# IMPLEMENTATION OF A ENERGY EFFICIENT MULTICAST ROUTING PROTOCOL FOR MANET's

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**Abstract**— The mobile adhoc network has light weighted nodes with autonomic behavior subjected to change its structure dynamically. MANET uses a Multicast communication that is suitable for an intrinsic broadcast capability with a shared-tree architecture that maintains a group membership, where the group includes a group leader and group member. Existing methodology have more complexities like link breakage, energy loss due to low battery and bandwidth loss. Here, we propose a new mechanism to reduce all the above stated disadvantages by using a novel energy efficient multicast routing protocol has lesser control overhead. This technique is suitable for MANET. A Shared Multicast tree is constructed for multicast nodes which reduces the overhead of the network. The routes are discovered in the MANET by locating the physical location of nodes that are present in the network using which the route searching and energy consumptions are reduced. Apart from this technique, we also introduce a new Zone topology concept to differentiate the nodes which has minimum and maximum hops. In order to overcome link failure in MANET, a back-up node is maintained near the source node which contains all the details of the source node. In the event of failure of source node, backup node sends the failure information to all nodes in the network. The network nodes are monitored in certain time interval to reduce the link failures that happen due to loss of energy in nodes, a node that has a lower energy will consume the energy i.e. it share its energy with its neighbor node instead of making a sub-path and the data are sent in an compressed form from a source to destination reduce the time in reaching its destination.

Index Terms:

Mobile Ad hoc Networks, Multicast Routing Protocols, Energy Efficiency.

**Introduction:**

An ad-hoc network could be viewed as a dynamic multi-hop autonomous network. A mobile ad-hoc network (MANET) is characterized by mobile nodes without any infrastructure. Mobile nodes self-organize to form a network over radio links. The goal of MANETs is to broaden mobility into the area of autonomous, mobile and wireless domains, where a set of nodes form the network routing infrastructure in an ad-hoc manner. In mantes the nodes are communicate with others using radio signals by broadcast nature. In multicasting the transmission is initiated by a single node but will be received by more number of nodes. Due to its broadcast capability, Multicast has more impact on the mobile networks where the data transmitted to be audio/video conferencing, collaborative and groupware applications and corporate applications.

By sending through multiple unicast, it takes more links and it costs too high for communication process. Instead of that, multicast is used for the communication purpose because it utilizes less link consumption, sender and router processing, communication costs and further reduces delivery delay. Tree-based and Mesh based protocols are the two category used in the Multicast protocols. When the connectivity changes, the network should be readjusted and repaired in the multicast protocol because its structures are frail. The network is frail and gets split due to low battery.

To overcome the disadvantages of the mobile network like overhead, latency, more energy usage, we propose a new novel energy efficient approach for MANET environment. The proposed methodology uses a good bandwidth and energy usage in the network. The back up is used in the source node for reuse purpose in case of failure. Performance and reliability in terms of reduced overhead, less consumption of power and bandwidth is improved using the local connectivity technique and preventive route reconfiguration on the basis of the current status of the nodes. These techniques also ensure good reduction in latency in case of link breakages and prevention of the network from splitting.

In the wired networks there are two different multicast tree structures schemes are used namely : shortest-path tree and core based tree. The shortest path multicast tree is constructed based on the shortest path from every source node to the destination nodes and one of the source node is considered as a root node of the multicast tree, so that there may be any number of shortest paths exists in the network. In core-based multicast trees, shortest path from the source node to the destination node cannot be guaranteed, but only one tree would be needed to connect the set of the source nodes to a set of the receiver nodes.

However, it would be a difficult and challenging task to offer energy efficient and reliable multicast routing in MANETs. It might not be possible to recharge / replace a mobile node that is powered by batteries during a mission. The inadequate battery lifetime imposes a limitation on the network performance. To take full advantage of the lifetime of nodes, traffic should be routed in a way that energy consumption is minimized. In recent years, various energy efficient multicast routing protocols have been proposed. These protocols have unique attributes and utilize different recovery mechanisms on energy consumption. This project will provide a comprehensive understanding of these multicast routing protocols and better organize existing ideas and work to make it easy to design multicast routing in MANETs. The goal of this paper is to help researchers to gain a better understanding of energy-efficient routing protocols available and assist them in the selection of the right protocol for their work.

**Motivation:** In the mobile network the chances of link failure is more which should be avoided during communication. Further, the network should save power consumption by reducing the bandwidth and battery usage. The process of locating a node should also be easier which reduces the energy consumption.

In existing system, when a node in the selected path for the communication gets lower in energy, the source node will select a new path for sending the data. In our proposed approach, the source node will not select a new path for communication. Instead of this, the node which gets lowered in energy will be forced to share the energy with its neighbor node. As a result, when the energy gets lowered, the source node will not waste its energy to find the new path for communication. The energy can be consumed. The rest of the paper is organized as follows: Section 2 explains about the Related work, Section 3: describes about the proposed Methodology, Section 4: Implementation and Validation, Section 5: Conclusion of the work.

## 2. Related Work:

Due to the great potential of the network type , MANETs, are gaining tremendous focus from researchers and application developers. So many research has been done in the area of Multicast routing Protocols, we explore few of them in this paper and we discuss the prose and corners of the protocols.

M.Mohammed and M. Cheng, J. Shun, M. Min ,Y. Li and W. Wu have studied the performance and capacity of multicast routing protocols over MANETs in ([16], [17]). Omari et al summarized traffic models for multicast routing protocols in MANETs ([18], [19]). They also evaluated the performance of the existing multicast protocols in MANET using similar traffic models to justify their proposal. Multicast routing protocols were categorized into tree-based mesh-based, stateless, hybrid-based and flooding protocols.

with a focus on how to rise above the constraints present in the previously proposed multicast protocols. The four multicast routing protocols discussed in [18] are: On-Demand Multicast Routing Protocol (ODMRP), Multicast Ad Hoc On-Demand Distance Vector Routing Protocol (MAODV), Forwarding Group Multicast Protocol (FGMP) and Core-Assisted Mesh Protocol. Chen et al gave a general survey of multicast routing protocols in MANETs [20] and called attention to the constraints, including Quality of Service (QoS) and reliability, faced in the design of these protocols when they are applied in highly dynamic environments, characteristics of MANETs.

Due to the lack of resources from sharing wireless bandwith among nodes and topology changes as they move, its difficult to guarantee the quality of service in Manets. Protocols such as Location Guided Tree (LGT) [21], Ad hoc Multicast Routing protocol utilizing Increasing id-numberS (AMRIS) [22], [23] and Core-Assisted Mesh Protocol (CAMP) [24] may not be realistic to use, because QoS was not considered in the design as it requires finding a route from a source to a destination and satisfying the end-to-end QoS requirement which is usually given in terms of bandwidth or delay. Proper QoS cost metrics such as bandwidth, delay, packet loss rate should be used in the design of multicast routing protocols [21].

The MAODV protocol constructs multicast trees to reduce end-to-end latency while ODMRP constructs a multicast mesh to guarantee robustness. The Position Based Multicast (PBM) protocol neither constructs a tree nor a mesh; it uses the geographic position of the nodes to make forwarding decisions. The Progressively Adapted Sub-Tree in Dynamic Mesh (PASTDM) protocol builds a virtual mesh spanning all the members of a multicast group. In order to transmit and deliver packets, it depends on the underlying unicast routing protocol, leading to longer delays and lower on packet delivery [25]. Dewan also introduced a new protocol;

On Maximizing Lifetime of Multicast Trees in Wireless Ad hoc[26], Networks Lifetime – Refining Energy Efficient of Multicast Trees (LREMiT) is proposed which aims to maximize the lifetime of the multicast tree through refinement operation. This operation continues in rounds coordinated by the source node. The Protocol for Unified Multicasting through Announcement (PUMA) is proposed in [27], which uses a set of core nodes for multicasting by creating and maintaining a shared mesh for each multicast group without depending upon a unicast routing protocol. PUMA delivers data at a higher efficiency, while also provides a tight bound for control overhead in a wide range of network scenarios.

In Adaptive Demand Driven Multicast Routing (ADMR) [16], senders and receivers cooperate to establish and maintain forwarding states in the network to allow multicast communication [17]. ADMR adaptively monitors the proper execution of forwarding states and maintains connectivity when one or more forwarding nodes or receivers become disconnected. The Lifetime-aware Multicast Tree (LMT) [18] routing algorithm maximizes multicast lifetime by finding routing solutions that minimizes the variance of the available energy levels in the network [8].

Prioritized Overlay Multicast (POM) [19] aims to improve the efficiency and robustness of the overlay multicast in MANETs by building multiple role-based prioritized trees [20]. Usually it takes the benefits of location information. Cordeiro et al. provide information about the current state-of-the art in multicast protocols for MANETs, and compares them with respect to several performance metrics. In [21] and [22], the authors classify the multicast protocols into four categories based on the creation of the routes by the members of the group: tree-based approaches, meshed-based approaches, stateless multicast and hybrid approaches.

Energy-efficient broadcast routing algorithms called Minimum Longest Edge (MLE) and Minimum Weight Incremental Arborescence (MWIA) are introduced in [5][20]. MLE is able to achieve a longer network lifetime by reducing the maximum transmission power of nodes. With

MLE, the likelihood that a node is overused is reduced significantly. This scheme was expanded by considering a scenario where we introduce edge weights on the basis of the remaining energy of the sending nodes and receiving nodes. MWIA was derived from this idea, which is the best possible solution for broadcast routing with the minimum largest edge-weight. Cheng et al. proposed the Minimum Incremental Power (MIP) algorithm and it is known as the most energy-efficient heuristic in terms of the total energy consumption among all the topologies [17]. MIP is developed based on the Broadcast Incremental Power (BIP) algorithm.

The MIP algorithm is used as a comparison for the solution to the Energy-balanced topology control problem, which instead of minimizing the total energy, minimizes the maximum energy consumption at each node.

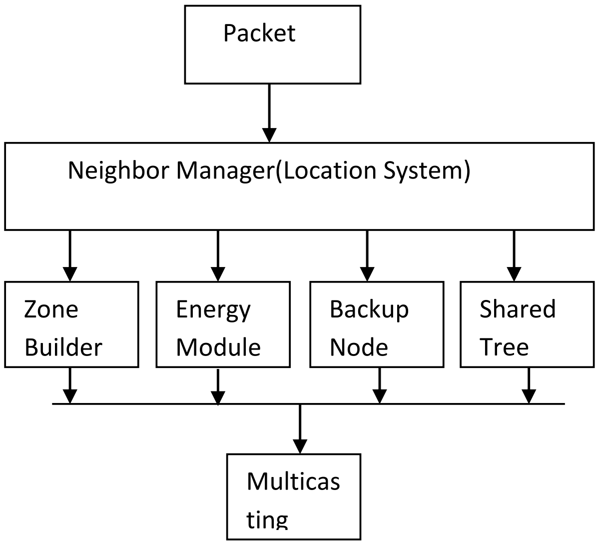
Energy Efficient Location Aided Routing (EELAR) Protocol [3] was developed on the basis of the Location Aided Routing (LAR) [25]. EELAR makes significant reduction in the energy consumption of the mobile node batteries by limiting the area of discovering a new route to a smaller zone. Thus, control packet overhead is significantly reduced. In EELAR, a reference wireless base station is used and the network's circular area centered at the base station is divided into six equal sub-areas. During route discovery, instead of flooding control packets to the whole network area, they are flooded to only the sub-area of the destination mobile node. The base station stores locations of the mobile nodes in a position table. Simulations results using NS-2 [26][27] showed that EELAR protocol makes an improvement in control packet overhead and delivery ratio compared to AODV [28], LAR [29], and DSR [30][31] protocols.

Li et al proposed the Online Max-Min (OMM) power-aware routing protocol [21] for wireless ad-hoc networks dispersed over large geographical areas to support applications where the message sequence is not known. This protocol optimizes the lifetime of the network as well as the lifetime of individual nodes by maximizing the minimal residual power, which helps to prevent the occurrence of overloaded nodes. In most applications that involve MANETs, power management is a real issue and can be done at two complementary levels (1) during communication and (2) during idle time. The OMM protocol maximizes the lifetime of the network without knowing the data generation rate in advance. The metrics developed showed that OMM had a good empirical competitive ratio to the optimal online algorithm [21] that knows the message sequence and the max-min achieves over 80% of the optimal node lifetime (where the sender knows all the messages ahead of time) for most instances and over 90% of the optimal node lifetime for many problem instances [5].

The Power-aware Localized Routing (PLR) protocol [32] is a localized, fully distributed energy-aware routing algorithm but it assumes that a source node has the location information of its neighbors and the destination. PLR is equivalent to knowing the link costs from the source node to its neighbors, all the way to the destination. Based on this information, the source cannot find the optimal path but selects the next hop through which the overall transmission power to the destination is minimized [5].

Power-aware routing (PAR) [33] maximizes the network lifetime and minimizes the power consumption by selecting less congested and more stable route, during the source to destination route establishment process, to transfer real-time and non real-time traffic, hence providing energy efficient routes. PAR focuses on 3 parameters: Accumulated energy of a path, Status of battery lifetime and Type of data to be transferred. At the time route selection, PAR focuses on its core metrics like traffic level on the path, battery status of the path, and type of request from user side. With these factors in consideration, PAR always selects less congested and more stable routes for data delivery and can provide different routes for different type of data transfer and ultimately increases the network lifetime. Simulation results shows that PAR outperforms similar protocols such as DSR and AODV, with respects to different energy-related performance metrics even in high mobility scenarios. Although, PAR can somewhat incur increased latency during data transfer, it discover routed that can last for a long time and encounter significant power saving.

Minimum Energy Routing (MER) can be described as the routing of a data-packet on a route that consumes the minimum amount of energy to get the packet to the destination which requires the knowledge of the cost of a link in terms of the energy expanded to successfully transfer and receive data packet over the link, the energy to discover routes and the energy lost to maintain routes [22]. MER incurs higher routing overhead, but lower total energy and can bring down the energy consumed of the simulated network within range of the theoretical minimum the case of static and low mobility networks. However as the mobility increases, the minimum energy routing protocol's performance degrades although it still yields impressive reductions in energy as compared performance of minimum hop routing protocol [34].




In existing system the mobile ad hoc system the communication will be stopped due to the link breakages and the energy is lost heavily. This lowers the usage of the network; to avoid this condition here we propose a novel approach that is used in the MANET system to avoid the link breakages that happen due to low battery energy level. The proposed working model consists of six components namely Neighbor Manager, Zone Builder, Multicasting, Backup Node, Shared Tree Building.

**Neighbor Management:**

The information about the nodes of the group member will reduce the searching mechanism of the sender node. The location systems will give the information about the nodes. The data structure is maintained in the Table format where the Location information's are stored in the Table Format and the Score cards are also maintained as a table. Location table is used for locating the neighboring node and score card Table is maintained for the how “good” the node is predicted. Thus, the novel based approach is used in the network for consuming less energy and to propose a network without any link breakages.

The location system receives packets from the higher and the lower layers. It is responsible for executing the HELLO protocol, managing location table, implementing estimation methods, running the other modules, and providing them with the required information according to the packet type. It uses a location table that assigns an entry for each neighboring node, which includes all the information related to the node such as its position, residual energy, estimated transmission delay, required transmission energy toward it, and estimated packet delivery ratio. They are updated upon each reception of a HELLO packet. Periodically, or upon observing significant change in some parameters, each node broadcasts a HELLO packet including its current position, residual energy, and its estimation of the other local parameters. Obviously, high frequency (short period) of HELLO packets exchange provides relevant and up-to-date information, but it would become resource consuming. This means it is required that this period should be carefully selected to maintain proper balance between information freshness and cost.

**Zone Building:**

After the forwarding mesh between a multicast source and receivers is established in the entire network, mesh-based multicast routing zones are created according to the distribution of source node. Multicast source node will firstly establish mesh-based multicast zone, named source zone. It collects the information of its nearest downstream ZANs from RREP messages that it receives. Such information includes IP address and distance (in terms of hop counts). If the source’s nearest downstream ZAN is far away from itself, e.g., more than 3 hops away, and relatively sparse, then the source node will not establish source zone (or we can say the zone size is 0). It just tunnels multicast packets in the unicast packets to its nearest downstream ZANs. If the source node finds many ZANs within N hops, then it establishes source zone with a zone radius of N. Source node becomes the leader of this source zone. A zone leader is in charge of constructing and maintaining a zone.

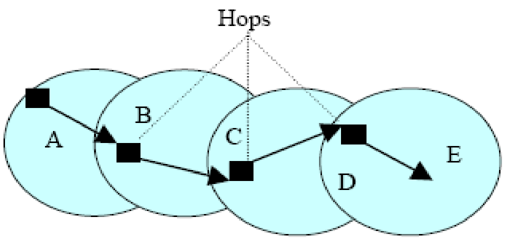



**Figure 1. a (Describes about the number of hops in Zones)**

The above figure describes about the hops in the Zone building. The source Node A to destination Node E have 3 hops. A zone is built for the nodes.

Energy Module:

Upon receiving and sensing packets each node will be loosing certain amount of power. Based on the amount of data it receiving and forwarding the node energy will be calculated and updated in the location table and score card table.

**Backup Node:**

The loads of the primary node are lessened by the Backup node. The more power node with high stability with slow movement is selected as the Backup node. This back up node will be used as a secondary forwarding node in case of link failure.

**Multicasting:**

Most of the multicast protocols proposed for mobile ad hoc networks can be broadly categorized into two types, namely tree based multicast and mesh-based multicast. Multicast mesh does not perform well in terms of energy efficiency due to excessive overhead as it depends on broadcast flooding within the mesh. On the other hand tree structure is known for its efficiency in utilizing the network resource optimally which is the motivation behind the selection of tree based multicast. Instead of using unicasting the packet for multiple times the Multicasting is used for the packet delivery is described in Fig 1 (b).

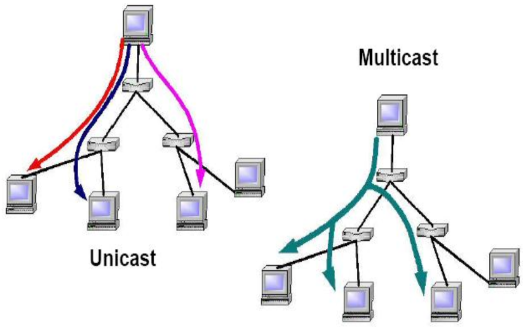



**Fig1. b (Describes the Unicast & Multicast tree structure)**

**Shared Tree Structure:**

In case of shared multicast tree the protocol dependency on a root node to maintain the group information burdens the root node. Due to this shared tree multicast is particularly not suitable from energy balancing point of view because the root of the tree takes on more responsibility for routing, consumes more battery energy, and stops working earlier than other nodes. This leads to reduced network lifetime [12] and the whole multicast tree is disconnected into a number of partitions which consumes a lot of wireless bandwidth for reconstructing the multicast tree from all these partitions. To avoid the overload for the source about the nodes the shared tree structure is used.

**Novel Energy Efficient Approach:**

The main objective is to minimize the utilization of the energy in mobile network. We are making our project not only as energy efficient but also for speed delivery of packets and also for preventing link breakages.

In the mobile network all the nodes will not be in a position. If a node has a packet it wants to send it to the neighbor node which has the good energy to receive and forward it. Hence, a node should be aware of the neighboring node. Two tables , are used for location information. First is the location table and the other one is score card table. This makes a node to avoid energy in searching a neighbor node. Then, well known Location Aided Routing is used of locating the node to send the packet in below algorithm.

**Algorithm1: Neighbor Sensing**

While( true)

- Receive Hello Message from other Nodes.
- Create entry in the Location Table.
- Update location information and energy information.
- Wait for constant time.

End while

In order to track the location information of the neighbouring nodes, our approach follows the Neighbor sensing algorithm. Initially it broadcast the hello packet and receives the reply from the neighbor nodes which are inside the coverage of the node. The reply packet contains the location information of the neighbor node and energy values of the neighbor. The multicast node creates an new entry in the location table if the node is new to its region or updates the location information and energy value.

Based on the location information the zone building is done. From the multicast zone, we choose the best path to send the information according to energy constraint. The node which has more energy is selected as the next forwarding node. The node which has more power will be selected as the back up node.

In order to route the packets towards destination it follows the algorithm 2. Upon receiving a packet, It reads the time to live value of the packet and if the ttl is greater than 16 it simply drops the packet. If the packet belongs to own node, it consumes the packet, otherwise it forwards the packet towards the destination.

**Algorithm 2:** Location Aided Routing (LARP)

LARP (Data Packet DP) {

//Target: Routing the data packet to destination node through shortest path.

If (DP.Time-To-Live=>16)* Exit(); //DP has to be retransmitted from the source of DP

Else{

If(DP.Dest_Addr.IP==Node_Address) {

Consume the DP;

Exit();                } Else{

DP.Time-To-Live++;

Cal BNSSA();

}}}//End of alogorithm 2

**Result and Discussion:**

Here we discuss about the results produced according to our algorithms. The picture below shows the initial step of our proposed approach called multicast zone building. We considered the node 7 as the source node and node 16 as the destination node. There exists a path as 7=>28=>26=>16 between node 7 and 16. We have shown the multicast zone according to our algorithm.

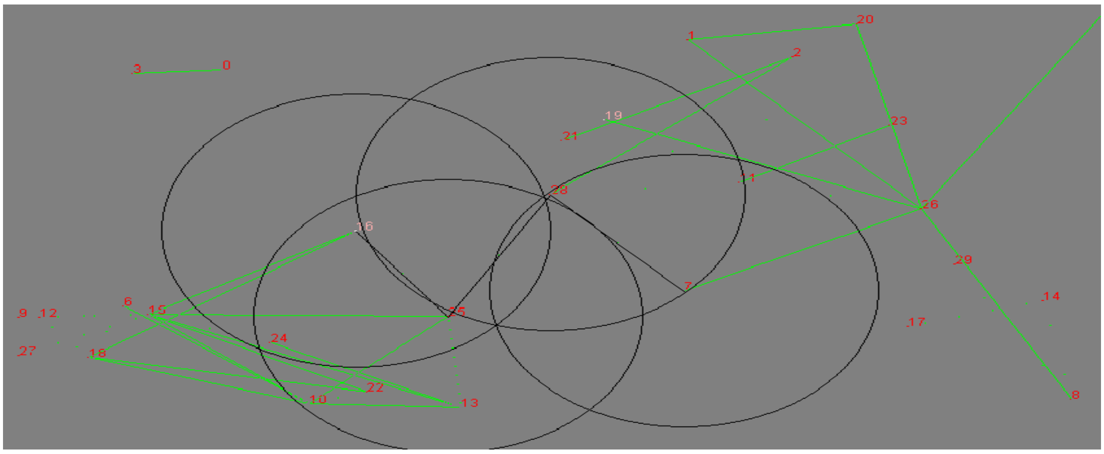


**Fig 2. Displays result of zone building**

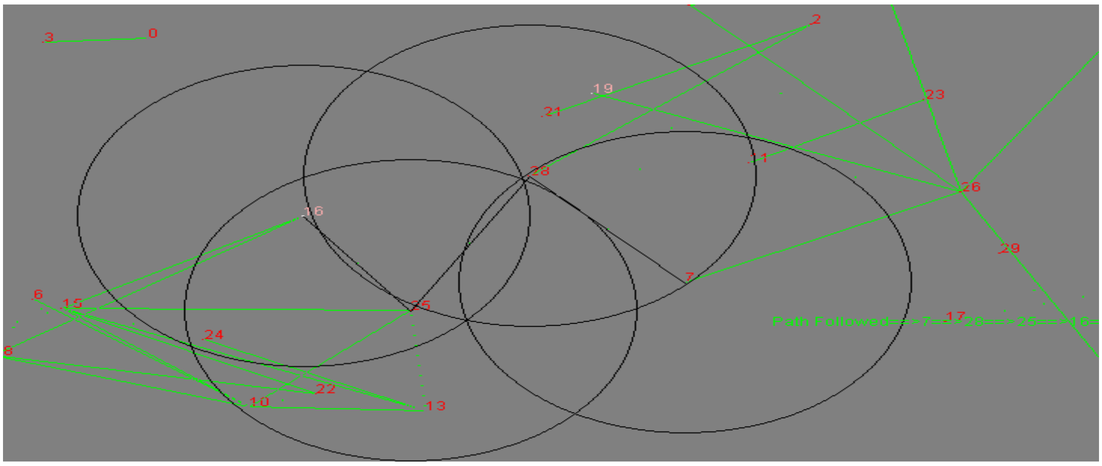


**Fig 3. Displays the multicast path between Node 7 and Node 16**

In Fig we have shown the multicast path and also the transmission path is displayed bottom right of the picture. The transmission paths also shown in black lines. Here the selected backup node is node no 28 due to its more power.

**CONCLUSION:**

In order to control the overhead of the network and to minimize the utilization of energy in the MANET, our novel energy efficient approach could be used. Instead of unicasting, multicasting is used for the speed delivery of the data to all nodes in the network. Novel Scheme is used in the network to eliminate the drawbacks like loss of energy due to less battery power, overhead and the like. Our algorithm also ensures good reduction in latency during the splitting of the network as well as eases the locating process of a node. It has a shared tree structure to avoid the congestion in the source node and it contains a backup root node which acts when the source node fails. Thus the energy is balanced in each and every delivery of data by sharing energy during failure of a node.

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