Performance Evaluation of MultipathAODV Routing Protocol

Ms. Néeraj Rathore, prof. Umesh Barahdia, prof. Pawan Jain  
neeraj.rathore36@yahoo.com, umesh.barahdia@gmail.com, pawanjainntm@gmail.com  
Department of Electronics Engineering, NITM Gwalior

Abstract:  
A mobile ad-hoc network is a temporary 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 mobile ad-hoc network (MANET) is the design of robust routing algorithms that adapt to the frequently and randomly changing network topology. A variety of routing protocol has been proposed and several of them has been extensively simulated or implemented as well. In this paper, compare and evaluate the performance of two types of on-demand Reactive routing protocol for MANET: Ad-hoc On demand Distance Vector (AODV) Routing Protocol. Which is unipath and multipath ad-hoc On Demand Distance Vector (MAODV) Routing Protocol. This paper investigates all these reactive routing protocols corresponding to Packet delivery fraction (PDF). Packet loss, Number of packet dropped, Average end-to-end delay. The NS-2 Simulation results showed that AODV has always low compare to MAODV In both statics and dynamic network for each set of connection. All these case MAODV is a better efficiency analyzed varying to pause time, but worst in case of end-to-end delay.

Keywords: Manet, Ad-hoc networks, routing protocol, Simulation, Performance evaluation, ns-2.

1. Introduction:  
A Mobile Ad-hoc network (MANET) [1] is a collection of wireless mobile nodes in an autonomous system of mobile nodes connected by wireless links. Each node operates not only as an end system, but also as a router to forward packets. The nodes are free to move and organize themselves into a network. These nodes change its position frequently. MANET is future wireless networks consisting entirely of mobile nodes that communication on-the-move without base stations. Nodes in this network will both generate user and application traffic and carry out network control and routing protocols. Rapidly changing connectivity, network partitions, higher error rates, collision interference, bandwidth and power constraints together pose new problem in network control ----particularly in the design of higher level protocol such as routing and in implementing application with Quality of Service Requirements[2-4].

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 predetermined 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.

This paper work is based on Ad-hoc On-demand Distance Vector (AODV). In this protocol, a node broadcasts a route request packet to find a route to the destination. When one node in the ad-hoc network receives one RREQ packet, it setups a reverse route to the source node of the received of the received RREQ packet, and then rebroadcasts the RREQ packet. The route discovery procedure has to broadcast RREQ packets, multi-path routing technique the data transmission for signal path is break than stop the data transmission so this technique using one path is break then searches another alternate path and transmits data continuously. This Routing procedure it’s good and efficient for on demand routing procedure.

2. Classification on Routing Protocol:  
In topology based approach, routing protocol classified in three categories, based on the time at which in the routes are discovered and updated.

1. Proactive Routing Protocol (Table-driven)
2. Reactive Routing Protocol (On-Demand)
3. Hybrid Routing Protocol

Proactive Routing Protocol is also referred to as table –driven routing protocol [2]. Consistent and up-to-date routing information of the network topology of all nodes is maintained at each node with respect to the time. Routes are building from each node to every other node before they are
needed. Any changes occurring in topology is broadcasted through the network, notifying all the nodes of the changes. Proactive protocols hence maintain routing information about the available path in the network even if these paths are not currently used. The major drawback of these approaches is that the maintenance of unused paths may occupy an important part of the available bandwidth if the topology changes frequently. An example of proactive protocol is DSDV, WRP, CGSR etc.

Reactive routing protocols are also referred to on-Demand routing protocol. In the on-demand routing approach, a route is created only when a source node desires to send data to a destination node [2]. It invokes the route discovery mechanisms. Only the routes that are currently in use are maintained, there by maintaining low control overhead and reducing the network load since a small subset of all available router is in use at any time. Reactive routing protocol has some inherent limitations. First, since route is only maintained while in use, it is usually required to perform a route discovery before packets can be exchanged between communication peers. This lead to a delay for the first packet to be transmitted. Second, even though route maintenance for reactive algorithms is restricted to the routes currently in use, it may still generate an important amount of network traffic when the topology of the network changes frequently. Finally, packets to the destination are likely to be lost if the route to the destination changes. An example of reactive protocol is AODV, MAODV and TORA etc.

Hybrid protocols seek to combine the Proactive and Reactive approaches. An example of such a protocol is the Zone Routing Protocol (ZRP).

2.1 Background:
On-Demand routing protocol work on the principle of creating route as and when required between a source and destination node pair in a network topology. In our paper, we are concentrated on two on-demand ad-hoc Routing Protocol: AODV and MAODV, as follow…

2.1.1 Ad-hoc On-Demand Distance Vector Routing (AODV)

Ad-hoc on demand distance vector (AODV) routing algorithm Is a routing protocol designed for ad-hoc mobile network AODV is capable of both unicast and multipath routing, it is on demand algorithm. Meaning that it build route between nodes only as desired by source nodes. AODV is a stateless on-demand routing protocol. the ad-hoc on demand distance vector classified under reactive protocol. The operation of the protocol is divided in two function route discovery and route maintenance. The protocol start route discovery. Then the source node send route request message to its neighbors. And if those nodes do not have any information about the destination node, they will send the message to all its neighbors and soon. And if any neighbor node has information about the destination node. The route request reply message to the route request message initiator. On the basic of this process a path is recorded in the intermediate nodes. This path identified the route and is called the reverse path. since each node forwards route request message to all of its neighbors, more then one copy of the original route request message can arrive at a node. A unique id is assigned , when a route request message is created. When a node received, it will check this id and the address of the initiator and discarded the message if it had already processed that request. Node that has information about the path to the destination send route reply message to the neighbor from which it has received route request message. This neighbor does the same. Due to the reverse path it can be possible. Then the route reply message travels back using reverse path. When a route reply message reaches the initiator the route is ready and the initiator can start sending data packets.

2.1.2 Multipath On – Demand Distance Vector Routing (MAODV)

Multipath On-Demand Distance Vector Routing Algorithm (MAODV) protocol is an extension to the AODV protocol for computing “multiple loop-free and link disjoint paths” technique. in MAODV only disjoint nodes are considered in all the paths, thereby achieved path disjointness. For route discovery route request packets are propagated throughout the network thereby establishing multiple path at destination node and at the intermediate nodes. Multiples Loop-Free paths are achieved using the advertised hop count method at each node. This advertised hop count is required to be maintaining at each node in the route table entry. The route entry table at each node also contains a list of next hop along with the corresponding hop counts. Every node maintains an advertised hop count for the destination. Advertised hop count can be defined as the “maximum hop count for all the paths”. Route advertisements of the destination are sent using this hop count. An alternate path to the destination is accepted by a node if the hop count is less than the advertised hop count for the destination. In this paper MAODV work multipath node are used the data transmission for single path is break than stop the data transmission so this technique, using one path is break then searches another alternate path and transmits data continuously. This Routing Procedure it’s good and efficient for on demand routing procedure. The advantage of using MAODV is that it allows intermediate node to
reply to RREQs, while still selecting disjoint paths. But, MAODV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQs those results are in longer overhead.

3 Simulation Based Analysis using Network Simulator (NS-2)

In this section we have described about the tools and methodology used in our paper for analysis of ad-hoc Simulation tool, Simulation parameter (traffic mobility model) performance matrices used and finally the performance of protocol is represented by using excel graph.

3.1 Methodology:
To compare two on-demand ad-hoc routing protocol, it is best to use identical simulation environments for their performance evaluation.

3.2 Simulation Environment:
Table 1. Simulation parameter

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulator</td>
<td>NS-2.27, NS-2.31</td>
</tr>
<tr>
<td>Routing protocol</td>
<td>AODV &amp; MAODV</td>
</tr>
<tr>
<td>Number of node</td>
<td>50</td>
</tr>
<tr>
<td>Area</td>
<td>500mX500m</td>
</tr>
<tr>
<td>Packet size</td>
<td>512 byte</td>
</tr>
<tr>
<td>Simulation time</td>
<td>100</td>
</tr>
<tr>
<td>Pause time</td>
<td>0,25,40,60,80etc.</td>
</tr>
<tr>
<td>Max speed</td>
<td>10</td>
</tr>
<tr>
<td>Traffic type</td>
<td>CBR</td>
</tr>
<tr>
<td>Mac protocol</td>
<td>Mac /802.11</td>
</tr>
</tbody>
</table>

3.3 Network Simulator:
In this section, the network simulation are implemented using the NS-2 [9] Simulation tool the network simulator NS-2 is a discrete event simulator, which means it simulation such event as sending, receiving forwarding and dropping packets. For simulation Scenario and network topology creation it uses OTCL (Object Tool Command Language). To create new objects, protocols and routing algorithm or to modify them in NS-2, C++ Source code has to be changed. The simulator supports wired and wireless and satellite networks.

3.4 Performance Evaluation Metrics Used:
The following are used in this paper for the analysis of AODV and MAODV Routing Protocols.
1. Packet Delivery Fraction
2. Average End-to-End Delay
3. Packet loss (%)
4. No. Of Packet Dropped

Figure 1: Flow diagram for running MANET Routing protocols in ns-2.

Packet Delivery Fraction: This is the fraction of number of packet received at the destination to the number of packet sent from the source multiply by 100.

Packet loss (%): packet loss is the failure of one or more transmitted packet to arrive at their destination.

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.
No. Of Packet Dropped: this includes routing packet transmission subtract successfully received packet.

4. Simulation Result and Analysis:
We run the simulation environment for 500sec for four scenarios with pause times varying from 0 to 80sec. and also maximum connection varying in between 0 and 50 connections. Packet delivery fraction, packet loss, Average end-to-end delay and number of packets dropped are calculated for AODV and MAODV. The result is summarized below with their corresponding graphs.

Packet Delivery Fraction:

![Packet Delivery Fraction Graph]

Figure 2: Comparison of AODV and MAODV basis of PDF

We note that MAODV has a better pdf value when compared to AODV for each set of connections. This is because in the time waited at a node, MAODV can find an alternate route if the current link has broken whereas AODV is rendered useless at the point.

Packet Loss %

![Packet Loss Graph]

Figure 3: Comparison of AODV and MAODV on basis of packet loss.

We note that MAODV has better result as compare to AODV routing protocol.

Average end-to-end delay:

![Average End-to-End Delay Graph]

Figure 4: Comparison of AODV and MAODV on basis of Average end-to-end delay.

We note that AODV has a better average delay than compare to MAODV due to the fact if a link break occurs in the current topology.MAODV would try to find an alternate path from among the backup route between the source and the destination node pairs resulting in additional delay to the packet delivery time in comparison, if a link break occurs in AODV, the packet would not reach the destination due to unavailability of another path from source to destination , since we assume in AODV only singular paths exist between a source and destination node

NO. Of Packet Dropped:

![Packet Dropped Graph]

Figure 5: Comparison of AODV and MAODV On basic of no. of packet dropped.

We note that number of packet dropped in AODV is more than compare to the number of Packet dropped in MAODV.in this case better performance AODV routing protocol.
5. Conclusion:

In this paper, performance the evaluated of AODV and MAODV using NS-2. In different simulation scenarios and observed their behavior in terms of four significant parameter i.e. packet delivery fraction, average end-to-end delay, packet loss and number of packet dropped. We conclude that MAODV On Demand reactive routing protocol is better than compare to AODV On Demand reactive routing protocol. In this paper we also work in Enhanced Multipath AODV to control the congestion mechanism using packet format and route discovery mechanism. So that MAODV is better result in this case packet delivery fraction, packet loss, number of packet dropped compare to AODV reactive routing protocol.

6. References:


[4]. “Modified Routing Algorithm for AODV in constrained Condition” by G.S. Tomar, Member IEEE.


[7]. the ns Manual, formerly ns Notes and Documentation.

