International Journal of Software Engineering and Its Applications
Vol.8, No.8 (2014), pp. 119-130
http://dx.doi.org/10.14257/ijseia.2014.8.8,12

Performance Evaluation of E2AODV over AODV for Mobile Adhoc Networks

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Abstract

To reduce over head for mobile adhoc network, Adhoc on demand distance vector routing protocol is designed by the usage of Expanding Ring Search technique. In this MANET energy consumption is also considered due to the battery usage of nodes. In this paper, based on ERS we proposed an energy efficient route discover process for AODV. Our approach is to save the energy of the nodes by avoiding redundant rebroadcasting of the route request packet. Based on the broadcasting of RREQ packet of the node neighbors, the relaying status of the node is decided which helps in reducing route overhead that occurred during the discovery of route process. Using NS2 the simulations are performed to study the performance of Energy Efficient AODV (E2AODV).

Keywords: *Mobile Ad-hoc Networks, Ad-hoc On-Demand, Distance Vector Routing Protocol, Expanding Ring Search, Energy Consumption.*

1. Introduction

Network is a collection of interconnected nodes of wired and wireless. A wired network is linked by a Ethemet cables which is a collection of two or more computers, printers, and other devices. For communication between the nodes in a wired network uses high frequency radio waves rather than wires. Sharing of devices in wireless can be done without using networking cables that increases mobility and decreases the rang. A wireless Ad-hoc network is decentralized type wireless network. It is known as Ad-hoc as it does not depend on pre-existing infrastructure.

MANET is an infrastructure wireless network. The user directly communicates with an access point or base station. Using wireless links mobile nodes communicate with each other. In MANET nodes directly communicate with destination or neighbor intermediate node having any base station for the transmission of packets with in wireless transmission range. The node cooperation for transmission of packets from source to destination.

ISSN:1738-9984 IJSEIA

In MANET the mobile devices are limited battery life. Communication between the nodes is determined by protocol and the existing protocol can be modified to become more energy efficient. There are many applications of mobile ad-hoc network in various fields such as Emergency Services, military communication, automated battle fields, commercial and civilian environment, Education Entertainment Sensor network, Context aware services and Coverage extension, home and enterprise networking.

There are many protocols that are developed in many ways for MANETS. The routing protocol based on the network structure classified as flat routing, hierarchical and geographical routing. In flat routing nodes communicate with each other directly, which are further classified as proactive, reactive and hybrid.

The proactive protocol is also known as the Table driven protocol and maintains the routing information even before it is needed. In network every node maintains the routing information. A route information is generally kept in the routing tables comes from the link-state routing and periodically updates as the network topology changes. The examples of the proactive protocol are distance vector (DV) protocol, Destination Sequenced Distance Vector (DSDV) protocol, Wireless Routing protocol , Fisheye state routing (FSR) protocol.

The reactive protocol is also known as the on-demand routing protocol. The reactive routing protocols do not maintain any routing information of the network node if there is no communication. In order to connect with another node for transmission and receiving of packets the reactive protocol searches for the route using on-demand manner. These protocols reduce the overhead. The examples of reactive protocol are Dynamic Source Routing (DSR), Ad-hoc on demand routing (AODV) and Associativity Based routing (ABR) protocols.

The combination of both proactive and reactive routing methods is called hybrid routing which is better than both used isolation. It includes the advantages of both protocols.

2. Related Work

For Ad-hoc mobile network a routing protocol is designed is known as Ad-hoc On Demand Distance Vector (AODV). AODV is an on-demand algorithm that builds routes between nodes that are desired by source node, the AODV used in both unicast and multicast routing. When it is required only AODV finds the route between source and destination pair.

In order to discover the path required by the source node AODV uses route request (RREQ) message flooded through the network. The RREQ is broadcasted to entire network so every neighbor nodes will receive and process it. All the nodes check the routing table for route when it receives the RREQ for the first time. If there is route, it unicasts the RREP to source, otherwise it rebroadcasts the RREQ to its neighbors. If RREQ is received, it will silently drop RREQ. If the node is destination, it unicast the RREP to the source. It maintains the route as long as it is required once the route is established. When the intermediate node losses the connectivity, the RERR will be send to the source and source sends the packets either through alternate paths or it will restart the route discovery process, this leads to the consumption of energy.

To overcome this problem by using the Expanding ring search. The Time To Live technique of expanding ring search avoid network wide broadcasting by searching a larger area around the source of broadcast. The goal of this algorithm is to find a node which gives the information needed for the destination in their way. ERS is widely used especially in multi-hop wireless networks.

The center of the search ring is the source node. Searching can be done over large area by ERS until the node gets the needed information. The maximum nodes of RREQ message can go through is determined by TTL value. Initially in ERS the value of TTL is set to a value say

N. Thus the message is broadcasted in a ring with the radius of N hops. N is decreased by the value say k when the route to destination is not found and again the message the broadcasted this is repeated until TTL value is more than threshold. When TTL value is more than threshold value is set to limited value then RREQ is broadcasted to entire network Node D on receiving the RREQ message reply to the node S by sending RREP message which indicates the way to D.

In the below Figure, in order to send the packet from source S to destination D, S uses ERS to find the path to D. The searching of destination D by ERS done by increasing the TTL value and forms the ring structure which is shown in fig. For simplicity, initial the value of TTL has been taken as 1 that is the S can send the RREQ to its one hop neighbors and forms the first ring. If the nodes in the first ring does not have any information about the destination the source again restart the search by increasing broadcast ID and TTL value.

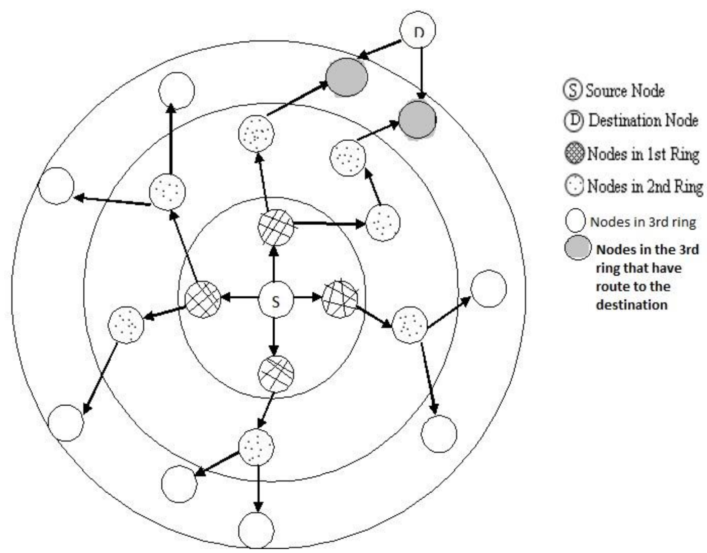


Figure 1. Examples of ERS Techniques

The TTL value for the 3rd ring is 4 and some nodes in the third ring have the route to the destination. So the node will unicasts the route reply (RREP) to the source. When the route D has not been found out in the 3rd search the S will rebroadcast the RREQ using the ring search technique till it find destination route.

The ERS mechanism, it has the advantage of using energy efficiently and reduces overhead but it has certain disadvantages. In this mechanism the RREQ message is rebroadcasted by source node several times if destination is far away from source. When the intermediate node receives the message has to process it again and again which leads to consumption of lot of energy and routing overhead. To overcome this problem various methods have been proposed.

The overhearing scheme is one of the proposed method that is used. In this local topology information of the node is collected in the first search and has been used in the next search by the nodes in the first ring. The nodes in the first ring forward the RREQ only when its RREQ is forwarded by its neighbors. There can be a problem occurred when TTL value is 2. If TTL value < 2 then its neighbors will not forward RREQ so the problem occurs that border nodes cannot able to transfer again RREQ. Thus it is not efficient in finding routes.

To find the route, in the ERS the source node will broadcast the RREQ to its neighbors. If the neighbor's node receives the node for the first time will relay the RREQ else it will just drop the packet. There will be useful information regarding the sender and last hop, dropping the duplicate packets wastes the neighbor's information.

For this we use the design which utilizes the information before dropping the duplicate RREQ packet to make decision about node's relay value. This design helps in reducing energy consumption for AODV routing protocol and helping making some nodes silent without forwarding redundant rebroadcast of RREQ. This improved ERS scheme is named as Energy Efficient AODV (E2AODV).

3. E2AODV

In E2AODV, the state of the node is determined as relaying or being silent by using the relay value of each node in the network. The values of all the nodes of relay and forward are initially set to 1 as shown in Figure 2, which means it will transfer the RREQ. Based on TTL value and the P-Addr field in the RREQ packet the values of relay and forward will be updated. By the information provided by the duplicate RREQ packet the value of the rely will be changed.

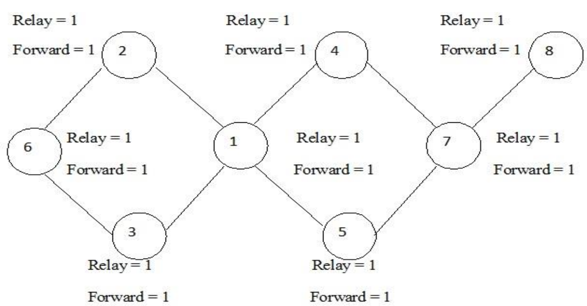


Figure 2. Nodes of Relay and Forward are Initially Set to 1

In Figure 3, the node 6 forwards RREQ packet to node 2. Then node 2 checks whether the received packet is duplicate or not. The RREQ packet is not a duplicate one. So it checks for the TTL > 0. If it is (TTL>0) then it checks whether the SD of RREQ is processed before or not. In this process, the SD pair is not processed before, so it checks for the (TTL>=2). If that (TTL>=2) is false then the relay should be set to 0 (R=0) and forward value to 1 (F=1) and relay the RREQ packet.

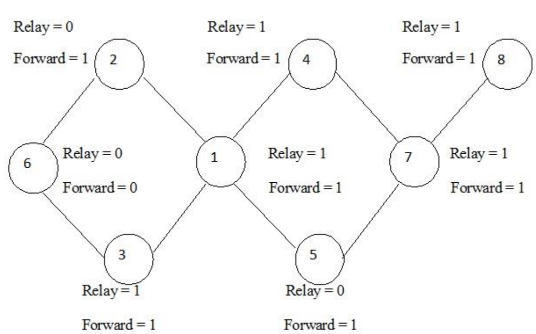


Figure 3. Node 6 Forwards RREQ Packet to Node 2.

In the Figure 4, node 6 checks the node addr is equal to the PreAddr or not. In this case the node addr is same as PreAddr. So that the relay value should be set to 1 (R=1).

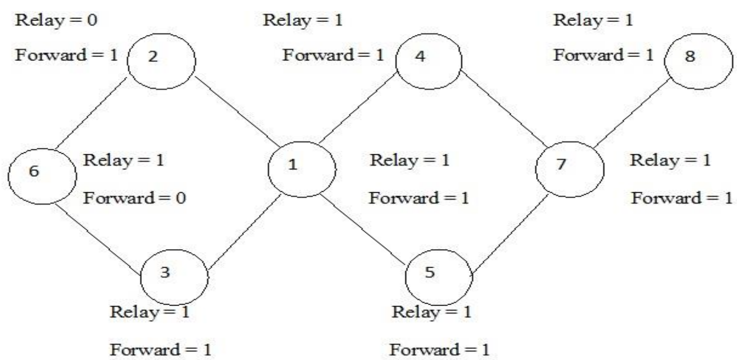


Figure 4. Node 6 Forwards RREQ Packet to Node 2

The node 6 wants to forward the RREQ to node 3. The procedure for forwarding RREQ is shown in Figure 5. The node 6 don't interact with in the network because the relay and forward is equal to zero.

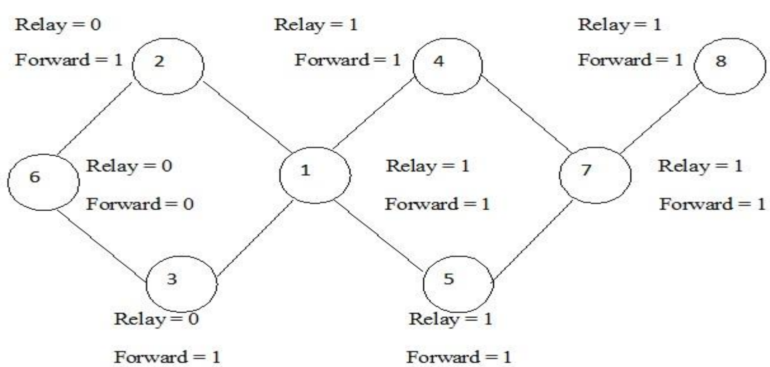


Figure 5. Node 6 Forwards RREQ Packet to Node 3

The node 3 is source node, it sends RREQ packet to the node 1. The procedure for forwarding RREQ is shown in Figure 6.

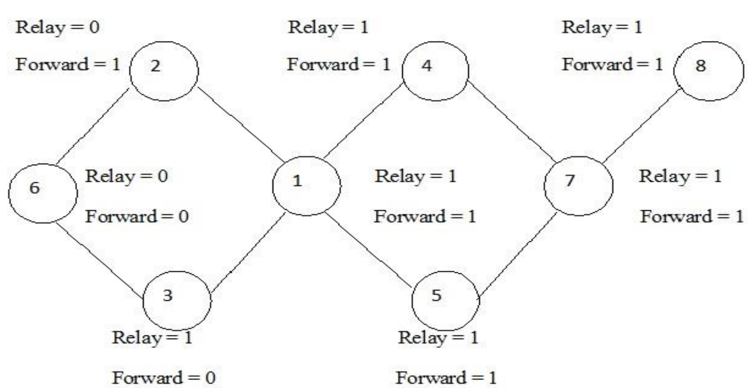


Figure 6. Node 3 Forwards RREQ Packet to Node 1

The node 1 address is same as the Preaddressed shown in Figure 7. So that the relay value is set to 1 (R=1).

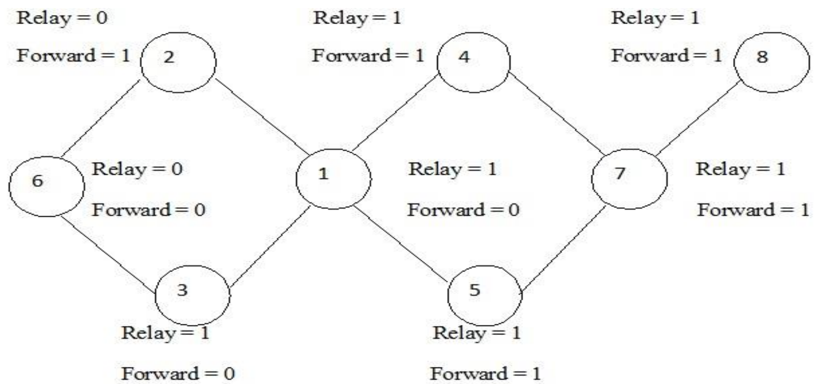


Figure 7. Node 1 Address is same as Node 3

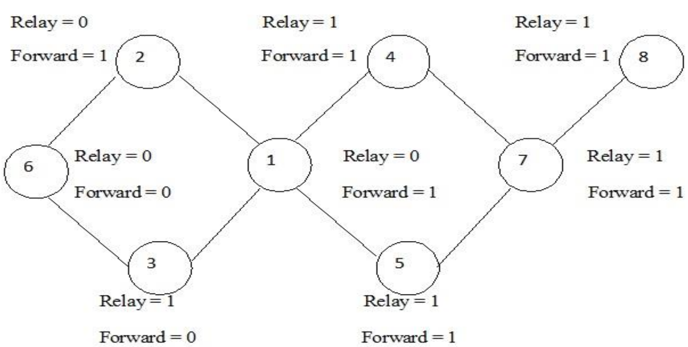


Figure 8. Node 3 Forwards RREQ to Node 4

The node 3 needs to forward RREQ to node 4, then it checks TTL>0 or not. If the TTL>0 then it checks whether the SD pair in RREQ is processed before or not. The SD pair is not processed before so it checks for the TTL>=2. It is true so its sets the relay and forward is equal to zero and then forward the RREQ.

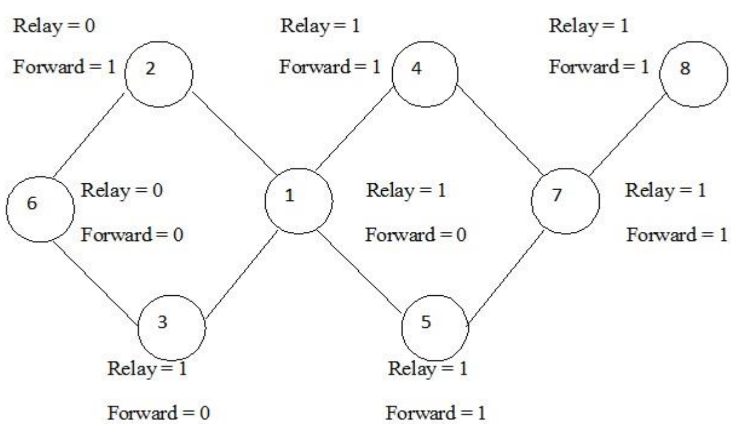


Figure 9. Node 3 Address is same as Node 1

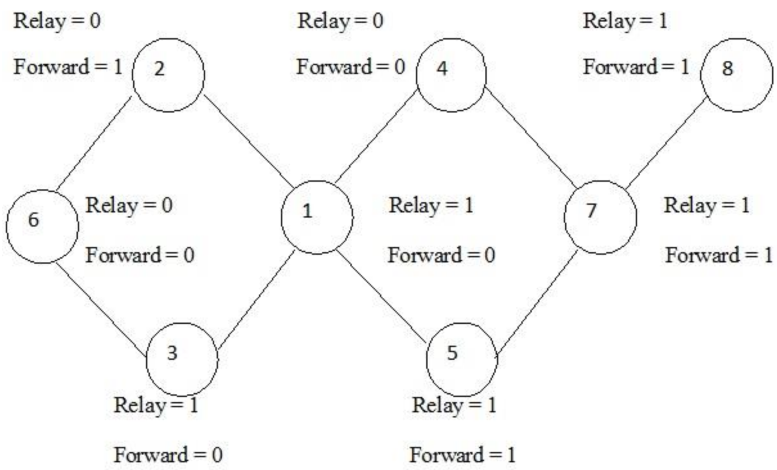


Figure 10. Node 1 Address is same as Node 3

The node 1 address is same as the preaddressed, so that the relay value is set to 1.

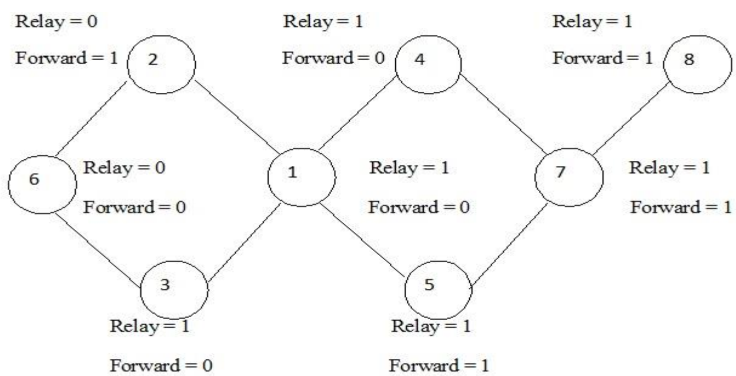


Figure 11. Node 1 Address is same as Node 4

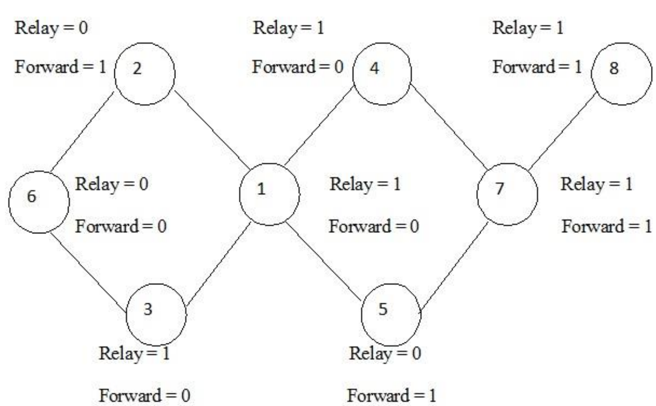


Figure 12. Node 1 Sends the RREQ to the Node 5

The node 1 sends the RREQ to the node 5. The node 4 sends the RREQ to node 7. The node 7 has the destination information. So that node 7 sends the RREP to the source node.

The node will check the P-Addr field in the RREQ when it receives a RREQ with TTL value as 0 or with duplicate RREQ that is with same broadcast ID. If the node receives the same P-Addr in the RREQ then the relay value will be set to 1, which means node participate in the process of searching else in the route discovery process.

When the RREQ for particular source destination pair (SD pair) is processes once then the relay value will be set to 0. The node checks whether the TTL value is greater than zero when it receives the node for the first time. If the value is greater than zero, it update the last address of received RREQ as P-Addr and add its own address as last address and forward the RREQ to its neighbors, if it is zero it will drop the message by checking the p-Add address.

The E2AODV have the following steps:

• The value of relay and forward are set to 1, as they take part in forwarding the RREQ of particular source destination pair (SD pair) for the first time. Then based on the TTL value of RREQ the relay and forward function will be called.

• Pre-Address (P-Addr) field is added with the RREQ packet. Source node appends its address into its P-Add field before initiating the RREQ. The intermediate nodes which are rebroadcasting the RREQ append the address of the node from which it got the RREQ packet to the RREQs P-Add field.

• When an intermediate node rebroadcast a RREQ for particular pair then the relay value will be set to 0. If the TTL value of the SD pair is greater than or equal to 2 then the forward value will be set to 0, else it remains same.

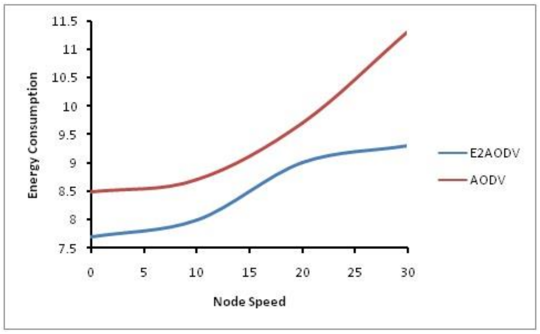
• The relay value will be set back to 1when the node receives the RREQ with its address in P-Add which means that node RREQ packet has been used by its neighbors for finding the path. By forwarding the RREQ for SD pair the node with relay value of 1 participates in finding the route.

• The node will not forward the RREQ for that SD pair if both Relay and forward are 0.

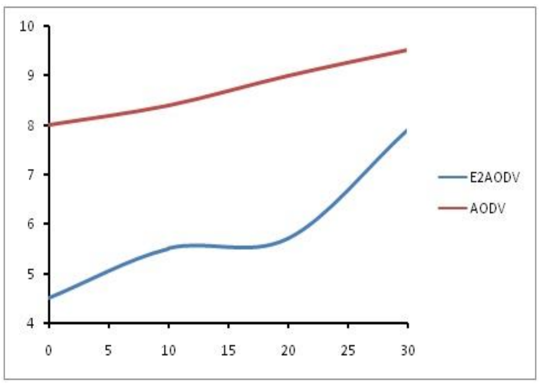
• Depending on the TTL value, the Relay forward function is called if the relay value is 0.

4. Simulation and Result Analysis

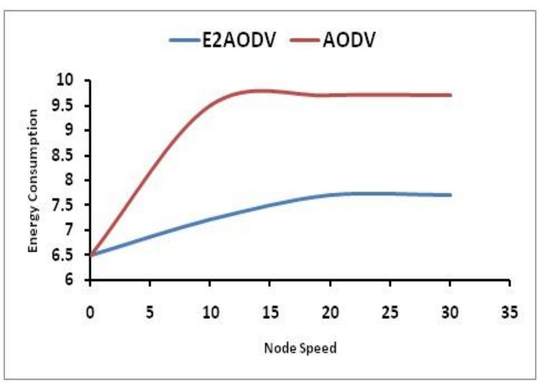
In this we used the NS2 tool. It is a Global Simulator and it is used to the parallel discrete event simulation provided by parsec, it's a C based simulation language. The simulation area is 1200m x 1200m size. The nodes are placed uniformly. The point model is used the random way, in the each node choose a random point and it move towards that point with a random speed and this random speed we specifies the minimum and maximum values. A node is wait for the specified pause time and continues and the movement is given above. The bandwidth of shared wireless channel is assumed 2 MHZ. The nodes are using the 802.11 as MAC protocol and IP as network protocol with output size of 100. The transmission range of all the nodes is set to be around 280m in the network. The parameter considered for the simulation are listed in the table1 and to study about the performance considered for the simulation are listed in the table1 and to study about the performance comparison of the AODV and E2AODV. In the AODV and E2AODV the CBR traffic of 4 packets per second is use randomly for each of 512 bytes size for selected SD pairs. In the same way three sets of simulation with different SD pairs of CBR traffic have been taken and the average of that is taken for consideration. The simulations are run for 10000 seconds and each data point represents an average of 3 set of CBR traffic with 4 traffic and these three run with different seed values for each set of CBR traffic .



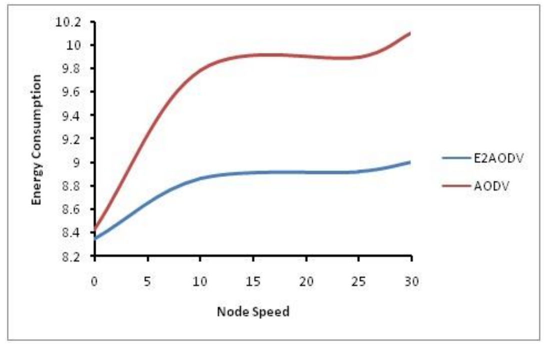
Graph (a)



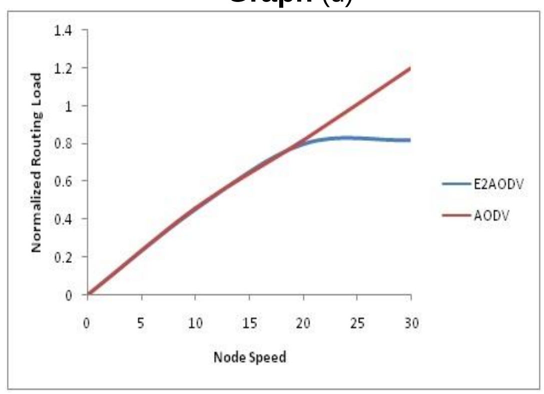
Graph (b)



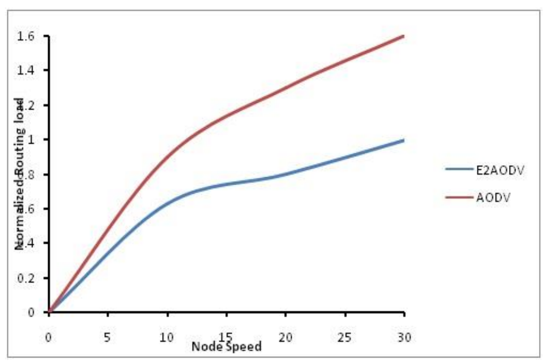
Graph (c)



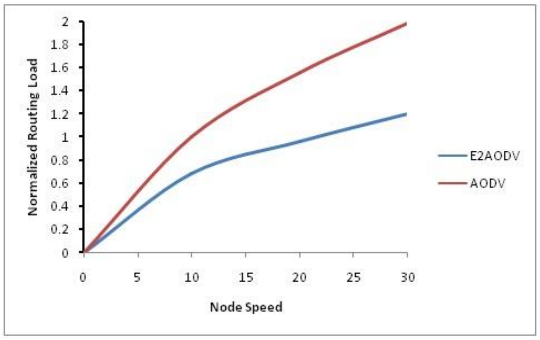
Graph (d)



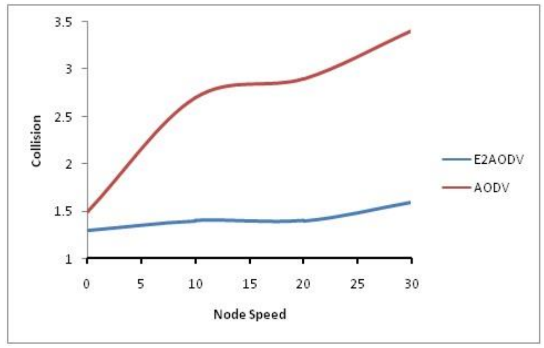
Graph (e)



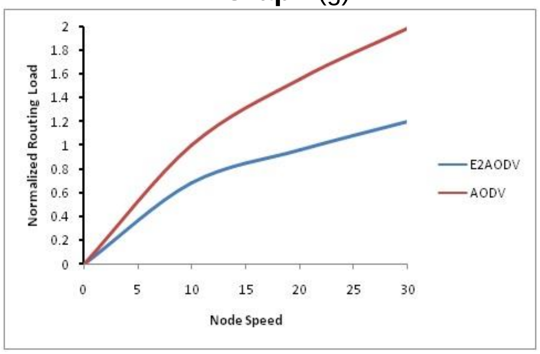
Graph (f)



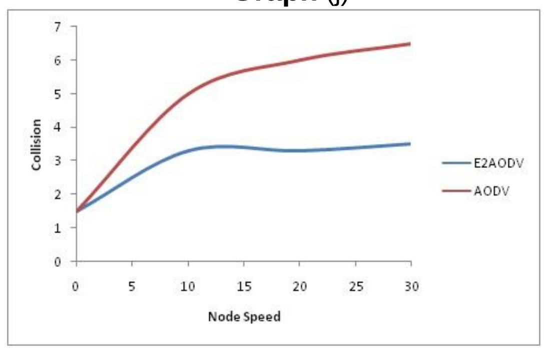
Graph (g)



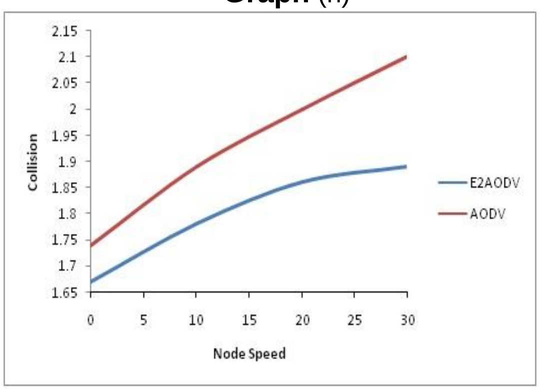
Graph (j)



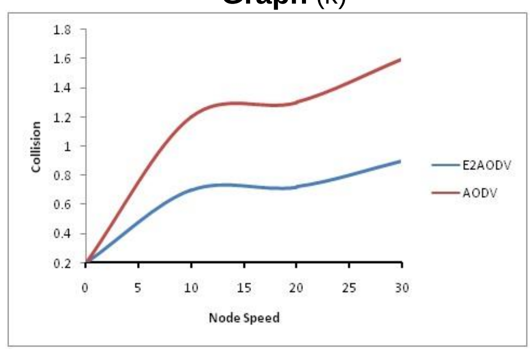
Graph (h)



Graph (k)



Graph (i)



Graph (l)

Figure 13. Graph (a) to Graph (l) Represents CBR Traffic with 4 Traffic and these Three Run with Different Seed Values for each Set

5. Conclusion

In this paper I propose an Energy efficient route discovery process for AODV based on ERS and the approach saves energy of the nodes by avoiding the redundant rebroadcasting of the route request packets. An important problem is how to minimize the number of rebroadcast packets while good retransmission latency and packets reachability are maintained. Even though the large number of rebroadcasts guarantees high reachability, the relaying status of the node is decided based on the broadcasting of its RREQ packets by its neighbors. E2AODV provides efficient energy consuming routing protocol with reduced routing overhead.

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