Comparative Analysis of Proactive and Reactive Protocols using 802.16 Network in MANET

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***Abstract*— Wimax stands for Worldwide Interoperability for Microwave Access. This technology is a telecommunications technology that offers transmission of wireless data via a number of transmission methods; such as portable or fully mobile internet access via point to multipoints links. In this paper, we investigate the evolution and performance of different routing protocol in 802.16 networks. The simulation results show that the Multipath Ad-hoc on demand Vector Routing Protocol (MAODV) has the best performance in terms of the packet delivery fraction, network load, packet loss and E-E delay comparison with other protocols.**

***Keywords*— MAODV, AODV, DSDV, 802.16**

I. INTRODUCTION

The wimax technology offers around 72 mega bits per second without any need for the cable infrastructure. This technology is based on IEEE standard 802.16, it generally called as broadband wireless access. To encourage compliance and interoperability of the wimax IEEE 802.16 standard Wimax forum created the name for wimax technology that was formed in mid june 2001. It is actually based on the standards that making the possibility to delivery last mile broadband access as a substitute to conventional cable and DSL lines. Wimax is the next stage to a broadband as well as a wireless world, extending broadband wireless across to new locations and over longer distances, as well as appreciably reducing the cost of bringing broadband to new areas. Wimax technology offers greater range and bandwidth then the other available or forthcoming broadband wireless technologies such as wireless fidelity (Wi-Fi) and ultra-wideband (UWB) family of standards. It provides a wireless substitute to wired backhaul. MANET is a wireless infrastructure less network having mobile nodes. Communication between these nodes can be achieved using multi hop wireless links. Every node will act as a router and forward data packets to another node. MANET is operating without any centralized base station. Mobile ad-hoc networks uses multi hop relaying. Since the nodes are free to move in any direction, it may be possible that there may be frequent link breakage. The basic advantage of MANET is its instant deployment. Various protocols have been developed for adhoc networks such DSDV (Destination Sequenced Distance Vector), AODV (Ad-Hoc On Demand Routing), MAODV (Multipath Ad hoc On-demand Distance Vector Routing). All of these protocols offer varying degrees of efficiency. It also proposes further research into more efficient protocols or variants of existing protocols such as MAODV. MAODV has three novel aspects compared to other on-demand multipath protocols. First, it does not have high inter-nodal coordination overheads like some other protocols (e.g., TORA [3], ROAM [7]). Second, it ensures disjointness of alternate routes via distributed computation without the use of source routing Finally, MAODV computes alternate paths with minimal additional overhead over AODV; it does this by exploiting already available alternate path routing information as much as possible. The main objective of this paper is to analyze MAODV protocol for ways it could be improved. This can be done by varying simulation time with respect to packet delivery fraction, network load, packet loss and E-E delay in the WIMAX (802.16) environment.

II. WIRELESS ROUTING PROTOCOLS

a. AODV

The Ad hoc On Demand Distance Vector (AODV) routing protocol builds on the DSDV algorithm. AODV is advancement on DSDV because it typically minimizes the number of required broadcasts by creating routes on a demand basis, as just opposed to maintaining a full list of routes as in the DSDV algorithm. AODV declare as a pure on-demand route receiving system, since nodes that are not on a selected way do not maintain routing information or participate in routing table exchanges. When a source node wants to send a message to the destination node and does not already have a valid route to that destination, it starts a path discovery process to locate the other node. It broadcasts a route request (RREQ) packet to its neighbor nodes, which then forward the request to their neighbor nodes, and so on, until either the destination or an intermediate node with a fresh enough routes to the destination is found. AODV use destination sequence numbers to ensure all routes are loop free and contain the most recent route information. Every node maintains its own sequence code, as well as a broadcast ID. The broadcast ID is incremented for every RREQ the node starts, and together with the node's IP address, uniquely recognized an RREQ. Once the Route request reaches the destination node or an intermediate node with a fresh enough route, the destination intermediate node responds by unicasting a route reply (RREP) packet back to the neighbor from which it first received the route request. As the route reply is routed back along the reverse path, nodes along this path set up forward route entries in their route tables which point to the node from which the RREP came. These forward route entries indicate the active forward route. Associated with each route entry is a route timer that will cause the deletion of the entry if it is not used within the specified lifetime. Because the RREP is forwarded along the path established by the RREQ, AODV supports the use of symmetric links only [1][2].

b. MAODV

Multipath Ad-hoc On Demand Multipath Distance Vector Routing Algorithm (MAODV) is proposed in. MAODV employs the "Multiple Loop -Free and Link-Disjoint path" technique. In Multipath AODV only disjoint nodes are considered in each and every path, thereby achieving path disjointness. For route discovery route request packets are propagated throughout the network thereby establishing multiple paths 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 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. Our objective in this section is to extend the AODV protocol to compute multiple disjoint loop-free paths in a route discovery. We assume that every node has a unique identifier (UID) (e.g., IP address), a typical assumption with ad hoc routing protocols. For simplicity, we also assume that all links are bidirectional, that is, a link exists between a node *i* to *j* if and only if there is a link from *j* to *i*. MAODV can be applied even in the presence of unidirectional links with additional techniques to help discover bidirectional paths in such scenarios. MAODV shares several characteristics with AODV. It is based on the distance vector concept and uses hop-by-hop routing approach. Moreover, MAODV also finds routes on demand using a route discovery procedure. The main difference lies in the number of routes found in each route discovery. In MAODV, RREQ propagation from the source towards the destination establishes multiple reverse paths both at intermediate nodes as well as the destination. Multiple RREPs traverse these reverse paths back to form multiple forward paths to the destination at the source and intermediate nodes. Note that MAODV also provides intermediate nodes with alternate paths as they are found to be useful in reducing route discovery frequency. The core of the MAODV protocol lies in ensuring that multiple paths discovered are loop-free and disjoint, and in efficiently finding such paths using a flood-based route discovery. MAODV route update rules, applied locally at each node, play a key role in maintaining loop-freedom and disjointness properties. Here we discuss the main ideas to achieve these two desired properties. Next subsection deals with incorporating those ideas into the MAODV protocol including detailed description of route update rules used at each node and the multipath route discovery procedure [2][5][6].

C. DSDV

The Destination-Sequenced Distance-Vector (DSDV) Routing Algorithm is based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing International Journal of Information and Communication engineering 3:8 2007 530 table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event driven. The routing table updates can be sent in two ways: - a "full dump" or an incremental update. A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be included whose sequence number has changed. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast changing network, incremental packets can grow big so full dumps will be more frequent [7].

III TRAFFIC AND MOBILITY

1. Traffic: - Traffic Patterns describe how the [8] 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 to 300 sec.
Number Of Nodes	50
Pause Time	1s
Maximum Connection	30
Maximum Speed	10 meter per second
Transmission Rate	2.0 packets per second
Area of Networks	300m X 800m

2. NS-2 (Network Simulator-2)

The NS-2 is a discrete event driven [8] 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 [9].

V SIMULATION RESULTS ANALYSIS

We ran the simulation environments with simulation time varying from 100 to 300 second. Packet delivery fraction, routing load, end to end delay and throughput are calculated for AODV, MAODV and DSDV. The results are analyzed below with their corresponding graphs.

1. Packet delivery fraction

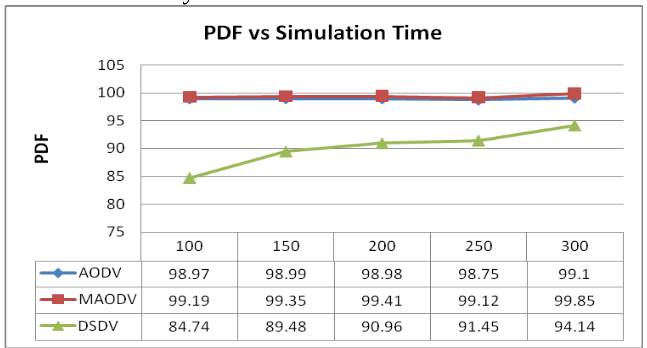


Figure 1: Comparison of AODV, MAODV and DSDV on basis of PDF

Analysis of the result:

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

2. Packet loss

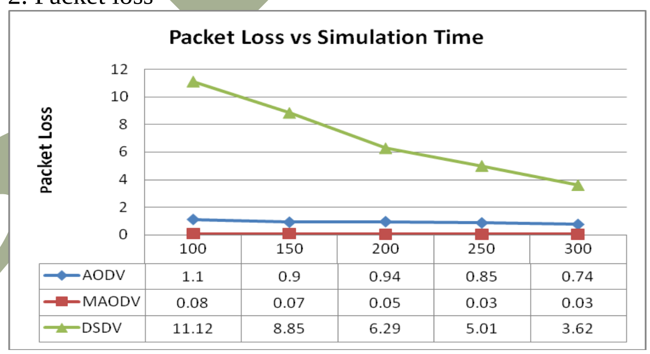


Figure 2: Comparison of AODV, MAODV and DSDV on basis of Packet Loss

Analysis of the result:

MAODV has minimum Packet Loss value for varying simulation time compared to AODV, DSDV for each set of connections.

3. Network Load

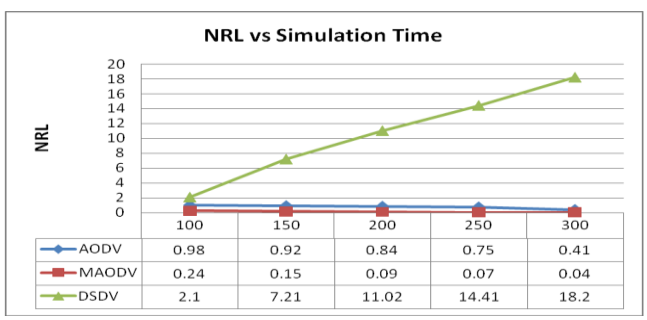
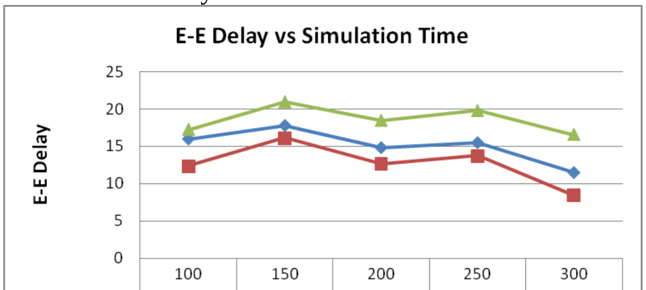


Figure 3: Comparison of AODV, MAODV and DSDV on basis of NRL

Analysis of the result:

MAODV has minimum Network Load value for varying simulation time compared to AODV, DSDV for each set of connections.

4. End to End delay



	100	150	200	250	300
AODV	15.95	17.74	14.78	15.45	11.45
MAODV	12.35	16.12	12.65	13.74	8.45
DSDV	17.25	20.95	18.47	19.78	16.57

Figure 4: Comparison of AODV, MAODV and DSDV on basis of e-e Delay

Analysis of the result:

MAODV has minimum Average End-to-End value varying simulation time compared to AODV, DSDV for each set of connections.

CONCLUSION

This paper evaluated the performance of AODV, MAODV and DSDV for MAC 802.16 using ns-2.31. Comparison was based on the packet delivery fraction, Packet Loss, end-to-end delay. Finally MAODV has best performance in all performance matrices simulation and each set of connections compared to AODV and DSDV.

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