation environments were run for 900 seconds on five different scenarios with varying number of nodes 30, 40, 60, 80 and 100. The simulation results are shown in the form of line graphs.

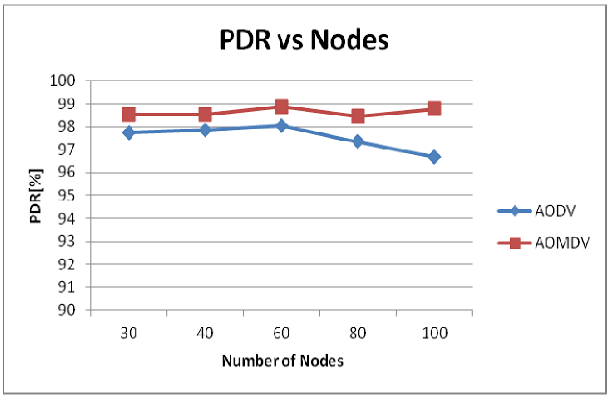

Figure 9: Packet Delivery Ratio measurement result

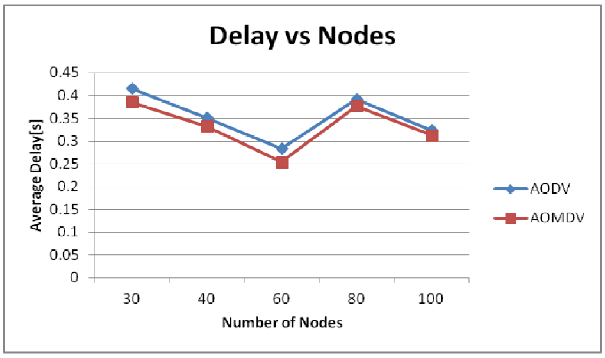

Figure 10: Average Delay Measurement Result

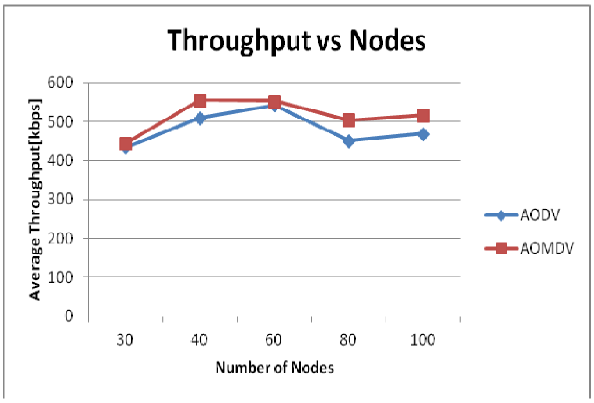

Figure 11: Average Throughput Measurement Result

IV. Result Discussion

Output results obtained from three different simulation scenarios as shown in graphs indicate that PDR in AOMDV is more than PDR in AODV. This is because of the fact that due to AODV being a uni-path routing protocol, if a link is broken, the packet will not be delivered to the destination node. Thus that packet will get dropped. But due to AOMDV being a multi path routing protocol, even if the current link breaks, the network will find an alternate path from the source to the destination node and have a better chance of packet delivery.

Delay improves remarkably with AOMDV. This is because the availability of the alternate routes on route failure obviates the need for a new route discovery. With fewer number of route discoveries, the multipath protocol reduces the negative impact of route discovery latency on the overall delay. Similarly average throughput is improved in the case of AOMDV as compared with AODV unipath routing protocol.

V. Conclusion and Future Work

In general, AOMDV offered a superior overall routing performance than AODV in a variety of number of nodes, mobility and traffic conditions. Hence it can be concluded that multipath routing achieves in general better performance than single path routing in high traffic loads and On-demand routing protocols with multipath capability can effectively deal with mobility-induced route failures in mobile ad hoc networks as opposed to their single path counterparts.

Performance analysis can be done between these two routing protocols on the basis of other performance metrics considering the different simulation environments of other different variables as a future work.

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