Performance Evaluation of AODV Protocol in MANET Using OPNET

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***Abstract*—MANET (Mobile Ad-hoc Network) is a group of individual mobile devices that communicate with each other by establishing their own temporary network. The nodes make their own topologies without any predefined strategy. The most common used routing protocols in MANET are proactive, reactive and hybrid but the reactive routing technique is very popular techniques for wireless network that provide a scalable solution for large network topologies. In this paper we will optimize the AODV routing protocol by changing the value of some perimeters in AODV. We will use some policies that help us to modify the default values of the perimeters in order to improve the efficiency of protocol and make an optimized AODV i.e. EAODV**

Keywords—OPNET, MANET, AODV

I. INTRODUCTION

Mobile Ad-hoc Network is a self established network where the different mobile nodes communicate with each other. These nodes may be cell phones, laptops or any other device. These nodes are free to move in the network and make the dynamic topology according to the need. The nodes that lie within the range of other node can communicate with each other by dynamically discovering each other. And if the nodes are not directly in the range can communicate through intermediate node. MANET becomes more popular now a days, because of its properties like dynamic topology, Bandwidth constrained, variable capacity links, Energy constrained operation, and limited physical security [1]. MANETs has plenty of applications in Tactical network-networks used in the defense services, commercial and civilian environments medical support, Entertainment and emergency services. Along with these great achievements in MANET there is some security issues in the network because of some features like open medium, dynamically changing network topology, Lack of centralized monitoring, cooperative algorithm, Lack of clear line of defense.

II. ROUTING IN MANET

Routing in MANET include to establish a link from source to destination in order to send or receive the data packets. Due to mobility of nodes a path established may not exist in the network for a long.

Routing protocols in MANET:-The routing protocols in the MANET is categorized into:

- Proactive routing protocol.
- Reactive routing protocols.
- Hybrid routing protocol.

A. Proactive Routing Protocol

It uses only symbols and signs to hide the information. It is further categorized into two ways: In proactive routing protocols every node has got the information about the whole network in order to maintain the table up to date. It also contains the information about any change or updating in the network. Here some predefined paths are available in the network and when any node intent to transfer data to other node it may use these routes. The benefits of these are that they perform quick action because of the availability of the routes, no need to discover the route and ultimately the delay will be less [2]. The drawbacks of these protocols are that every node contains the information about all those nodes where it is not required to communicate and use too many resources when the network is highly dynamic.

Examples:

- Destination Sequence Distance Vector (DSDV).
- Optimized Link State Routing Protocol (OLSR).
- Wireless Routing protocols (WRP).
- Cluster-head Gateway Switch Routing (CGSR).

B. Reactive Routing Protocols

These are also known as on demand routing protocols, here the node creates their route whenever needed. There is no pre defined path, the temporary path is generated on demand and this path may not exist after some interval of time. The route is discovered between two nodes by using some control packets i.e. Route Request (RREQ), Route Reply (RREP), Route Error (RERR). When any node wants to send data packets to destination it transmits the RREQ to its neighboring nodes. After receiving RREQ message the intermediate nodes sends RREP back to source node if their table contains the route to reach the desired destination [3]. This approach has less network overhead as compared to proactive routing protocols, but the discovering route process results in delay in the network. Examples:

- Ad-hoc On Demand Distance Vector (AODV)
- Dynamic Source Routing (DSR)
- Location Aided Routing (LAR)
- Temporally Ordered Routing Algorithm (TORA)

C. *Hybrid Routing Protocol*

Hybrid routing protocol is the combination of both proactive and reactive routing protocol. Some example of these protocols is:

Zone Based Routing Protocol (ZRP)

The structure of MANET is shown in the Fig. 1

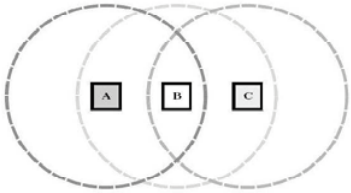

Fig. 1 Mobile Ad-hoc Network

III. WORKING OF AODV PROTOCOL

Ad-hoc On Demand Distance Vector (AODV) is the type of reactive routing protocol which creates the route only when a node wants to communicate with other node. In AODV protocol the route with high destination sequence number is preferred. In this protocol when a node wants to send the data packets to other node it sends directly to this destination node if it lies within its range, otherwise source node put out the RREQ packets to its neighboring nodes. The intermediate node receives the RREQ packet and takes the information about the route to destination node in its routing table. If there is no any fresh route present in the table it transfer the RREQ packets to the next neighboring node, and if there is a fresh route present then it checks the sequence number of destination node present in its table. The comparison of sequence number of destination node presents in the intermediate node and sequence number of destination node in RREQ packets takes place [4,5]. If the sequence number present in the intermediate node is higher or equal to the one present in the RREQ node then the route through this node is selected. Here this node sends the RREP packet to the source node in the same path from where the RREQ packet comes. After receiving RREP packet source node send data packets to this node to reach the destination node [6]. The packet format of RREQ and RREP is shown in the Table I and II respectively.

TABLE 1

Type	Flags	Reserved	Hop count
RREQ (Broadcast) ID			
Destination IP address			
Destination sequence number			
Source IP address			
Source sequence number			

(a) RREQ

TABLE 2

Type	A	Reserved	Hop count
Destination IP address			
Destination sequence number			
Source IP address			
Source sequence number			

(b) RREP

IV. PROPOSED METHODOLOGY

Here, we present different adaptable parameters to optimize AODV routing algorithm and describe their effects on energy constraints. The parameters we target to optimize AODV routing algorithm are Active Route Timeout, Hello Interval and Hello Message loss. The Active Route time out is the lifetime of the routing table. After this period of time the MANET will not consider this route. Hello interval is the time taken by the source node to send the hello message to the other node to make a contact with the intermediate node [7]. For each parameter, we present a discussion on how the parameter affects energy consumption through routing QoS and present an adaptation policy to reduce energy consumption by finding the appropriate value of these parameters considering the current channel conditions.

A. *Proposed Algorithm*

The proposed algorithm shows the effect of different parameters on energy consumption through routing QoS. And also helps us to find the appropriate value of the parameters. First we take an example of Active route time out i.e. the lifetime of a routing table entry if a route is not used and refreshed within this "Active route timeout" period, AODV marks the route as "Invalid" and removes it from IP Common Table. The constant value is used to modify the values of the parameters. First of all Set Active Route time as any value X and calculate the results of Quality of service and routing results for that value X. After taking the previous value suppose the constant value is added in this value then the value becomes XI. Then again the simulation takes place in different scenarios and calculates the result of QoS for XI if the result becomes better than X then calculates results for routing parameters, and if the result is not better than previous one then the value remain X. Then again simulation takes place for routing parameters if this result become better than X then the value of X become XI. If the result will not better than the previous one then the value of X will change. Similarly the value of Hello interval and Hello message is modified.

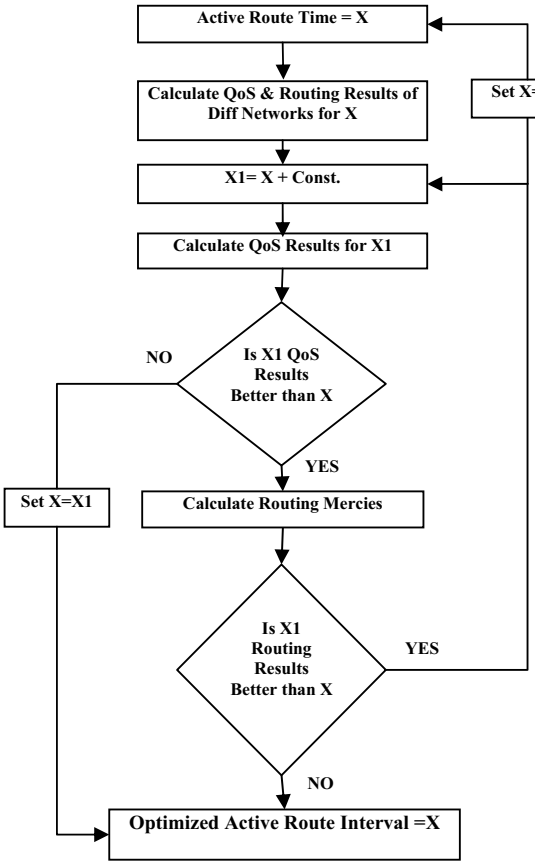

Fig. 2 Algorithm to modify AODV

B. *Comparison of AODV and EAODV*

1) *Simulation setup*

Using OPNET 14.5 simulator, we have designed and investigate Ad-hoc wireless network scenarios with different network size of [500*500 m^2, 1000*1000 m^2, 1500*1500 m^2, 2000*2000 m^2, 2500*2500 m^2]having with different number of [20, 40, 60, 80, 100] nodes respectively. Mobility model used is random waypoint model with mobility of 1000 meters, the performance of the reactive ad-hoc routing ADOV and EAODV protocol is evaluated by implementing different scenarios. The buffer size of data is set to 256Kbps for each mobile workstation at data rate of 54Mbps with 802.11b PHY layer & DCF MAC Protocol implementation. The traffic flows randomly between different Voice applications workstations placed at different distances. We take the different network size according to the number of node as on increasing the number of nodes in a MANET; there will obvious increase power consumption. So by changing the value of Active Route Time, Hello Loss, and Hello Interval we make a scenario (EAODV) and compare with the standard scenario (AODV). The simulation parameter of both scenarios is given in table IV and table V. The WLAN parameter is common to all mobility scenarios as Table III.

TABLE 3 SIMULATION PARAMETERS

Routing Protocol	AODV
Wireless LAN MAC Address	Auto Assigned
Physical Characteristics	IEEE 802.11g (OFDM)
Data Rates(bps)	54 Mbps
Transmit Power	0.005
RTS Threshold	256
Packet-Reception Threshold	-95
Long Retry Limit	4
Max Receive Lifetime(seconds)	0.5
Buffer Size(bits)	256000

TABLE 4 SIMULATION PARAMETERS-AODV

Active Route Timeout(sec)	3
Hello interval(sec)	1,1.1
Hello Loss	2
Timeout Buffer	2

TABLE 5 SIMULATION PARAMETERS–EAODV

Active Route Timeout(sec)	22
Hello interval(sec)	3.5,3.6
Hello Loss	4
Timeout Buffer	2

V. RESULT AND ANALYSIS

To evaluate the various performances of AODV and EAODV in different scenarios we have determined the various QOS and routing parameter such as Route discovery time, Retransmission attempts, No of hopes End to end delay and packet delivery ratio. Figure 3 shows the comparison of Route discovery time between AODV and EAODV at different number of nodes. Route discovery time shows the time taken by the source node to discover the route from source to destination. EAODV takes the less time as compared to AODV to discover the route. In case of 80 nodes the EAODV takes 0.1 sec and AODV takes 0.4 seconds. The value of route discovery time increases with increase in the number of nodes. The figure 4 shows the retransmission attempts versus number of nodes. This shows the number of attempts the source node takes to send data from sources to destination safely. At 100 nodes EAODV has very less retransmission attempts and its value decrease with increase in number of nodes. Figure 5 shows the number of hopes, at the initial state the value of Number of hopes in case of EAODV is more because the less number of nodes. In case of 40 or more than 40 nodes the value of number of hopes of EAOBV is decreased. The figure 6 shows the End-to-End delay[8][9]. It represents the end-to-end delay of all the data packets that are successfully received by the WLAN MAC and forwarded to

the higher layer. Our proposed protocol has less delay. The Figure 7 shows the packet drop ratio i.e. number of packet received from total number of packet sent, so in all the cases EAODV has better result.

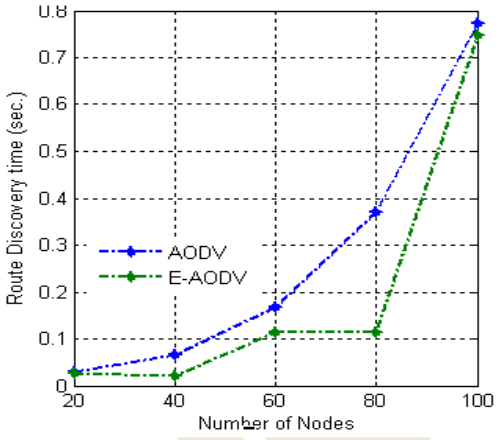

Fig. 3 Route Discovery Time Comparison of AODV and EAODV

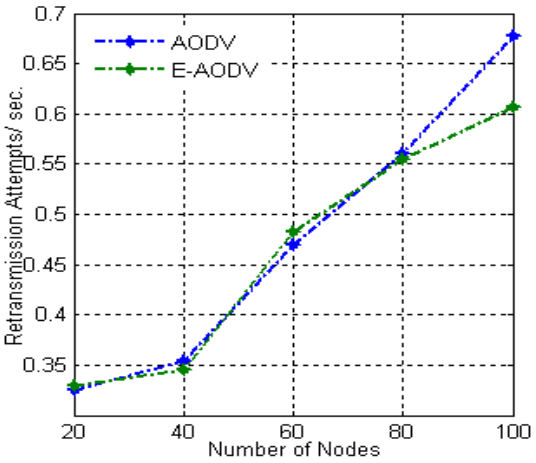

Fig. 4 Retransmission Attempts /sec

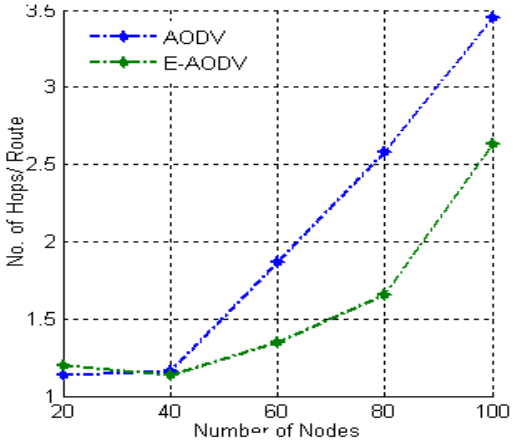

Fig. 5 No. of Hops/ Route

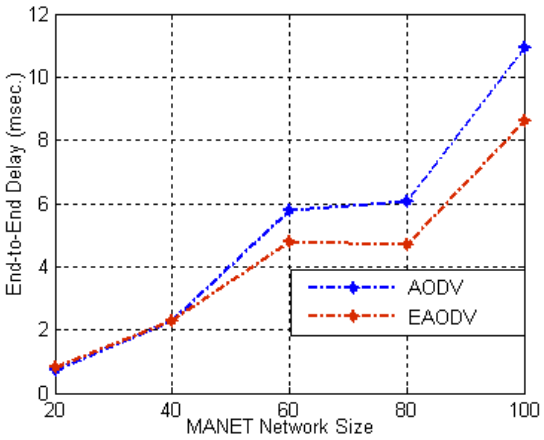

Fig. 6 End-to-End Delay

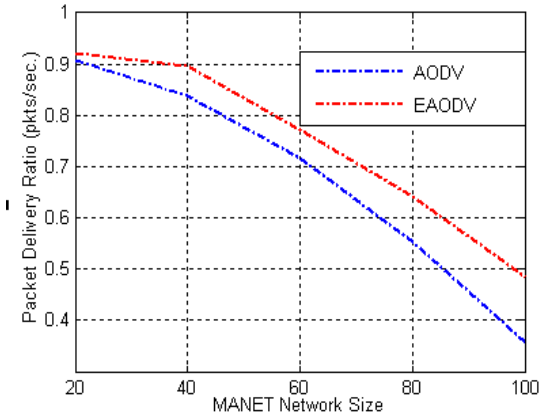

Fig. 7 Packet Delivery Ratio

VI. Conclusion

The simulation model of MANET network is developed using OPNET 14.5 simulator and analyzed for AODV routing protocol. We applied some methodology to improve the performance of AODV protocol by modifying the values of perimeters like Active Route Timeout, Hello Interval and Hello Message loss and make EAODV. We applied this modified AODV to different numbers of nodes like 20, 40, 60, 80 and 100 and concluded that this is effective in all the cases. It is concluded that EAODV has better Quality of service and Routing results than AODV protocol. In future work we will apply this algorithm to other routing protocols.

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