Performance Analysis of Different on-Demand Routing Protocols for MAC802.16 (WIMAX) in MANET using ns2

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***Abstract*- A Mobile Ad-hoc Network (MANET) is a wireless network that can be formed without the need for pre-existing infrastructure in which every node can act as a router. In the MANET has the main challenge is the design of robust routing algorithms that adapt to the frequent and randomly changing network topology. In this paper, we compare and evaluate the performance of three types of On demand routing protocols- Ad-hoc On-demand Distance Vector (AODV) routing protocol, Ad-hoc On-demand multipath Distance Vector (AOMDV) routing protocol ,Dynamics Source Routing Protocol(DSR) using the MAC802.16 layer. In this paper we compare three well know On-demand routing protocols AODV, DSR and AOMDV by using three performance metrics packet delivery ratio, average end to end delay and Packet Loss. This comparison has been done by using simulation tool NS2 which is the famous simulator.**

***Keywords*-Ad-hoc networks; routing protocols; Simulation;Performance evaluation.**

I. INTRODUCTION

A mobile ad-hoc network (MANET) [1] is a grouping of mobile nodes forming an ad-hoc network without the assistance of any centralized structures. Environment Nodes in mobile ad-hoc network are free to move and organize themselves in an arbitrary fashion. Each user is free to room about while communication with others. The path between each pair of the users may have multiple links and the radio between them can be heterogeneous. This allows an association of various links to be a part of the same network. In MANET, communication there is always a need of routing over multi-hop paths. The main objective of this paper is to study the routing protocols in a mobile ad hoc network using a simulator software NS-2. This paper carries out the analysis and discussion on the result set to find out which protocol is the best between AODV, AOMDV, and DSR for WIMAX.

II. CLASSIFICATION OF ROUTING PROTOCOLS

In Topology based approach, routing protocols are classified [2] into three categories, based on the time at which the routes are discovered and updated.

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

1. Proactive Routing Protocol (Table Driven)

The Proactive routing approaches [3 , 4] designed for ad hoc networks are derived from the traditional routing protocols. These protocols are sometimes referred to as table-driven protocols since the routing information is maintained in tables. Proactive approaches have the advantage that path are available the moment they are needed. However, the primary disadvantage of these protocols is that the control overhead can be significant in large networks with rapidly moving nodes. Proactive routing protocol includes Destination-Sequenced Distance-Vector (DSDV) protocol, Wireless Routing Protocol (WRP), Optimized Link State Routing Protocol (OLSR) etc.

2. Reactive Routing Protocol (On-Demand)

Reactive routing approaches take a [3, 4] departure from traditional Internet routing approaches by not continuously maintaining a route between all pairs of network nodes. Instead, routes are only discovered when they are actually needed. When a source node needs to send data packets to some destination, it checks its route table to determine whether it has a route. If no route exists it performs a route discovery procedure to find a path to the destination. Hence, route discovery becomes on-demand. The drawback to reactive approaches is the introduction of latency. That is, when a route is needed by a source node, there is some finite latency while the route is discovered. In contrast, with a proactive approach, routes are typically available the moment they are needed. Hence, there is no delay to begin the data session. Reactive routing protocol includes Dynamic Source Routing (DSR) protocol, Ad hoc On-demand Distance Vector (AODV) protocol, Ad hoc On-demand Multiple Distance Vector (AOMDV) protocol etc.

3. Hybrid Routing Protocol

Hybrid protocols seek to combine the [3, 4] Proactive and Reactive approaches. An example of such a protocol is the Zone Routing Protocol (ZRP).

Our discussion is limited to three On-demand ad-hoc routing protocols AODV, AOMDV and DSR as follows:

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

AODV is a reactive protocol that discovers [5] routes on an as needed basis using a route discovery mechanism. It uses traditional routing tables with one entry per destination. Without using source routing, AODV relies on its routing table entries to propagate an RREP (Route Reply) back to the source and also to route data packets to the destination.

AODV maintains timer-based states in each node, for utilization of individual routing table entries, where by older unused entries are removed from the table. Predecessor node sets are maintained for each routing table entry, indicating the neighboring nodes sets which use that entry to route packets. These nodes are notified with RERR (Route Error) packets when the next-hop link breaks. This packet gets forwarded by each predecessor node to its predecessors, effectively erasing all routes using the broken link. Route error propagation in AODV can be visualized conceptually as a tree whose root is the node at the point of failure and all sources using the failed link as the leaves. The advantages of AODV are that less memory space is required as information of only active routes are maintained, in turn increasing the performance, while the disadvantage is that this protocol is not scalable and in large networks it does not perform well and does not support asymmetric links.

2.2 Dynamic Source Routing protocol

The Dynamic Source Routing protocol (DSR) [6] is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes.DSR allows the network to be completely self-organizing and self configuring, without the need for any existing network infrastructure or administration. Dynamic Source Routing, DSR, is a reactive routing protocol which uses source routing, i.e. the source determines the complete sequence of hops that each packet should traverse. This requires that the sequence of hops is included in each packet's header. The protocol is composed of the two main mechanisms of "route discovery" and "route maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. Route discovery is used whenever a source node desires a route to a destination node. First, the source node looks up its route cache to determine if it already contains a route to the destination. If the source finds a valid route to the destination, it uses this route to send its data packets. If the node does not have a valid route to the destination, it initiates the route discovery process by broadcasting a route request message. The route request message contains the address of the source and the destination, and a unique identification number. Route maintenance is used to handle route breaks. When a node encounters a fatal transmission problem at its data link layer, it removes the route from its route cache and generates a route error message. The route error message is sent to each node that has sent a packet routed over the broken link. When a node receives a route error message, it removes the hop in error from its route cache.

2.3 Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV)

Ad-hoc On Demand Multipath Distance Vector Routing Algorithm (AOMDV) is proposed in [7, 8, 9]. AOMDV employs the “Multiple Loop -Free and Link-Disjoint path” technique. In AOMDV only disjoint nodes are considered in all the paths, there by achieving path disjointness. For route discovery route request packets are propagated throughout the network there by establishing multiple paths at destination node and at the intermediate nodes. Multiples Loop-Free paths are achieve during the advertised hop count method at each node. This advertised hop count is required to be maintained 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.

III TRAFFIC AND MOBILITY

1. Traffic: - Traffic Patterns describe how the [10] data is transmitted from source to destination. The widely used traffic pattern in MANET is CBR.

2. Constant Bit Rate (CBR)- The qualities of Constant Bit Rate (CBR) traffic pattern are

I) Unreliable: since it has no connection establishment phase, there is no guarantee that the data is transmitted to the destination.

II) Unidirectional: there will be no acknowledgment from destination for confirming the data transmission.

III) Predictable: fixed packet size, fixed interval between packets, and fixed stream duration.

IV METHODOLOGY

1. Simulation Environment

Simulation environment is as follows

Parameter	Value
MAC Layer	802.16
Traffic Type	CBR
Simulation Time	100 sec.
Number Of Nodes	100
Pause Time	1,2,3,4&5
Maximum Connection	15,30
Maximum Speed	10 meter per second
Transmission Rate	10 packets per second
Area of Networks	800m X 800m

2. NS-2 (Network Simulator-2)

The NS-2 is a discrete event driven [10] simulation and in this the physical activities are translated to events. Events in this are queued and processed in the order of their scheduled occurrences. The functions of a Network Simulator are to create the event scheduler, to create a network, for computing routes, to create connections, to create traffic. It is also useful for inserting errors and tracing can be done with it. Tracing packets on all links by the function trace-all and tracing packets on all links in nam format using the function nam trace-all.

3. Performance Metrics:

We report four performance metrics for the protocols:

Packet Delivery Fraction (PDF): The ratio between the number of data packets received and the number of packets sent.

End-to-End Delay: It is the ratio of time difference between every CBR packet sent and received to the total time difference over the total number of CBR packets received.

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

V SIMULATION RESULTS ANANALYSIS

We ran the simulation environments for 100 sec for five scenarios with pause times varying from 1 to 5 second and also maximum connections varying in between 15 & 30 connections. Packet delivery fraction, routing load, end to end delay and throughput are calculated for AODV, AOMDV and DSR. The results are analyzed below with their corresponding graphs.

1. Packet Delivery Fraction

Case 1: CBR-15

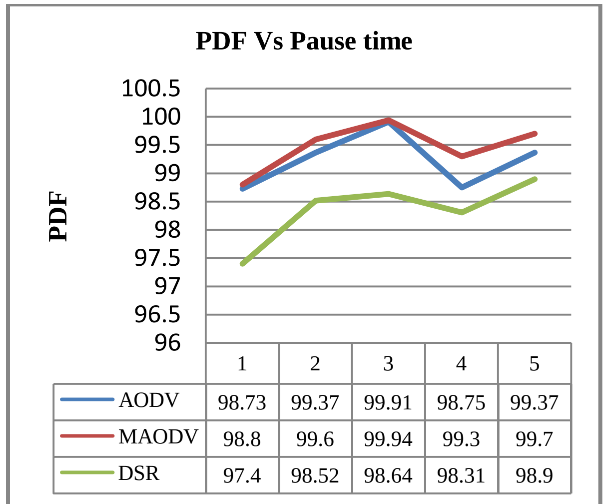


Figure 1: Comparison of AODV, AOMDV and DSR on basis of PDF at maximum connection 15

CASE 2: CBR-30

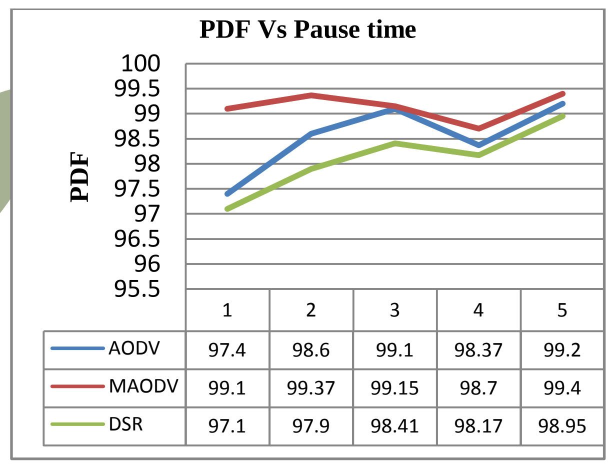


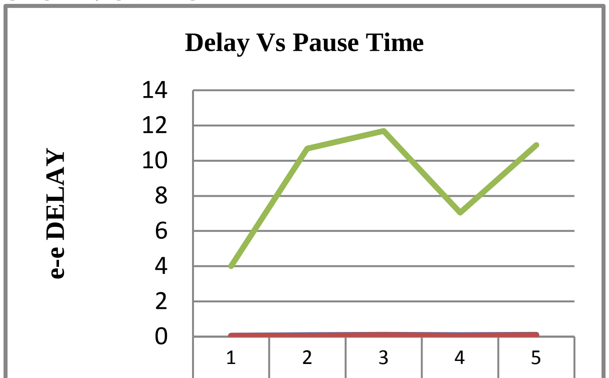
Figure 2: Comparison of AODV, AOMDV and DSR on basis of PDF at maximum connection 30

Analysis of the result

Here we see that when we used the varying pause time for MAC802.16 that time AOMDV has best PDF value. Compared to AODV, DSR for each set of connections.

2. End to End delay

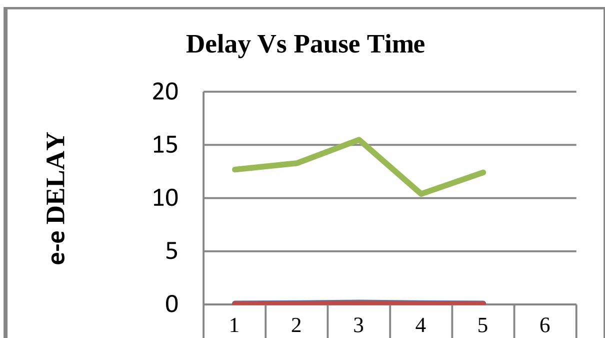
CASE 1: CBR-15



	1	2	3	4	5
AODV	0.06	0.08	0.1	0.09	0.1
MAODV	0.05	0.06	0.09	0.05	0.08
DSR	4	10.7	11.7	7.04	10.89

Figure 3: Comparison of AODV, AOMDV and DSR on basis of e-e Delay at maximum connection 15

CASE 2: CBR-30



	1	2	3	4	5	6
AODV	0.08	0.11	0.17	0.12	0.09	
MAODV	0.04	0.06	0.09	0.05	0.03	
DSR	12.7	13.3	15.49	10.4	12.43	

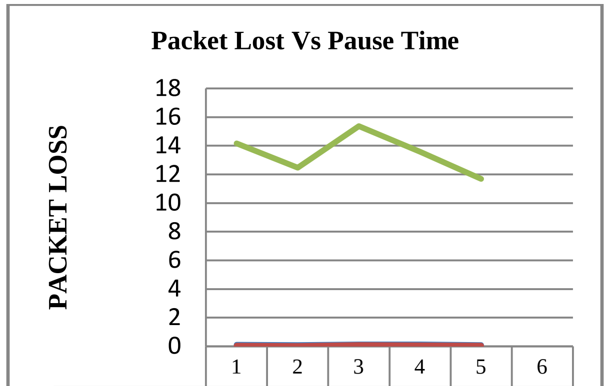
Figure 4: Comparison of AODV, AOMDV and DSR on basis of End –to –End Delay at maximum connection 30.

Analysis of the result

AOMDV has minimum Average End-to-End value 1 sec to 5 sec varying pause time compared to AODV, DSR for each set of connections.

3. Packet loss

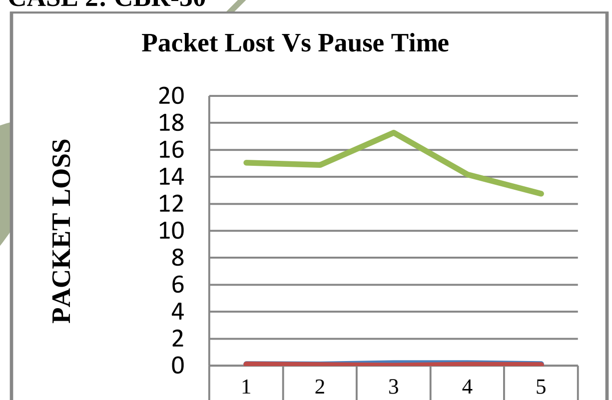
CASE 1: CBR-15



	1	2	3	4	5	6
AODV	0.09	0.07	0.12	0.11	0.08	
MAODV	0.03	0.02	0.08	0.07	0.05	
DSR	14.17	12.47	15.37	13.6	11.7	

Figure 5: Comparison of AODV, AOMDV and DSR on basis of Packet Loss at maximum connection 15.

CASE 2: CBR-30



	1	2	3	4	5
AODV	0.11	0.09	0.18	0.17	0.12
MAODV	0.09	0.06	0.012	0.08	0.06
DSR	15.05	14.88	17.29	14.18	12.75

Figure 6: Comparison of AODV, AOMDV and DSR on basis of Packet Loss at maximum connection 30.

Analysis of the result

AOMDV has minimum Packet Loss value for varying 1 sec to 5 sec pause time compared to AODV, DSR for each set of connections.

CONCLUSION

This paper evaluated the performance of AODV, AOMDV and DSR for MAC802.16 using ns-2.Comparison was based on the packet delivery fraction, Packet Loss, end-to-end delay. Finally AOMDV has best performance in all performance matrices simulation and each set of connections compared to AODV and DSR.

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