



## Modeling, Implementation and Performance Evaluation of E-AODV Routing Protocol in MANETs

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**Abstract--** In MANET, there is no pre defined infrastructure to monitor the resources used by the mobile nodes. The Ad Hoc On Demand Distance Vector (AODV) and most of the on demand ad hoc routing protocols uses the idea of particular route reply beside the reverse path. Due to immediate changes of network structure the route reply may not arrive to the source node resulting in sending many route request messages and decreasing the concert of the routing protocol. To overcome these all the problems, an efficient AODV (E-AODV) routing protocol is projected. In E-AODV the destination a node recognizes first route request message (RREQ), it produces Turn-Around route request (TA-RREQ) message and deluges it to neighbor nodes within transmission range. When the source node receives first TA-RREQ memo, then it starts packet broadcast, and late entered TA-Route Requests are saved for further use. It decreases route fail variation messages and gets very good performance as compared to existing AODV. The performances of AODV and Efficient AODV routing protocols are assessed based on varying pause time and maximum speed of nodes using NS-2.34. It is examined by the simulation results that the performance of E-AODV routing protocol is better than existing AODV routing protocol in the forms of packet delivery fraction, average throughput and end to end delay specially in high speed mobility and pause time.

**Keywords--** AODV, E-AODV, MANET, TA-RREQ.

### I. INTRODUCTION

A Mobile ad hoc network (MANET) is a compilation of wireless nodes that can passionately structure a network to exchange information without using any pre defined network infrastructure. These are generally mobile devices and that's why it is called as Mobile Ad hoc NETWORKS. MANETs are defined as a "mobile ad hoc network" is an independent system of mobile connected by wireless links the union of which built an arbitrary topology [1]. The routers are free to move randomly and place themselves randomly, that's why the network wireless topology can be change speedily and arbitrarily such a network may operate in an unbiased way. If two nodes are not within the diffusion range of each other, other nodes are needed to serve as middle routers for the message between sources to end node. Furthermore, mobile devices wander unconnectedly and converse via excitedly changing network. Thus, several change of network topology is a hard challenge for a lot of important issues, such as routing protocol heftiness, and performance ruin resiliency. Proactive routing protocol requires nodes to switch routing information infrequently and compute routes continually between any nodes in the network, in spite of of using the routes or not This means abundant network resources such as energy and bandwidth may be washed out, which is not advantageous in MANETs where the resources are very important. On the other hand, on-demand routing protocols do not exchange routing information infrequently [2]. Instead, they find out a route only when it is required for the communication between two nodes. Because of this active change of network on ad hoc networks, relatives between nodes are not fixed. In occasions, a node can't send packets to the projected next hop node and this will lost the packets. Loss of packets may authority on route performance in many ways. Along with these packet sufferers, loss of route reply brings much extra problems, because source node needs to reinitiate route detection course of action to send packets. In this paper we proposed well-organized AODV which has a new feature contrasted to other on-demand routing protocols on ad-hoc networks. In E-AODV, route reply message is not uni-cast, destination node uses turn-around RREQ (TA-RREQ) to find source node. It decreases route path fail alteration messages and can improve the performance. Thus, success rate of route discovery may be increased even in high node mobility condition. The simulation results show our proposed algorithm improves performance of AODV [9] in most metrics, including packet delivery fraction, average end to end delay and average throughput especially in high speed mobility of nodes and pause time [2].

### II. LITERATURE REVIEW

#### 2.1 Ad-Hoc on Demand Distance Vector Routing Protocol (AODV)

Royer et.al.[3] The Ad-hoc On-Demand Distance Vector routing Protocol (AODV), is one of more considered routing

algorithm in ad hoc networks and is based on the law of find out routes as required. AODV routing algorithm is a famous method for structure routes paths among network nodes. The request is made on-demand not in advance, to explanation for the frequently changing network topology, which is credible to in legalize routing tables over time. In AODV [4], when a source node requirement to send packets to the destination but no route is available, it begins a route discovery operation. In the route discovery process, the source transmits route request (RREQ) packets. The routing table stores information about next hop to the destination and a sequence number which is obtained route request packet to its neighbors. The RREQ has following fields: source address, source sequence number, destination address, broadcast ID, destination sequence number and hop count. When center nodes get hold of a RREQ, they amend their routing tables for a turn-around route to the source and like this process, when the center nodes receive RREP they revise the ahead route to the destination. The RREP contains the following fields: source address, destination address, hop count up and lifetime. AODV protocol uses sequence numbers to recognize the timeliness of each packet and to avoid configuration of loops. Once the RREQ reaches the destination, the destination or in-between node responds by uni-casting a route reply (RREP) packet reverse to the neighbor from which it first established the RREQ.

As the RREP [5][6] is routed rear along the reverse path, nodes along this path set up forward route entries in their routing tables which point to the node from which the RREP came. These forward route entries point out the present forward route. The route timer is used to removal of the entry if it is not used within the particular lifetime. Since the RREP is forwarded along the path formed by the RREQ. Routes are maintained as follows. If a source node moves from its original position to other place, it is able to re-initiate the route discovery process to find another route to the destination. If a node along the route moves, its upstream neighbor examine the move and shows a link failure notification to each of its lively upstream neighbors to inform them of the removal of that part of the route. These nodes in turn circulate the link failure information to their up-stream neighbors, and so on awaiting the source node is reached. The source node may then choose to re-initiate route discovery for that end if a route is still required. AODV algorithm uses Route Error Message (RERR) route failures and link failures propagated by using RERR message from a broken link to the source node of the matching route. When the next hop link fails, RERR packets are sent by the starting node of the link to a set of neighboring nodes that communicate over the failed link with the end node [7][8][9].

### III. Problem Statement

AODV and most of the On-Demand Ad Hoc Routing Protocols in MANETs [10] [14] use solitary route reply along overturn path. Quick change of network topology causes that the route reply could not get there to the source node, i.e. after a source node sends several route request messages; the node obtains a reply message, particularly on high speed mobility. This causes decrease routing performance, like, long end-to-end delay, low packet delivery fraction and average throughput. Therefore, we are considering how merely to decrease the breakdown of RREP messages.

### IV. MODELING OF PROPOSED EFFICIENT-AODV (E-AODV)

We propose the E-AODV to avoid RREP loss and improve the presentation of routing in MANET. E-AODV uses precisely same procedure of RREQ of AODV to deliver route reply message to source node. We call the route reply messages *turn-around route request*. E-AODV protocol can respond from end to source if there is at slightest one path to source node. In this way, E-AODV put offs a large number of re-transmissions of route request messages, and hence diminish the overcrowding in the network. Moreover, E-AODV will get better the routing performance such as packet delivery fraction, throughput and end-to-end delay especially in high speed mobility of nodes and pause time

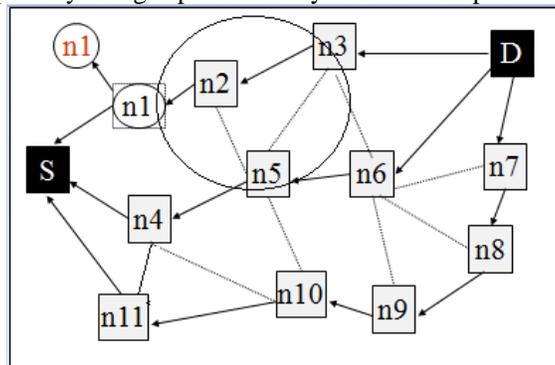


Fig 1: TA- Route Request in Efficient AODV

Let's see the same case of AODV, we have mentioned, in Fig 1. In E-AODV, destination does not uni-cast reply along fixed shortest reverse path D-n3-n2-n1-S. It floods TA-RREQ to find source node S. And forwarding path to end is built throughout this TA-RREQ. Following paths might be built: S-n4-n5-n6-D, S-n11-n10-n9-n8-n7-D, and etc. Node S can decide best one of these paths and start forwarding data packet. So RREP delivery be unsuccessful problem on AODV does not occur in this case, even although node 1 moves from broadcast range.

#### 4.1 Implementation

AODV and efficient AODV are tested on NS-2.34 which is a separate event simulator targeted at networking do research work. It provides substantial support for simulation of TCP, routing and multi-cast protocols on restless and wireless networks both. It consider of two simulation tools. The ns-2 simulator has quite a few features that make it suitable for investigational result.

#### 4.2 ALGORITHM FOR PROPOSED E-AODV PROTOCOL

The efficient AODV (E-AODV) routing protocol discover out routes on-demand using a turn-around route discovery mechanism. In E-AODV the end node receives first route request message (RREQ), it generates turn around route request (TA-RREQ) message and broadcasts it to neighbor nodes within broadcast area. When the source node receives first TA-RREQ message, then it starts packet broadcast, and late arrived TA-RREQs are put aside for prospect use. It reduces route fail alteration messages and gets good performance than the accessible AODV.

**STEP-1** In E-AODV Route request message have following fields like source IP address, end IP address, hop add up, broadcast ID, source sequence number, request time and destination sequence number to uniquely recognize this route request message.

**STEP-2** When the destination node gets initial route request message, it makes turn around route request (TA-RREQ) message and transmits it to neighbor nodes within broadcast area.

**STEP-3** In E-AODV turn-around route request message contain subsequent fields like broadcast ID, destination IP address, Destination Series Number, Source IP address, Reply Time and hop count.

**STEP-4** When transmitted TA-RREQ packet arrives to center node, it will check for photocopy communication.

**STEP-5** If it beforehand received the similar message, the message is dropped, else forwards the message to succeeding nodes.

**STEP-6** When the source node get hold of first TA-RREQ message, then it starts distribution packet.

**STEP-7** Late indoors TA-RREQs are reserved for further use.

**STEP-8** The transaction routes can be used when the main route breaks connections.

#### 4.3 IMPLEMENTATION CODE FOR PROPOSED E-AODV PROTOCOL

The following modification is done in original AODV code for put into practice efficient AODV routing protocol in Route Reply, small proposed code snippet is shown below:

```
recvTurnAroundRouteRequest(Packet *p) {
    struct hdr_ip *ih = HDR_IP(p);
    struct hdr_aodv_reply *rp = HDR_AODV_REPLY(p);
    char suppress_reply = 0;
    double delay = 0.0;
    aodv_rt_entry *rtc;
#ifdef DEBUG
    fprintf(stderr, "%d - %s: received a RQREP\n", index,
            __FUNCTION__);
#endif // DEBUG
    if (rp->rp_src == index) {
#ifdef DEBUG
        fprintf(stderr, "%s: Got my own RQREP\n",
                __FUNCTION__);
#endif // DEBUG
        Packet::free(p);
        return;
    }
    aodv_rt_entry *rt0; // it is reverse path
    rt0 = rtable_rt_lookup(rp->rp_src);
    if (rt0 == 0) {
        rt0 = rtable_rt_add(rp->rp_src);
    }
}
```



Traffic type	CBR
Packet Size	512 bytes
Maximum Speed	10,20,30,40,50,60 m/sec
Simulator	NS-2.34
Mobility Model	Random Waypoint
Packet Rate	2.0 packet/sec

### VI. RESULT ANALYSIS OF MOBILITY BASED AODV AND E-AODV

In this section the untried results is shown for mobility based performance of AODV routing protocol and proposed E-AODV. We compare them using three metrics:

*The end to end delay:* is defined as the time a data packet is received by the destination minus the time the data packet is generated by the source.

*Packet delivery fraction:* The ratio of the data packets delivered to the Destinations to those generated by the constant bit rate sources. Packets delivered and packets missing are taking in to reflection.

*Average Throughput:* There are two symbols of throughput; one is the amount of data transferred over the period of time expressed in kilobits per second (Kbps).

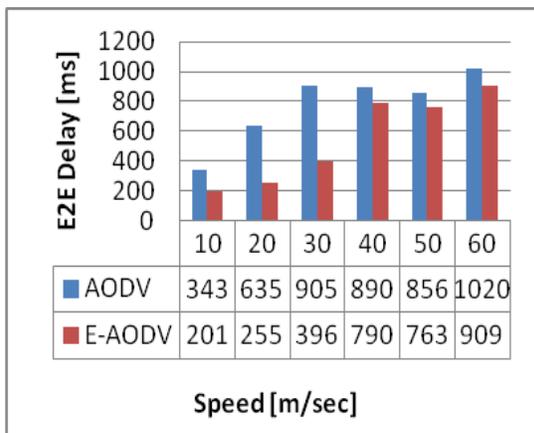


Fig 2: Mobility Vs End to End Delay

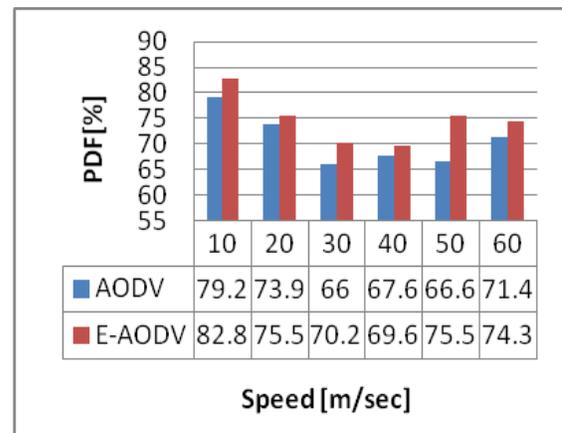


Fig 3: Mobility Vs Packet Delivery Fraction

Figure 2 shows the average end-to-end delay of each protocol. It should be noted that the delay is considered for the packets that actually arrive at the destinations. We can see that E-AODV has lower delay than AODV. The reason is that AODV chooses route earlier, E-AODV chooses recent route according to turn around request. Especially E-AODV gives lower delay in high speed mobility it is clearly shown in the figure.

Figure 3 shows packet delivery ratio of each protocols on varying node speed. In almost all cases, E-AODV shows better performance in packet delivery ratio. From Figure 4 it is clear that at 10m/s onwards E-AODV outperforms than AODV because as the throughput of AODV decreases with node velocity.

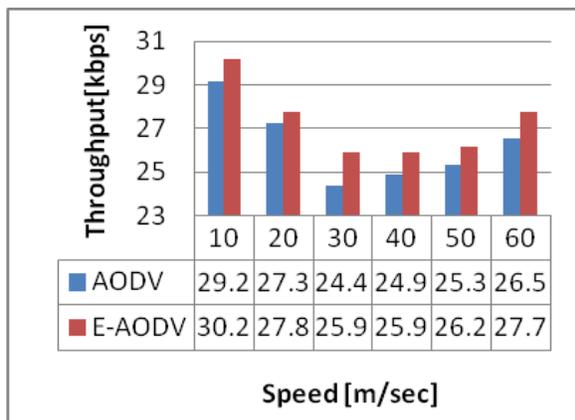


Fig 4: Mobility Vs Average Throughput

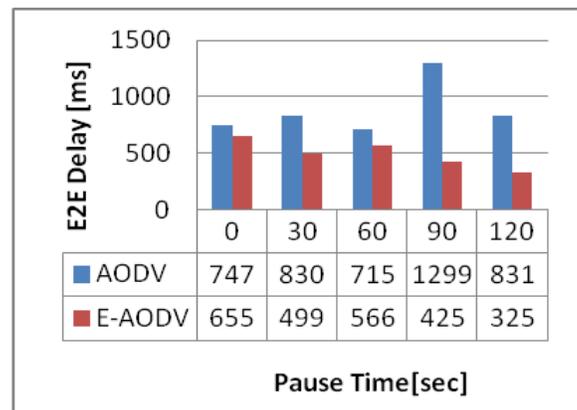


Fig 5: Pause Time Vs End to End Delay

VII. PAUSE TIME BASED PERFORMANCE EVALUATION OF AODV & E-AODV

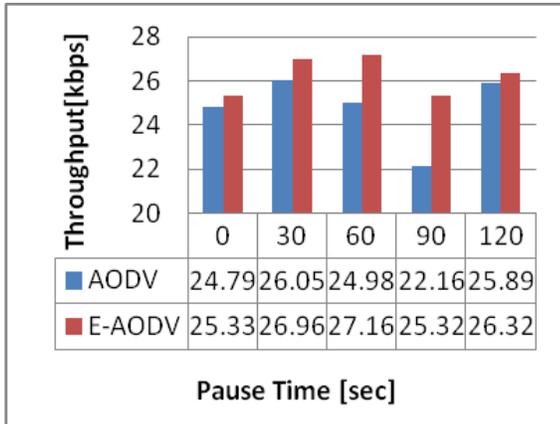


Fig 6: Pause Time Vs Packet Delivery Fraction

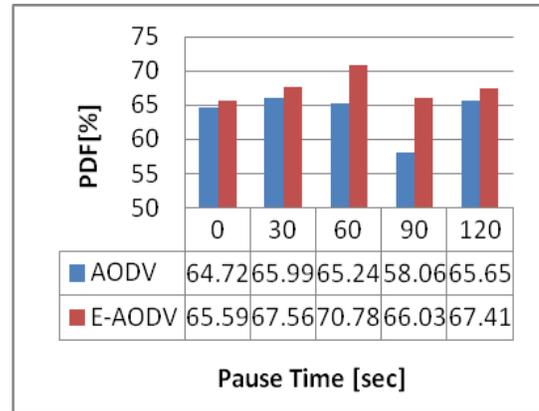


Fig 7: Pause Time Vs Average Throughput

Figure 5 shows that the average end-to-end delays of each protocol. It should be noted that the delay is considered for the packets that actually arrive at the destinations. It is clearly shown in the figure at pause time 0 onwards E-AODV has lower end to end delay than AODV. The lowest delay of E-AODV is 325 ms at pause time 120. The reason is that AODV chooses route earlier, E-AODV chooses recent route according to turn around request.

Figure 6 shows the result of Packet Delivery Fraction (PDF). This part of analyzing is important as it describes the rate of packets drop as well as it affects the overall network throughput that the network can support. It shows packet deliver ratio of AODV and E-AODV, by increasing pause time brings apparent difference between the two protocols. The Average End-to-End Delay is defined as the interval time between sending by the source node and receiving by the destination node, which includes the processing time and queuing time. The End to End Delay is a significant parameter for evaluating a protocol which must be low for good performance.

Figure 7 it is clear shows that, when pause time increase than E-AODV produce good result in compare to existing AODV. The highest throughput of E-AODV routing protocol is 27.16 kbps at pause time 60 because as the throughput of AODV decreases with node velocity.

VIII. Conclusion

In AODV routing protocol route reply messages are extremely important for ad hoc networks for send messages. The loss of route replies causes grave destruction on the routing performance. This is since the rate of a route reply is very high. If the route reply is lost, a large quantity of route discovery effort will be washed out. In addition, the source node has to re-initiate another route detection to establish a route to the end. In this paper it is proposed that the idea of efficient AODV, which attempts turn around route request (TA-RREQ). E-AODV route detection succeeds in smaller amount tries than AODV. We conducted widespread simulation study to evaluate the performance of E-AODV and compared it with that of existing AODV using NS-2 simulator. The results show that E-AODV improves the performance of AODV in most metrics, as the end to end delay, packet delivery fraction and average throughput especially in high speed mobility of nodes and as well as in pause time. Our Future work will be to evaluate the performance of AODV and E-AODV routing protocols by taking different metrics like by varying traffic source etc. The proposed algorithm would be used and tested on diverse routing protocols like DSR and Hybrid protocols.

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