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A comparative investigation on AODV and AOMDV in MANET

Girija Ratnu
Computer Science and Engineering
Poornima University
Jaipur,Rajasthan

Dr. Madan Lal Saini
Computer Science and Engineering
Poornima University
Jaipur,Rajasthan

Abstract—Many solutions approaches using routing protocols and their modifications were worked out by the researchers such as; Ad-Hoc On-Demand Distance Vector, Weighted Clustering Algorithm, Delay-Oriented Shortest Path Routing, Dynamic Source Routing, Congestion Adaptive AODV, Secure Message Transmission, Secure Single-Path, Dynamic Load Aware Routing protocol, Adaptive Congestion Routing Algorithm, Destination Sequenced Distance-Vector, Ad-Hoc On-demand Distance Vector with Load and Mobility, Adhoc On-demand Multipath Distance Vector, Route Request. In reviewed papers there were many protocols which were compared with AODV for the performance analysis. It also includes comparison for congestion avoidance in MANET. Most of the researchers used referred as a future technique for the improvement in the AODV protocol as Ad-Hoc on demand Multipath Distance Vector (AOMDV). So AOMDV was selected as the protocol to compare it's performance with the AODV. The report includes comparison carried out by taking two experimental scenarios one with varying simulation time and the other varying number of nodes for 512 and 1024 packet sizes.

Key words: AODV, Ad-Hoc, Demand, Distance, Scenarios

I. INTRODUCTION

A wireless ad hoc network is a collection of mobile hosts, which forms a temporary network without the aid of any pre established infrastructure or centralized administration. When the network population is large, the set of nodes is often partitioned into clusters so that the resource can be handled in an efficient way. "Generally, a cluster is defined as a number of mobile hosts, which can directly transmit and receive the packets to/from each other and content the same network bandwidth. Mobile members in a cluster are often located within a limited coverage area, which is decided by the transmission power. Moreover, a mobile host is allowed to belong to many clusters at any time. Rapid progression in technology for mobile devices including laptops and handheld computers and the availability of inexpensive wireless networking hardware has resulted in a large interest in wireless connectivity among mobile users. One approach to providing wireless connectivity is through the formation of Mobile Ad Hoc Networks (MANET) [21]. This approach does not assume the support of any pre-existing infrastructure but, instead, uses other nodes in the ad hoc network as routers to facilitate message delivery.

Zone Routing Protocol, or ZRP is a hybrid Wireless Networking routing protocol that uses both proactive and reactive routing protocols when sending information over the network. ZRP was designed to speed up delivery and reduce processing overhead by selecting the most efficient type of protocol to use throughout the route. If a packet's destination is in the same zone as the origin, the proactive protocol using an already stored routing table is used to deliver the packet immediately. If the route extends outside the packet's originating zone, a reactive protocol takes over to check each successive zone in the route to see whether the destination is inside that zone. This reduces the processing overhead for those routes. Once a zone is confirmed as containing the destination node, the proactive protocol, or stored route-listing table, is used to deliver the packet. In this way packets with destinations within the same zone as the originating zone are delivered immediately using a stored routing table". Packets delivered to nodes outside the sending zone avoid the overhead of checking routing tables along the way by using the reactive protocol to check whether each zone encountered contains the destination node.

The proposed algorithm for creating cluster heads and clustering is Weighted Clustering Algorithm (WCA) that effectively combines each of the system parameters via The battery power, mobility and the degree (i.e. the number of nodes attached to a single node)with certain weighing factors chosen according to the system needs. The authors conducted simulation experiments to measure the performance of our clustering algorithm and demonstrate that it performs significantly better than both of the Highest-Degree and the Lowest-ID heuristics. In particular, the number of re-affiliations for WCA is about 50% of that obtained from the Lowest-ID heuristic. Though the approach performs marginally better than the Node-Weight heuristic (which does not give any basis of assigning the weights to the nodes), it considers more realistic system parameters and has the flexibility of adjusting the weighing fact.

The related works for balanced network are load balancing protocols which can be divided in two types first traffic size based which comprises of three protocols Dynamic Load-Aware Routing Protocol (DLAR), Load-Balanced Ad Hoc Routing Protocol (LBAR) and Load-Sensitive Routing Protocol (LSR), second is delay based which comprises of two protocols Delay-Oriented Shortest Path Routing Protocol (DOSPR), Load-Aware On-Demand Routing Protocol (LAOR). The Virtual Paths Routing protocol (VPR) which utilizes two well known routing techniques, namely source and table routing. The proposed solution approach by author was Traffic-Size Aware (TSA) Routing which is compared with Implicit Source Routing (ISR) protocol. The ISR used is close to the previously used VPR protocol. Authors used three performance metrics to compare our schema to ISR. The comparison done in the simulation between TSA and ISR is done using three metrics first metric is the Packet Delivery Ratio, second metric is the Routing overhead of both protocols third metric used is the Average End-to-End Delay of the data packets. In contrast to all proposed protocols authors proposed scheme measures the network traffic in bytes, not in number of packets. Measuring the traffic in bytes gives an accurate traffic load metric as opposed to measuring the traffic in number of packets because packet sizes may vary.

The key contribution of the paper is that the author uses Route Request (RREQ) messages to solve the problem. The related work for the load balancing was use of routing load of the intermediate nodes is used as the primary route selection metric. A RREQ message keeps recording queue occupancy information of each node it visits, and the destination selects a path that it considers as the best based on the queue occupancy information recorded in the RREQs. This scheme, however, lacked in path diversity since it was a single-path mechanism. To improve in path diversity the next protocol used multiple paths per destination, and they are maintained at source nodes and used in turn for routing. The basic idea of these schemes was to distribute traffic among multiple paths. These multi-path protocols also incur additional routing overhead due to maintaining more than one route per destination when compared to single-path protocols. The paper solves the problem by using the new scheme which is motivated by the observation that ad hoc on demand routing protocols flood Route Request (RREQ) messages to acquire routes, and only nodes that respond to those messages have a potential to serve as intermediate forwarding nodes. If node ignores RREQ messages within a specific period, it can completely be excluded from the additional communications that might have occurred for that period otherwise. Thus, a node can decide not to serve a traffic flow by dropping the RREQ for that flow. The paper uses simulation to compare the base AODV protocol and AODV-WAL protocol which uses the proposed scheme in which AODV-WAL demonstrated up to 32% less routing overhead than the base protocol. The advantage was that the network throughput is not adversely affected but rather improved by applying the new scheme to the base protocols. The new scheme successfully balances the network load among nodes, and it can easily be incorporated with existing on-demand routing protocols to work on top of them

METHODOLOGY

The "AODV (Ad-Hoc On-Demand Distance Vector) routing protocol is a reactive routing protocol that uses some characteristics of proactive routing protocols. Routes are established on-demand, as they are needed. However, once established a route is maintained as long as it is needed or till the time the route does not fails. An advantage of this approach is that the routing overhead is greatly reduced. In AODV, the network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time. When a link fails, a routing error is passed back to a transmitting node, and the process repeats.

Congestion Adaptive AODV Routing Protocol (CA-AODV):- CA-AODV was designed to ensure the availability of primary route as well as alternative routes and reduce the route overhead, DLAR discussed that the destination sends the load information attached in the RREP packet to source, Work Load-Based Adaptive Load-Balancing proposed that the nodes forward or broadcast the RREQ packet on the condition that they do not have a route to the destination. The protocol preserves the multiple paths carrying a higher hop count value and used them as alternate routes in case of link failure and modification will reduce congestion by choosing non congested routes to send RREQ and data packets and to transfer the load to higher hop count alternate paths if the nodes or route turn out to be congested.

Ad-hoc On-Demand Multipath Distance Vector (AOMDV):- The node that needs a connection in the network broadcasts a request for connection. Other AOMDV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. When a link fails, a routing error is passed back to a transmitting node and then the source node chooses the other saved path in the memory of the nodes and starts forwarding the packets.

II. EXPERIMENTATION

The algorithm which is followed by the AODV protocol the steps are:

Step 1:- Read source and destination ids
Step 2:- The source node sends RREQ messages to its neighbors which forwards the messages to other nodes till the destination is reached.
Step 3:- If anode receives a RREQ message more than once it replies with RREP message to indicate that it has received RREQ message which means that node is already added to some route to the destination.
Step 4:- The destination then reply via RREP messages which defines the path from source to destination. If RREP message is not received by the source node until a given predefined time it resends RREQ messages.
Step 5:- The routes is selected by the source node and then packets are forwarded to next node which forwards the packet to the next node in the queue this follows till the packet is not delivered to the destination node.

Details of Network Parameters used

The network parameters used for simulation scenarios were varied to analyze the performance of network routing protocol. The parameters those have been varied and their values are discussed below. The inputs are:

- Nodes Density: Node Density is the number of nodes in the network. It is given as the input to the system whose value has been varied linearly.
- Simulation Time: Simulation time is the time for which the simulation will run. It is given as an input to the system whose value has been varied linearly.
- Mobility: The mobility is applied to the nodes so that the simulation is represented as real time situation. The mobility of the nodes is kept random way point.

- Packet Size: This is an important input as it defines the size of the data packet that will be forwarded in the network from the source to the intermediate nodes which will transfer it to the destination node. The default packet size is 1024 bytes. But for the system two values are used which are 512 bytes and 1024 bytes.
- Type of Communication Protocol: The communication protocol used in the system is Transmission Control Protocol (TCP), which gives the acknowledgement message when the packet is received at the destination node.
- Speed of nodes: The speed of mobile nodes is the speed by which the node travels in the simulation. The speed of the mobile node is kept random.

III. Experimental Results & Analysis

Experimental Scenario I: -

Fixed Parameters:

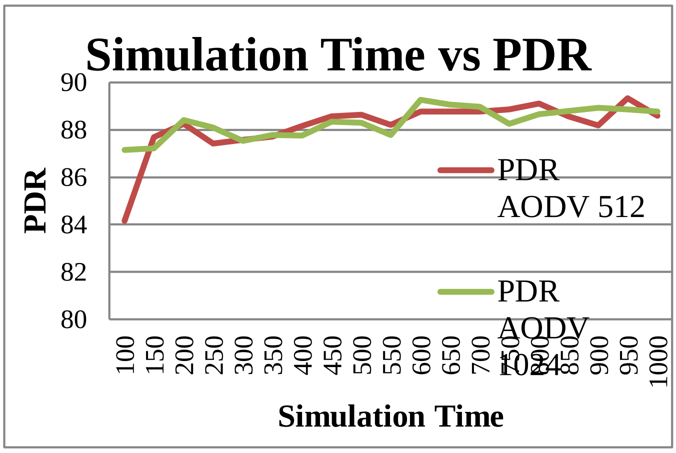
- Number of Nodes:- 200 nodes
- Mobility: Random Way Point

Varying Parameters:

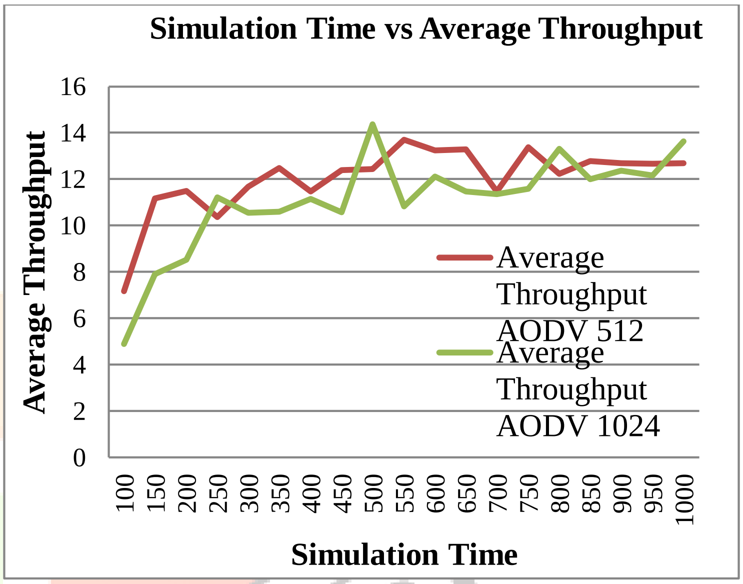
- Protocol Type: Varied with two values AODV and AOMDV
- Packet Size:Varied with two values 512 and 1024
- Simulation Time: 100 - 1000 in step of 50

Experimental Scenario II: -

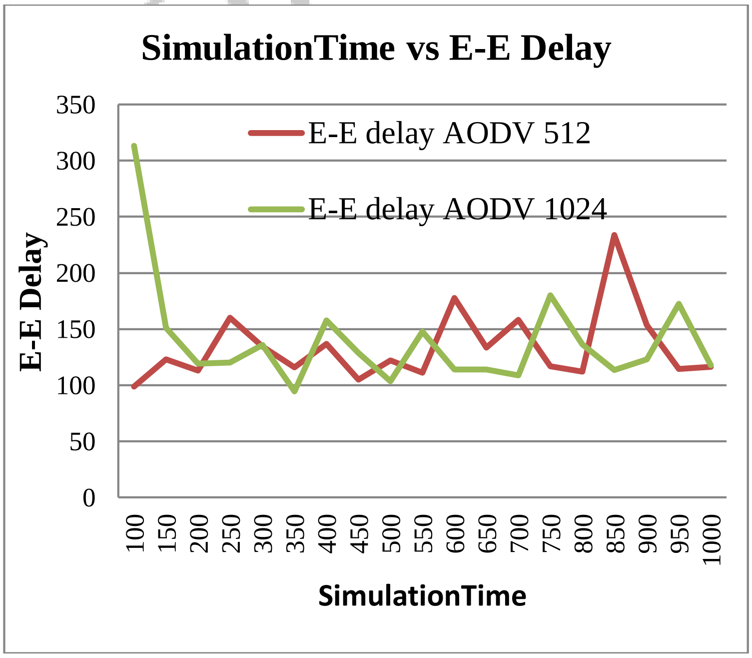
- Fixed Parameters:
- Mobility: Random Way Point.
- Simulation Time: 600 ms
- Varying Parameters:
- Protocol Type: Varied with two values AODV and AOMDV
- Packet Size: Varied with two values 512 and 1024
- Number of Nodes:- 50-500 nodes in step of 50



Analysis for 1024 Packet Size with Varying Simulation TimPDR vs Simulation Time (AODV)



Average Throughput vs Simulation Time (AODV)



Performance analysis of AODV with reference to

Scenario I:-

In this scenario we have fixed number of nodes to 200 and mobility to random way point and the Simulation Time the variable against which the graphs are plotted.
As the Simulation Time is increased it could be found that PDR randomly vary in values but is increasing by nature. It is also found that the performance of AODV is approximately same for both packet sizes. The PDR is worst for 100ms simulation time and it is best for 600ms simulation time for packet size 1024 bytes and for the 512 bytes packet size PDR is worst for 100ms and best for 950ms simulation time.
Average throughput also varies randomly in values but is increasing by nature with simulation time. The average throughput is worst for 100ms simulation time and it is best for 500ms simulation time for packet size 1024 bytes and for the 512 byte packet size average throughput is worst for 100ms and best for 550ms simulation time.
E-E Delay also varies randomly with time in values within the range of 98 to 233 for AODV of 512 packet size and for AODV of 1024 packet size E-E Delay varies within the range of 103 to 312. The E-E delay is worst for 100ms simulation time and it is best for 750ms simulation time for packet size 1024 bytes. It is also found that the performance of AODV is approximately same for both packet sizes.

Conclusion

Comparative performance analysis of two protocols AODV and AOMDV with reference to different network parameters was carried out. For the selected network parameters and their variations simulation was carried out using NS-2 (See Appendix 1) and the performance parameters PDR, Average Throughput, End to End Delay were analyzed. The performance analysis was done by comparing the various results obtained by the simulation. The results were analyzed for AODV for the experimental scenarios and then for AOMDV for the same scenarios. In the last step AODV and AOMDV are compared with each other for the performance analysis. It could be found that AOMDV performs better than AODV.

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