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Energy Efficient DSR using Multipath

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Abstract

In mobile ad hoc network limited life of node is one of the primary concerns because nodes in the mobile network have been supported by a battery. Most of the battery is consumed in communication and routing related computation. There are lots of researches has been done in order reduce this battery consumption and increase the life of network which further results in more data transfer. In this paper a new method is proposed in order to conserve the energy of the node as well as of network by modifying standard DSR (Dynamic Source Routing) and analysis is done by comparing the standard DSR with the newly proposed method.

Key words : MANET; Energy conservation, DSR, RREQ; RREP; DOS;

I. Introduction

Mobile Ad hoc Network (MANET) is a self organizing network which consist of mobile node does not require any help from exist infrastructure in order to communicate[1]. In MANET the nodes which are within range of each other can communicate directly otherwise intermediate node acts as router to them. The union of nodes connected by wireless link does not have any base station that is no fixed infrastructure and nodes are free to move which form arbitrary topology means they do not have fixed topology. The dynamic source routing is the routing protocol that makes use of source routing techniques[2]. Here sender have complete sequence of nodes through which packet is to be send. The DSR protocol allows to dynamically discovering a source route, it makes use of two operations Route Discovery and Route Maintenance.

1.1 Route Discovery :

Route discovery allows dynamic discovery of route to any other host in the ad hoc network. The source initialize route discovery by simply broadcasting a route request packet. The route request packet contains the address of destination host. If the route discovery is successful the host who send receives a route reply packet. Packet contains a sequence of network nodes through which data can be sent to target. Each route request packet is identified by a unique request id. Each host receiving the packets is not the destinations it forwards the request. For example, node A is attempting to discover a route to node E. For the route discovery A broadcasts a RREQ message packet. RREQ message contains the record listing the each intermediate node through which the particular RREQ message has been forwarded. This flooding of RREQ terminates when it reaches either the destination or it reaches the maximum hop count. Upon receiving the RREP, the source node can start transmitting the data packets towards the destination using the route contain in the RREP.

1.2 Route Maintenance :

Route maintained periodically by sending periodic routing updates. If the status of a link/router gets change the changes will be reflected to all other routers, presumably resulting in the computation of new routes.

1.3 Energy[3] Issues of DSR :

- The routing overhead generated by DSR routing algorithm do large amounts of energy wastage.
- The generated Route Request (RREQ) occupies large amount of band-width, consume energy and can be used as source of DOS attack in network.
- Protocol will not useful in the case of large networks, as the amount of over-head keep on increasing as the network diameter increases.

II. METHODOLOGY

The main aim of the algorithm is to provide an energy saving concept for the mobile ad hoc networks. Energy saving concept depends on several other factors like delay in the network, number of hopes between source and destination. DSR only stores an arbitrary path between a source and destination pair during its route discovery phase. Whenever a RREQ packet is sent by a source then it is flooded till it reaches the destination and on reaching the packets are destroyed and the path traversed is simply cached there. But in this algorithm three concepts are used:

- ***Load balancing:*** for load balancing, the nodes whose remaining energy is higher than threshold is selected.
- ***Multipath:*** the multipath concept is used to find optimal path, mean who consume less energy or who have less energy loss The energy loss is computed using following formula because energy loss is directly proportional to number of hops, delay, and packet size

  $E = (n * \text{delay}) + (m*\text{packet size}) + \text{constant}$ ……………..1

  Where E = energy loss

  n = number of hops

  Constant value is the value associated with the node type like sending receiving or idle node
- ***Transmission power adjustment approach:*** there node will transmit using optimal power instead of full power, where optimal mean sufficient to get connect to required node.

There following steps are used

Step1: In this step node create a route request packet (RREQ) in order to discover route. The packet contain a unique number for identification, address of both source and destination along with route record in order to store information of intermediate node through which RREQ is forwarded, and threshold (THr) field. As shown in Figure 1

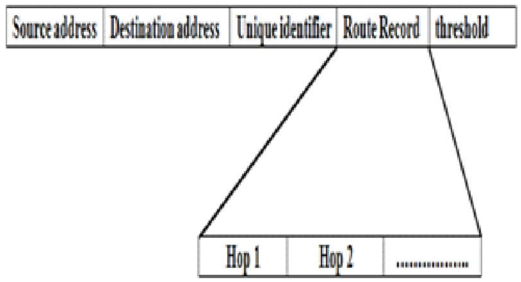


Figure 1 Packet format

Step 2: In this step when a node receive RREQ message first it will compare its remaining energy (Ri) with threshold. Based on comparison to case are formed as shown in Figure 2. In this figure node1 is source and node10 is destination.

Case 1: If the remaining energy (Ri) of the node is greater than the threshold (THr) value than it will broadcast the RREQ packets to all the neighbors.

Case 2: If the remaining energy (Ri) of the node is less than the threshold (THr) value than it will not broadcast the RREQ packets to all the neighbors. As shown in figure 2

Step 3: At destination after receiving RREQ request there two cases may be possible

Case 1: when only one request is received, in this case DSR work similarly as Original one.

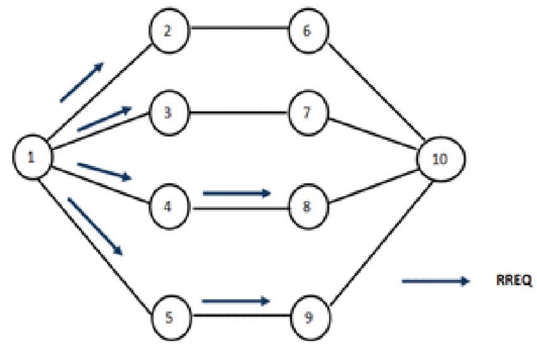


Figure 2 Broadcast of RREQ

Case 2: when there more than one RREQ is received, in this the value for energy lose is compute using formula number 1 as written above and path having minimum value of Energy loss is selected as optimal path. As shown in figure 3. There are two paths from source to destination named 1-4-8-10 and 1-5-9-10 which satisfied threshold value. Let E value for 1-4-8-10 and 1-5-9-10 is 10, 12 respectively than 1-4-8-10 is selected as optimal path. As shown in figure 3

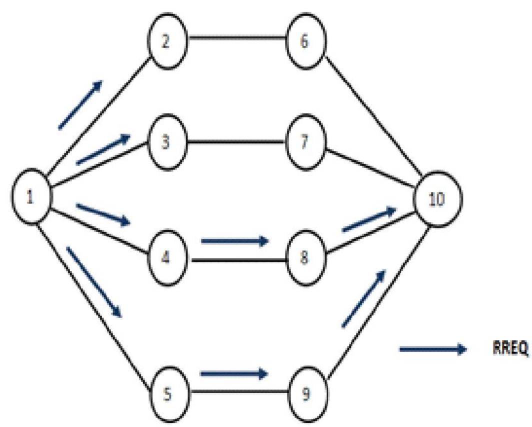


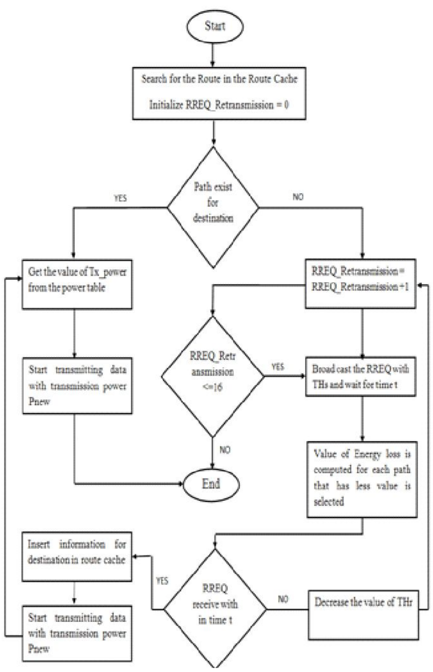
Figure 3 computation of Energy loss

Step 4: it may be happen that remaining energy of all node is less than threshold value in this case source does not get any Route replay message (RREP). In this case sender wait for certain period of time and again retransmit RREQ message by reducing Threshold value.

In brief these steps can be written as follow:

- First route request message is send or broad casted by sender in the network
- Nodes after receiving RREQ compare remaining energy with threshold energy is more than forward the packet otherwise not
- At destination value of energy loss for each path is computed.
- That path whose E value is minimum, selected as optimal path.

Flow Chart



III. IMPLEMENTATION

3.1 Performance Evaluation Parameter :

The performance of the proposed algorithm is evaluated on the basis of following parameters:

- End- to –End delay
- Packet delivery ratio

End-to-End delay: End-to-end delay is the time interval a packet required to reach at destination from source.

Mathematically End-to-End Delay is shown below:

End to End Delay = (Number of Links) * (Transmission delay + propagation delay + processing delay)

For good algorithm End-to-End delay should be low.

Packet delivery ratio: it can be defined as the ratio of the number of packets received by destination to the number of packets sent by the source.

$$\text{PDR} = \frac{\sum \text{number of packet recieved}}{\sum \text{number of packet send}}$$

For good algorithm packet delivery ratio should be high.

3.2 Simulation Model :

To simulate proposed work some parameters have to be fixed. Fixed parameters are used to set an environment for simulation are shown in Table 1

Table 1 Fixed Parameters

Parameter	Value
Simulator	NS-2.34
Studied protocols	DSR and EE-DSR
Simulation time	500 seconds
Simulation area	1500 m x 1500 m
Traffic type	TCP
Data payload	512 bytes/packet
Channel type	Wireless Channel
MAC type	802.11
Mobility Model	Random waypoint model
Antenna model	Omni
IFQ Length	50

On the basis of methodology which is explained earlier in the standard DSR is modified. A discrete event based simulator[4,5] NS2 is used to simulate the network and analysis has been done by comparing of “Standard DSR” and “EE-DSR”.

Comparison of DSR and EE-DSR (modified DSR) the simulation uses four different network sizes are created by varying nodes in a network to 25 nodes, 35 nodes and 45 nodes, which are shown in Figure 4 to Figure 6

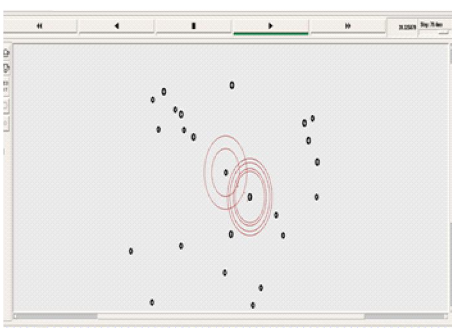


Figure 4 Network with Number of nodes 25

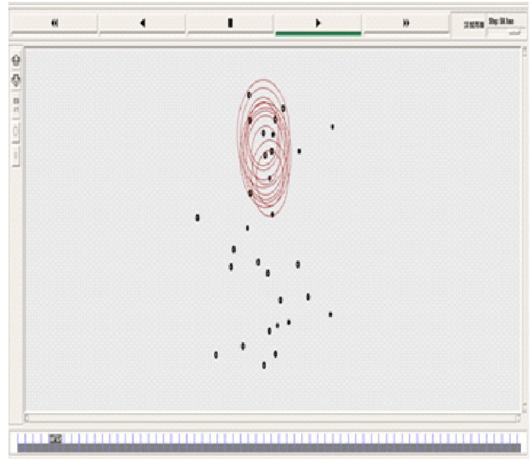


Figure 5 Network with Number of nodes 35

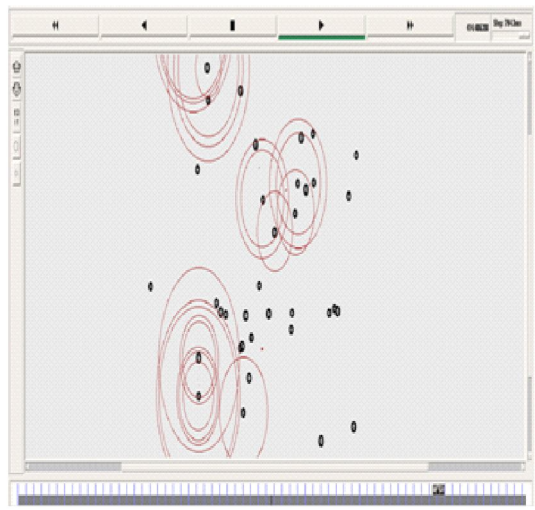


Figure 6 Network with Number of nodes 45

IV. RESULT ANALYSIS

After designing simulation model, configuring network, simulation executed and trace files generated. Post simulation process performed on generated trace files using AWK scripts, following results obtained. The results of the average end-to-end delay of the network is shown through Table 4.3-4.5

Table 2 Results of End-to-End delay for network size of 25 nodes

Number of Nodes 25			
	Mobility 1	Mobility 2	Mobility 3
DSR	3390	2805	3050
EE-DSR	3345	2750	2959

Table 3 Results of End-to-End delay for network size of 35 nodes

Number of Nodes 35			
	Mobility 1	Mobility 2	Mobility 3
DSR	2600	2350	1850
EE-DSR	2500	2200	1750

Table 4 Results of End-to-End delay for network size of 45 nodes

Number of Nodes 45			
	Mobility 1	Mobility 2	Mobility 3
DSR	2250	1801	1569
EE-DSR	2200	1740	1500

from the results obtained above on End-to-End delay for all scenarios the Graph is shown in Figure 7

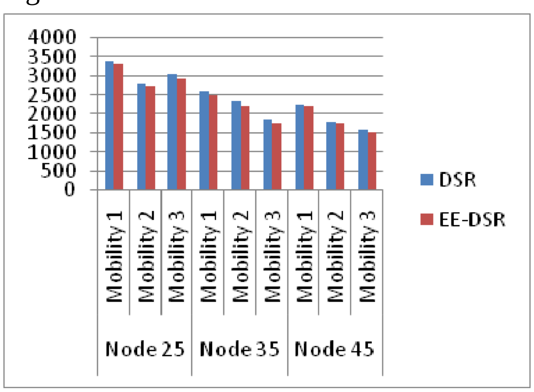


Figure 7 Average End-To-End Delay

Analysis of above Results on End to End delay:

- Average end to end delay of DSR of nodes 25 is 3081.66 Sec whereas the average end to end delay of EE-DSR is 3018 Sec which is 2.06 % lesser than DSR.
- Average end to end delay of DSR at 35 nodes is 2266.66 sec whereas the average end to end delay of EE-DSR is 2150 sec which is 5.14% lesser than DSR.
- Average end to end delay of DSR at 40 nodes is 1873.333 sec whereas the average end to end delay of EE-DSR is 1813.33 sec which is 3.202% lesser than DSR.
- An overall average gain of EE-DSR in average end to end delay is 3.701% of DSR, which is obtained by averaging all the average gain of individual network size.

From the above analysis it is found that maximum gain in the average end to end delay is 5.14% when network size is of 35 nodes, minimum gain in the average end to end delay is 2.06% when network size is 25 nodes, and overall average gain of EE-DSR in average end to end delay is 3.701% of DSR. An improvement in average end to end delay is found in all scenarios discussed above. The reason behind such an impressive improvement in average end-to-end delay is that the proposed algorithm tries to eliminate unnecessary energy loss, which causes the elimination of node from the network. Therefore, with the help of above results it can be said that EE-DSR performs better than DSR in terms of the average end to end delay for scenarios discussed above.

The results of the average packet delivery ratio of the network are shown through Table 5 to 6

Table 5 Results of Packet Delivery Ratio for network size of 25 nodes

Number of Nodes 25			
	Mobility 1	Mobility 2	Mobility 3
DSR	60	70	71
EE-DSR	61	72	75

Table 6 Results of Packet Delivery Ratio for network size of 35 nodes

Number of Nodes 35			
	Mobility 1	Mobility 2	Mobility 3
DSR	63	70.5	75
EE-DSR	64	70.9	76

Table 7 Results of Packet Delivery Ratio for network size of 45 nodes

Number of Nodes 45			
	Mobility 1	Mobility 2	Mobility 3
DSR	66	71	78
EE-DSR	68	72	79

From the results obtained above on End-to-End delay for all scenarios the Graph is shown in Figure 8

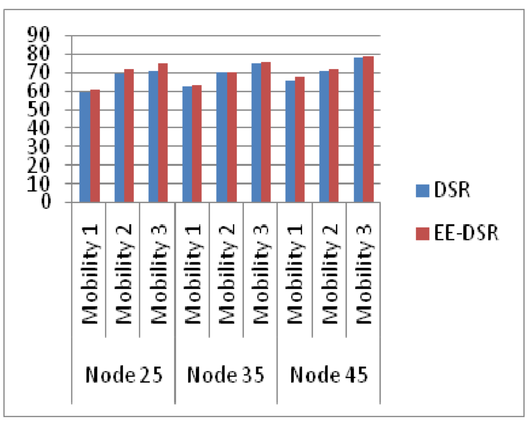


Figure 8 Average Packet Delivery Ratio (PDR)

Analysis of above Results on packet delivery ratio:

- The average packet delivery ratio of DSR at 25 nodes is 67 whereas the packet delivery ratio of EE-DSR is 69.33, which is 3.48% greater than DSR.
- The average packet delivery ratio of DSR at 35 nodes is 69.5 where as the average packet delivery ratio of EE-DSR is 70.3, which is 1.15 % greater than DSR.
- The average packet delivery ratio of DSR at 40 nodes is 71.66 whereas the average packet delivery ratio of EE-DSR is 73, which is 1.86% greater than DSR.

After analyzing the results obtained on performance parameters it is found that overall average gain achieved by EE-DSR over the standard DSR on parameters end-to-end delay and packet delivery ratio is 5.14%, 2.16% respectively. The positive trend is found for all the obtained results, which show that EE-DSR increases the responsiveness of network by decreasing the average end to end delay and increases efficiency of the network by increasing the average throughput of network. As far as reliability of the network is concerned it is not compromised by EE-DSR. So it can be said that EE-DSR performs better than DSR for above discussed scenarios and parameters.

V. Conclusion

In this paper an algorithm is developed for MANET which is Energy efficient multipath, load balancing and Transmission power adjustment approach known as Energy

Efficient Dynamic Source Routing EEDSR by modifying the standard of DSR.

By selecting energy efficient path in the algorithm reduces broadcasting of the packet so, energy of the network gets consumed and it provides energy efficient network. And addition and deletion of nodes in the network affects the performance of the network so, this approach helps to provide good scalability of the network. MANET is the network which has Energy consumption problem due to power drainage of batteries.

On that basis of analysis it is concluded that EE-DSR is better than DSR. EE-DSR provides better delivery of packets to the destination and as compare to standard DSR.

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