

# Routing Scheme for Min-Max Energy based Dropping Power Consumption in MANET

**Miss Neha Sharma**

*Scholar*

*Computer Science Engineering  
Truba Inst. of Eng. and  
Information Technology  
Bhopal, India*

**Mr. Amit Saxena**

*Professor*

*Computer Science Engineering  
Truba Inst. of Eng. and  
Information Technology  
Bhopal, India*

**Dr. Manish Manoria**

*Director*

*Computer Science Engineering  
Truba Inst. of Eng. and  
Information Technology  
Bhopal, India*

**Abstract**— Mobile Ad hoc Network (MANET) is the significant issue for communication. However, the portable communications devices in ad hoc networks are loose batteries operated and have limited energy, so the network is an energy-constrained system. The Energy efficient routing is required to minimize the energy consumption of mobile nodes. In this research proposed Minimum Energy based Routing scheme selecting the nodes in routing that is having the enough energy for routing packets and data packets in network. Routing protocols are finding shortest path, that is, the least hops routing, which do not consider the energy efficient problem. How to protect the nodes energy and extend the lifetime of the network regularly plays an important role on evaluating the performance of ad hoc network proposed MIN-MAX scheme. The MIN-MAX scheme routing strategies are scalable because the protocol can minimize the energy consumption under not just some specific operative conditions such as lower mobility, light traffic load or low number of node but also in dense and loaded network. This means that the design of an energy efficient routing protocol should consider also scalability issue in order to apply it in wider scenarios and to be sure that the MIN-MAX performance do not degrade too much when the energy degrades because of set of energy threshold value. In proposed scheme routing protocol either to route data through the path with minimize energy or to maximum the routing overhead, end to end delay and improves network life time of network.

**Index Terms**—MANET, Energy, Routing, MIN-MAX, Performance, Network life

## I. INTRODUCTION

Mobile Ad Hoc Networks (MANETs) consists of a collection of mobile nodes which are not bounded in any infrastructure. Nodes in MANET can communicate with each other and can move anywhere without constraint [1]. This non-restricted mobility and easy deployment characteristics of MANETs make them very popular and highly suitable for emergencies, natural adversity and military operations. Nodes in MANET have limited battery power and these batteries cannot be replaced or recharged in complex scenarios. To extend or maximize the network lifetime these batteries should be used efficiently. The energy consumption of each node varies according to its communication state: transmitting, receiving, listening or sleeping modes. Researchers and industries both are working on the mechanism to extend the lifetime of the node's battery. But routing algorithms plays an important

role in energy efficiency because routing algorithm will decide which node has to be selected for communication [2]. The main purpose of energy efficient algorithm is to maximize the network lifetime. These algorithms are not just related to maximize the total energy consumption of the route but also to maximize the life time of each node in the network to increase the network lifetime. Energy efficient algorithms can be based on the two metrics: i) Minimizing total transmission energy ii) maximizing network lifetime. The first metric focuses on the total transmission energy used to send the packets from source to destination by selecting the large number of hops criteria. Second metric focuses on the residual battery energy level of entire network or individual battery energy of a node.

## II. ENERGY EFFICIENCY ISSUE

Nodes in Mobile Ad hoc Networks (MANETs) [3, 4] are battery driven. Thus, they suffer from limited energy level problems. Also the nodes in the network are moving, if a node moves out of the radio range of the other node, the link between them is broken. Thus, in such an environment there are two major reasons of a link breakage:

- 1) Node dying of energy exhaustion
- 2) Node moving out of the radio range of its neighboring node.

Hence, to achieve the route stability in MANETs, both link stability and node stability is essential.

Since most wireless nodes in ad hoc networks are not connected to a power supply and battery replacement may be difficult, optimizing the energy consumption in these networks has a high priority and power management is one of the most challenging problems in ad hoc networking.

Energy consumption in ad hoc node can be due to either useful or wasteful source. Useful energy consumption can be due to:-

- (1) Transmitting / Receiving data,
- (2) Processing query requests,
- (3) Forwarding queries / data to neighboring nodes.

Wasteful energy consumption can be due to:-

- (1) Idle listening to the media,
- (2) Retransmitting due to packet collision,
- (3) Overhearing, and
- (4) Generating/handling control packets.

In general, radios in an ad hoc network node can operate in four distinct modes of operation: transmit, receive, idle,

and sleep [5]. Transmit and receive modes are for transmitting and receiving data. In the idle mode, the radio can switch to transmit or receive mode. Idle is the default mode for an ad hoc environment. The sleep mode has extremely low power consumption. Therefore, taking advantage of the sleep mode is very important in energy efficient protocols. As noted above, energy efficient routing is important and necessary.

Therefore it is imperative that at any moment some specific number of nodes having sufficient energy and the rest remain are not able to take part in communication. We keep number of sufficient energy nodes in desirable way, so network lifetime will be prolonging by far. If energetic nodes can cover desirable level of network, less number of energetic nodes will be required in total network and will not be the empty space of energetic node. We balance energy consumption of nodes by means of selecting reliable energy nodes for forwarding data. It has been shown [6] that energy consumed in the retransmit operations is responsible for a considerable amount of energy consumption. Since this case cannot be avoided with the use of energy-efficient algorithms [7]. In this title the proposed scheme is utilized the energy of mobile nodes and provides the reliable routing in dynamic network. The selection of mobile nodes are dependent on the higher energy level of neighbors and also the nodes having energy is below the threshold value then that nodes are not participating in routing that minimizes the packet loss and improve network performance.

### III. RELATED WORK

The majority of energy efficient routing protocols for MANET try to minimize energy consumption by means of an energy efficient routing metric. The some work that has done is mentioned in this section.

In this paper [1] proposed a Reliable Minimum Energy Cost Routing (RMECR) energy efficient scheme. RMECR can increase the operational lifetime of the network using energy-efficient and reliable routes. In the design of RMECR, we used a detailed energy consumption model for packet transfer in wireless ad hoc networks. RMECR was designed for two types of networks: those in which hop-by-hop retransmissions ensure reliability and those in which end-to-end retransmissions ensure reliability. The general approach that we used in the design of RMECR was used to also devise a state-of-the-art energy-efficient routing algorithm for wireless ad hoc networks, i.e., Reliable Minimum Energy Routing (RMER). RMER finds routes minimizing the energy consumed for packet traversal. RMER does not consider the remaining battery energy of nodes, and was used as a benchmark to study the energy-efficiency of the RMECR algorithm. Extensive simulations showed that RMER not only saves more energy compared to existing energy efficient routing algorithms, but also increases the reliability of wireless ad hoc networks.

In this paper [8] they proposed Efficient Power Aware Routing (EPAR) which is basically an improvement on DSR. This study has evaluated three power-aware ad hoc routing protocols in different network environment taking into consideration network lifetime and packet delivery

ratio. Overall, the findings show that the energy consumption and throughput in small size networks did not reveal any significant differences. However, for medium and large ad-hoc networks the DSR performance proved to be inefficient in this study. In particular, the performance of EPAR, MTPR and DSR in small size networks was comparable. But in medium and large size networks, the EPAR and MTPR produced good results and the performance of EPAR in terms of throughput is good in all the scenarios that have been investigated. From the various graphs, we can successfully prove that our proposed algorithm quite outperforms the traditional energy efficient algorithms in an obvious way.

In this title Enhanced Power Control MAC Protocol EPCMAC [9] protocol transmits all the packets with optimum transmission power and periodically increases the power of the DATA packets to a suitable level to eliminate the collisions. The periodic pulse power is found based on maximizing the channel capacity, reducing the carrier sensing range and considering the Signal to Interference Ratio. It reduces the number of unnecessary back-off nodes and allows successful concurrent transmission with limited interference at the neighborhood nodes. Our simulation result shows that the EPCMAC scheme achieved more total data delivered per joule. This means that the EPCMAC scheme can achieves a high reduction in the energy consumption.

In this title [10], we study the energy efficient topology control problem with CC model by taking the energy efficiency of routes into consideration. Taking advantage of physical layer design that allows combining partial signals to obtain the complete data, we formally define cooperative energy spanner in which the least energy path between any two nodes is guaranteed to be energy efficient compared with the optimal one in the original cooperative communication graph. We then introduce the energy-efficient topology control problem with CC (ETCC), which aims to obtain a cooperative energy spanner with minimum total energy consumption, and prove its NP-completeness. Therefore, as solutions for ETCC, we propose two topology control algorithms to build energy-efficient cooperative energy spanners. Both algorithms can guarantee the bounded energy stretch factor and are easy to be implemented in a distributed and localized fashion.

This paper [11] proposed a novel algorithm is find the optimal power assignment for every link such that the expected power consumption of the unicast from the source node to every other node in the network is the minimum among all possible power assignment. They consider two different scenarios: either the link layer reliability or the transport layer reliability is implemented. Notice that, in practice, certain link layer reliability is already implemented in the MAC layer. Our second contribution is the study of integrated power assignment and energy efficient routing using multipath routing techniques. Our third contribution is a multicast method that integrates the optimal power assignment and energy efficient multicast tree construction. In our multicast method, we assume an overlay based multicast. The proposal theoretically proves that their multicast routing is almost optima it means the

expected total power consumption of the constructed multicast tree is within a small constant factor of the optimum. Simulations show that their protocols significantly reduce the expected energy consumption of routing.

#### IV. PROPOSED SCHEME TO IMPROVE ENERGY EFFICIENCY

In this research we proposed the Energy Efficient Utilization Routing Algorithm to minimize the energy consumption of mobile nodes in MANET. The every operation of nodes is requires the energy or power and this power is provided by limited capacity battery source. The nodes are moves freely and every time instance the topology in network is changes. The sender/s are establishing the connection with receiver/s through intermediate nodes. In a particular network numbers of senders are trying to sends their data to receiver. Almost all data is received by destination but some of the data is drop due to link failure, early energy depletion and node/s goes out of range without any confirmation. The sender always by default selects shortest path for sending data in network and receiver is receives data. In this communication procedure intermediate nodes are playing the very important role because they are receiving data from sender of neighbor and forward that data to next node or destination. Each communication procedure requires some energy and for successful data deliver following steps are required:-

1. Sender sense the neighbor for forwarding Route Request (RREQ). Energy is required for sending is called Sense energy.
2. Sender sends RREQ and neighbor that receives that RREQ is replies (RREP) route replies that also required energy for sending and energy for receiving.
3. If the nodes are not taking participation in routing will be in idle state. It implies that it also consume energy but equal to negligible called Idle energy.
4. The nodes in network that are not able to participating in routing or deplete their energy completely is going to sleep mode. The sleep mode is also required negligible amount of energy.

The Transmission Energy (Tx) is the highest consumption source of energy. After that, receiver is consumes highest energy for data received i.e. Receiving Energy (Rx). In rest of the energy consumption parameters like Sense Energy Consumption, Idle Energy Consumption, Sleep Energy Consumption is required negligible energy. Every successful efficient communication is also continuously depleting the energy of mobile nodes. The sender is frequently selecting the same node for data delivery then this node is exhaust their energy early and if their energy is finish in the time of data delivery causes heavy packet dropping. The MAX energy proposed scheme is utilizes the energy consumption of mobile nodes and improves the reliability of data delivery.

Proposed Steps of Selecting the MAXimum Energy Path based on (LELC)

The routing procedure is depending on the protocol used. But the proposed (LELC) energy scheme is not depending on the routing protocol. The proposed energy efficient MAX scheme is applying to all MANET routing protocols by changing the rule of minimum hop count or shortest path.

1. In this research we consider the AODV routing because this is on demand and this protocol performance is better as compare to other routing protocols.
2. In this research the steps of energy efficient routing is started from the Sender Route Request (RREQ). The RREQ is also containing the energy information of nodes.
3. The route selection is depending on the section of maximum energy base of mobile nodes and each node is maintaining the energy table values of neighbors.
4. The neighbor nodes which receives the RREQ is reply to sender by Route Reply (RREP) packets and if the any node is destination then no need to identified highest energy path.
5. If the next neighbor is not a destination then in that case forward the RREQ to next intermediate nodes for finding destination and also the energy table of nodes is created for detecting the most reliable path.
6. The RREQ of sender through intermediate nodes reaches to destination node. The destination nodes are replies to sender through most reliable path because the data delivery will be possible through that path.
7. It is obvious that the sender RREQ is reaches to destination through multiple paths and in Normal Energy routing (RMECR) the shortest path is selected but here the path is selected among the multiple path that has maximum energy.
8. If the path is selected that has maximum hop count is considered for routing because that path reliability is more as compare to shortest path.
9. The data is delivering so that LELC based maximum energy path is selected and the same procedure is still call again and again until the nodes energy is exhausted completely in the dynamic network.
10. At the end simulation is stop in a given simulation time.

#### Proposed Algorithm for MAX energy base Route Selection

```

Create mobile node = N;
Set routing protocol = AODV; // for Routing Protocol
Number of of Mobile Nodes = Nn
Set of Intermediate mobile node's = Ni
Set sender Node = Ns; // Ns ∈ N
Set Destination Node = Nd; // Nd ∈ N
Set MAC = 802.11; // for Media access control
Set initial energy of each node = (En)
Step1: Route Established (Sender, Destination, En, Node_Range)
Step2: {if (Node_Radio_Range <= 250 && next hop count!= Destination && En > 0)
{

```

**Step3:** If (path exist in Source ( $N_s$ ) to  $N_i$  &&  $N_i \neq N_d$ )  
 Increment the hop count by one Broadcast route packet to available neighbours;  
**Step4:** While (path exist in between Source, Intermediate ( $N_i$ ) &&  $N_i \neq N_d$ ) // check the possibility of destination  
 {  
 Broadcast routing packets to next neighbour;  
 Increment hop count value of Sender including  $N_i$  ;  
 Goto step 4;  
 }  
**Step5:** If ( $N_i == N_d$  (Destination)) // Compare the Intermediate node is a destination node  
 {  
 Maintain routing table of  $N_d$  Destination Node;  
 Create energy table of nodes  $N_s-N_i-N_d$  ;  
 Reply to Sender ( $N_s$ ) ;  
 }  
**Step6:** If (Path Established is  $>1$ ) // for identified MAX energy path  
**Step7:** If (path  $N_i$  from S to D && another from path  $N_i$  from S to D) // Check two paths reliability  
 {  
 Construct routing table of  $N_s$  (Source) via path  $N_i$  to  $N_d$  (Destination);  
 }  
**Step8:** Find MAXimum energy of established path// Find Maximum energy route  
**Step9** Select route via MAX Energy path ;  
**Step10:** End  
 } }

On the basis of proposed algorithm any node in the network are always select the nodes that has a maximum energy value. It means that it solves the problem of link breakages in network. In this proposed algorithm these chances are negligible it means that sender are not do the normal routing (RMECR) in network it apply the maximum (MAX) energy selection method and ignores minimum (MIN) value of nodes in network. And if the path in between the sender and destination is established then also compare the energy value of alternative path and select the best one on the basis of maximum energy value. If we compare it with normal energy efficient scheme then in case of threshold the energy remains in network are wasted and for best result it is necessary to apply optimal scheme to stop the energy losses in routing. This proposed method provides the reliable and strong connection between the sender and receiver by the energy utilization are increases and unnecessary energy consumption reduces.

**Simulation Tool Used**

Simulation of proposed MAX energy based routing is performed and compared with normal Energy based AODV using NS-2 [12] to evaluate the protocol. A total of 50 nodes were simulated for duration of 100s in an area of 800m x 800m. The mobility model is the random way point to model the mobility of the nodes in the network with the simulation time of 100 m/s. The MAC layer protocol used was IEEE 802.11. The transmission range for each node was 250m and the channel capacity was 512 kbps. The

initial energy of the node is set randomly in network in joules.

The energy aware Routing Mechanisms are compared with following energy efficiency metrics:

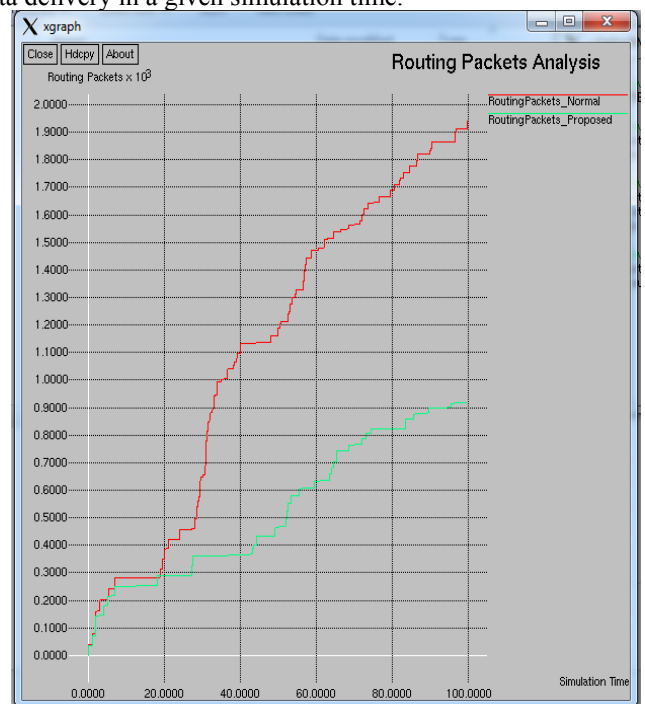
1. **The relative routing overhead:** It is the ratio of the number of control packets over the number of delivered data packets.
2. **The delivery ratio:** It is the Ratio of number of packets delivered over the total number of packets sent.
3. **UDP Packet loss:** It is the number of packets that not reach to destination or loss in network.
4. **The end-to-end delay:** It is the average of delays between each pair of a communication session.

**V. SIMULATION RESULT**

In this section the simulation results are evaluated in case of normal energy routing and proposed MAX- energy scheme.

**A. Routing Packets Analysis**

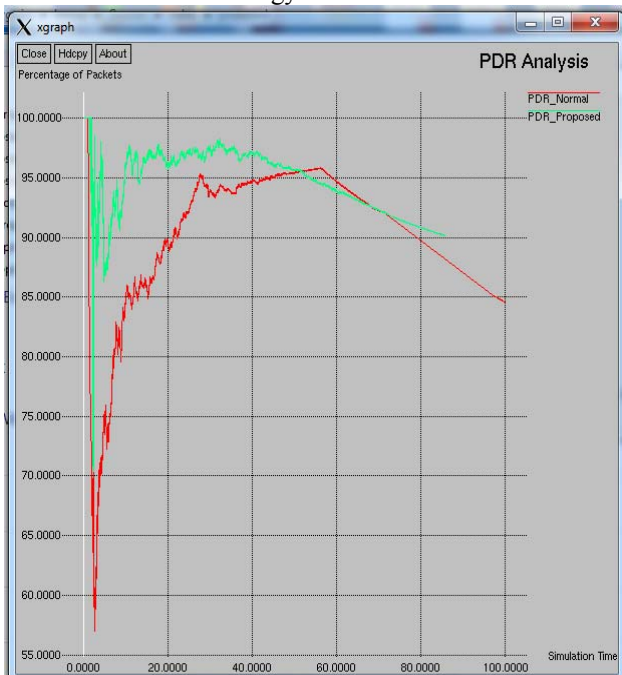
The number of routing packets is sending by sender/s in network to established connection in between sender and destination. The routing packets in network are also consumes energy for sending and receiving. The number of routing packets in normal energy routing (RMECR) is more routing load due to link breakage that occurring the condition of retransmission in MANET. The performance of proposed MAX routing (LELC) is much better than normal. In proposed routing the routing packets delivery is less due to strong link connectivity. The total routing packets in normal energy routing is more than 1900 packets but in proposed the quantity is about 900 packets. The nodes that are selected for communication is reliable in term of energy capacity and due to that the possibility of data loss and retransmission is reduced and provides better data delivery in a given simulation time.



**Fig:1 Routing Packets Analysis**

**B. PDR Analysis**

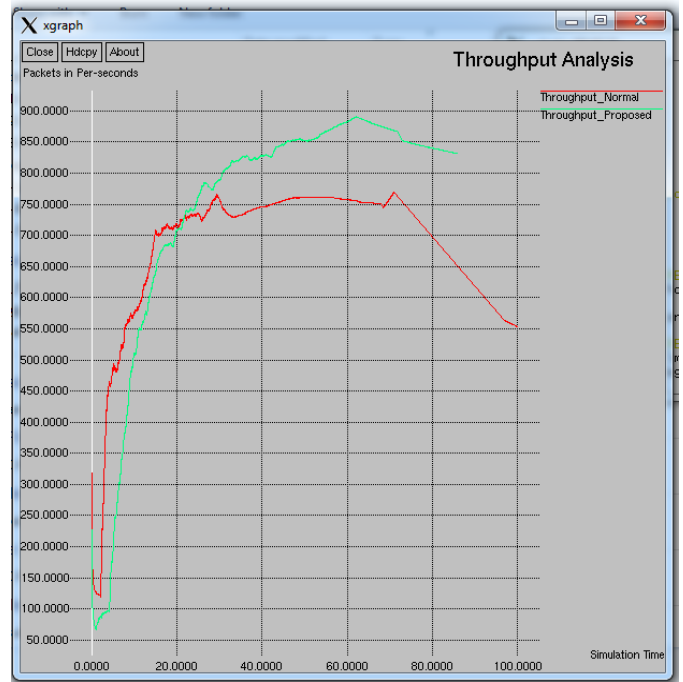
The Packet Delivery Fraction (PDF) performance metrics is represents the percentage of successful percentage of data received at destination. The number of nodes in MANET are died early due to energy exhaustion. In this graph the PDR performance of normal energy routing (RMECR) with AODV and proposed LELC scheme with AODV is evaluated and identified that the PDR of proposed LELC scheme is slightly more but in normal energy based routing that is slightly low. The PDR performance is depend on the ratio of input and output. If the data packets are less transmitted as equal to the receiving, it means PDR is good but in case of large packets transmission data is also received, in good quantity but the percentage value is not possible more than 100%. In the proposed energy condition packets receiving is more that shows the better energy utilization.



**Fig:2 PDR Analysis**

**C. Throughput Analysis**

Throughput is measure on the basis of number of packets is delivering in network per unit of time. The value of received packets in network is showing the better performance. This graph represents the throughput analysis in case of normal energy (RMECR) routing and Proposed LELC routing in network. The performance of proposed energy based LELC routing is about 900 packets/seconds only from time up to 85 seconds. The normal energy routing has worked on the basis of shortest path but in this routing the possibility of link breakage is more that consumes energy for establishment again i.e. the wastage of energy. In this graph, we observe that the throughput of normal is about 550 packets/seconds up to end of simulation. The throughput performance improvement is shows the better data delivery in a particular considered time i.e. utilized energy for data delivery.



**Fig: 3 Throughput Analysis**

**D. Summarized Performance**

The accurate performance of normal energy routing and proposed LELC routing is mentioned in Table 1. The performance metrics like PDR, delay and routing load through number of packets is evaluated and observe that the proposed scheme is provides the better performance and improves the energy utilization of nodes in dynamic network with enhancement of network life time and reduction of energy consumption.

**Table 1 Summarized Performance Analysis**

Performance Metrics	Normal (RMECR)	Proposed (LELC)
SEND	4768	6464
RECV	4032	5664
ROUTINGPKTS	1940	920
PDF	84.56	87.62
NRL	0.48	.16
Average e-e delay(ms)	505.32	311.7
No. of dropped data (packets)	664	637

**VI. CONCLUSION AND FUTURE WORK**

Battery power of mobile nodes is consumed in MANET during the transmission and reception of data, transmission of control packets, retransmission and overhearing. In this paper the proposed MIN-MAX scheme is selecting the node for routing that is maximum energy among all neighbors and consumes the minimum energy at the time if routing. The minimization of power consumption during the transmission and reception of data is improves the energy utilization efficiently in network. The MIN-MAX scheme minimizes the energy consumption between the nodes to compute the energy required to

transmit the data from a node to its neighboring node up to destination. The performance matrices in case of proposed MIN-MAX energy based routing is better as compare to normal energy routing. The performance of proposed scheme utilizes the battery power of mobile nodes in dynamic network gracefully in terms of reduces the possibility of retransmission. The energy computed is occupied in the selection of the most favorable path which requires minimum energy to route the data from source to destination that maximizes the life of network as compare to normal energy routing.

The nodes in MANET of fast mobility are not reliable for communication. Now in future the proposed scheme is also applied with prediction of the mobility of mobile nodes that reduces the loss of energy due to speedy nodes in MANET.

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