Energy Efficient Routing Algorithm in MANET Using Optimized Euler Digraph

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Abstract - **By using Energy Efficient Routing algorithm, we will try to find out the optimized network. Euler Digraph is used for data transmission from one node to another in the form of spanning tree. This is a graph in which there are equal number of incoming and outgoing links. In this digraph we will try to make shortest path for sending and receiving the data packet and try to avoid those nodes which have been participated earlier in the path. So we are trying to balance the energy consumption among the nodes in selection of the path from sender to receiver. So our energy efficient approach for routing overcomes the problem of energy dissipation for some specific nodes.**

Keywords: **Energy consumption, routing, energy distribution, adaptive routing, spanning tree.**

I. INTRODUCTION

The critical challenge in adhoc network is power consumption. By transmitting information at the time of necessity, battery powered nodes try to conserve energy but attacker can attempt to consume batteries by forwarding unnecessary packets to a node or route requesting. With the help of energy efficient routing algorithm we can improve the capacity of network. There are some probabilistic and deterministic techniques which are used in power control algorithm for building network topology for minimizing the cost improving the network life time. These approaches also preserve connectivity of network and minimize the unconditional interference. For power management Graph theory (using Euler Digraph) techniques are considered for solving the problem of power consumption and improvement of the network life time.

In graph theory approach a limited number of nodes has to be considered as vertices of the graph and the wireless links between the nodes is to be considered as the edges of the graph. If there is no any loop and parallel link between nodes, then that type of topological graph is said to be simple graph or strongly connected graph means a path lies between two nodes of that topological graph. The distance between two nodes of simple graph is Euclidean distance. By using optimized Euler Digraph we try to make energy efficient routing algorithm in MANET.

A. There are some major issues in designing mobile Adhoc network model by using graph theory approach

- **Efficiency**: Minimum number of transmissions should be made to deliver a data packet to all group members.
- **Control Overhead**: Adhoc wireless networks demands minimum control overhead for routing session because of scarce bandwidth availability.
- **Quality of Service**: QoS support is essential in routing because, in most cases, the data transferred in routing session is time sensitive.
- **Scalability**: Adhoc network should have ability to scale according to the number of nodes used.
- **Security**: Authentication of session members should be maintained and prevention of non-members from gaining unauthorized information is essential.
- **Shortest path problem**: In this finding a path between two vertices (or nodes) in a graph such that the sum of the weights of its constituent edges (from source to destination) should be minimized.
- **Key exchange problem**: How to exchange whatever keys or other information are needed so that no one else can obtain a copy is essential.

II. PREVIOUS WORK

In **"**[19] The k-Neighbors Approach to Interference Bounded and Symmetric Topology Control in Ad Hoc Networks" In wireless ad hoc networks topology control is an important feature. In which for conserving energy and also for reducing interference, nodes adjust their transmission range. On the other hand in most of the literature on topology control which emphasis on reducing energy consumption, in this given paper authors focuses the topology control issue by limiting interference as much as possible and also with high probability,

the communication graph is connected. This approach depends on maintaining the number of physical neighbors of every node, which is equal to or slightly below a specific value k. On the resulting communication graph, this approach is related to symmetry. Thereby the operations of higher layer protocols are easily performed. For evaluating the performance of this approach, the value of k has been estimated. So the connectivity of the communication graph is guaranteed with high probability, either theoretically or by simulation. In this k-Neigh is defined, which are fully distributed. Asynchronous and positioned protocol used for distance estimation. The most efficient protocol is k-Neighbor in which logarithmically bounded physical degree at every node is guaranteed. A 2n message in total are required in this protocol and n is the number of nodes in the network, and instead of existing protocols it relies on simpler assumptions. Again, it is verified with simulation that the network topologies show good performance which is produced by k-Neigh. This performance is verified in terms of node energy consumption and expected interference.

In **"[18] Power Control in Ad-Hoc Networks: Theory, Architecture, Algorithm and Implementation of the COMPOW Protocol"** Authors present a new protocol for power control in adhoc networks. They explain the issues in the form of concept for power control problem. By which an architecturally simple and theoretically well founded solution is provided. For satisfying the three simultaneous objectives, the solution is given, (a) The traffic carrying capacity of the entire network is maximizing, (b) By providing low power routes, battery life is extending and (c) At the MAC layer, contention is reducing. Again the protocol consists of the plug and play property, which can be employed with any routing protocol in conjunction, in which a routing table is pro-actively maintained. In the Linux kernel, the protocol, known as COMPOW, has been implemented and they explain the architecture of software and knowledge about implementation.

In **"[17] Minimum Energy Disjoint Path Routing in Wireless Ad-hoc Networks"** For finding minimum energy disjoint paths in all-wireless network, authors develop algorithms. These are for both the node and link disjoint cases. A novel polynomial time algorithm is included in their major results that optimally solve the problem of minimum energy to link-disjoint paths. Also a polynomial time algorithm is used for the problem of minimum energy k node-disjoint paths. In addition, They present efficient heuristic algorithms for both the problems. Link-disjoint paths consume substantially less energy than node-disjoint paths are shown in their results. They also analyze that the incremental energy decreases for additional link disjoint paths. Due to the fact that in general networks additional paths are typically longer than the shortest path, this finding is surprising. However, Due to the broadcast nature of the wireless medium, additional path can be obtained at lower energy in wireless network. Lastly, Issues in distributed implementation are discussed and of The optimal centralized algorithms for present distributed versions are presented in this paper.

In "[8] Topology Control of Multihop Wireless Networks using Transmit Power Adjustment" The problem of adjusting the nodes' transmit powers in a multihop wireless network are considered by authors. Which is also known as an ad hoc network for creating a desired topology? They describe it with formulae like constrained optimization problem. It is two constraints connectivity and biconnectivity and objective of optimization means maximum power used. There are two centralized algorithms presented by them used for static networks and their optimality is proved. On the other hand for mobile networks, two distributed heuristics are presented in which according to topological changes, node adaptively adjust transmit powers and by using minimum power, a connected topology is attempted to maintain. The throughput, power consumption and delay of algorithms are analyzed by them with the help of a prototype software implementation an emulation of a power controllable radio and a detailed channel model. The performances of multihop wireless networks can be substantially increased with topology control are shown in their result.

III. PROPOSED WORK

Energy consumption is one of the major factors that have to be taken into consideration in Wireless Ad-hoc Network. This is because the nodes that form Ad-hoc network topology rely on battery power for smooth operations. A major contribution to the dissipation of energy in the autonomous nodes is known as transmission power. This can be because transmission power determines the amount of energy consumed by each node. The transmission power must be high so that the transmission is guaranteed and should be low enough so that nodes energy is saved. Therefore, there is a need for Transmission Power Control (TPC) technique to be incorporated with efficient routing protocol. In that manner the network lifetime as well as the node lifetime will increase. It will minimize the consumption of energy at each node.

In this paper we proposed an Energy efficient routing algorithm based on the distance between a pair of nodes. Each node will send data packets with an optimal transmission power level to its neighboring nodes or intermediate nodes and it will use a Multihop Technology to convey information to the destination node. With this proposed algorithm, energy consumption will be minimized in transmission of data packets from the source to the destination using short range hops which uses less transmission power with respect to distance than a longer distance which uses a high transmission power.

In MANET, the mobile nodes are connected to other mobile nodes. These mobile nodes are free to send data packets to other nodes and also free to receive data packets from other nodes. Power is required for such activities.

By using Energy Efficient Routing algorithm we will try to find out the optimized network for data transmission from one node to another in the form of spanning tree of Euler Digraph. Euler Digraph are those graph in which there are equal number of incoming and outgoing links. In this digraph we will try to make shortest path for sending and receiving the data packet and count the number of times occurring of shortest path nodes, if shortest path consists of those nodes which are near the threshold value, then another node is to be considered for data packet transmission, whether these nodes consist a long route and it can be obtained by using energy efficient routing algorithm and threshold value is applied to every node to overcome the problem of energy dissipation for some specific nodes.
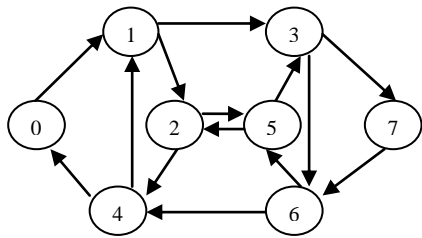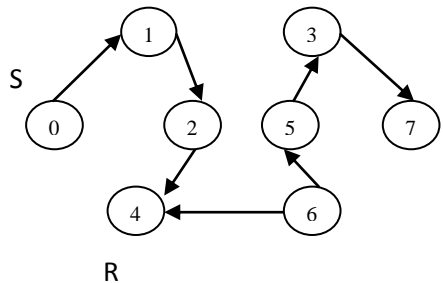

Fig 1: Euler Digraph For Maximum Length Sequence.

Fig 2: Spanning Tree Rooted at R

With the help of Euler Digraph we can find the energy efficient algorithm for a given network and equally distribute the data to every node and if one node is traversed more than one time then count the number of times and decide a threshold value. Before this threshold value we change the path through which packet is to be traversed. By using DSR we can find the shortest path for a given Euler Digraph. Each node maintains route cache in a network. Entries in the route cache are continually updated. If node occur in a network takes number of

count greater than a given limit in a shortest path route at the time of data transfer, then another node is to be consider either it is not in the shortest path but occur less number of times for receiving the data.

The protocol consists of two major phases:
  (i)   Route discovery
  (ii)   Route maintenance

Route discovery: In this phase source node (S) wants to send some data packets to some destination (R), it first consult to route cache for determining whether it already has a route to the destination. Cache initiate route discovery process by using route request data packets, if cache does not have shortest distance route to the destination.

In the fig:2 data packet is send from source to destination with the help of intermediate nodes are considered by determining the minimum spanning tree for a given digraph.

Route Maintenance: When route fails at the time of sending and receiving data packet, then route maintenance has to be done.

- If a node belong the route moves, its upstream neighbor notices the move and propagate a link failure notification message (route reply packet with infinite metric) to each of its active upstream neighbor to inform them of the breakage of that part of route.

- In a whole network data packet is traversing from source to destination through intermediate nodes. It may be possible that same node is considered more than one times, so energy consumption for this node is more than other nodes, so the energy distribution will be disturbed within the whole network due to those nodes which occur more than one time.

- For balancing the energy consumption between every node in the whole network, we consider a counter and a threshld value.

Proposed Algorithm

- First of all shortest path is to be considered between every node pair.

- After finding the shortest path, data packet is to be transferred from source to destination.

- When data is to be send from source to destination, it may be possible that any intermediate node can be considered more than once and more power is needed for a particular node.

- Due to this problem energy distribution is disturbed in the whole network and we have to distribute the equal energy to whole network.
- We take a counter value for network and consider a threshold value for every node in the network and check if specific node's value is exceeds a given value then another node is to be considered for data packet transmission.
- In that way energy consumption of every node does not exceeds to a given value and energy is equally distributed in whole network.
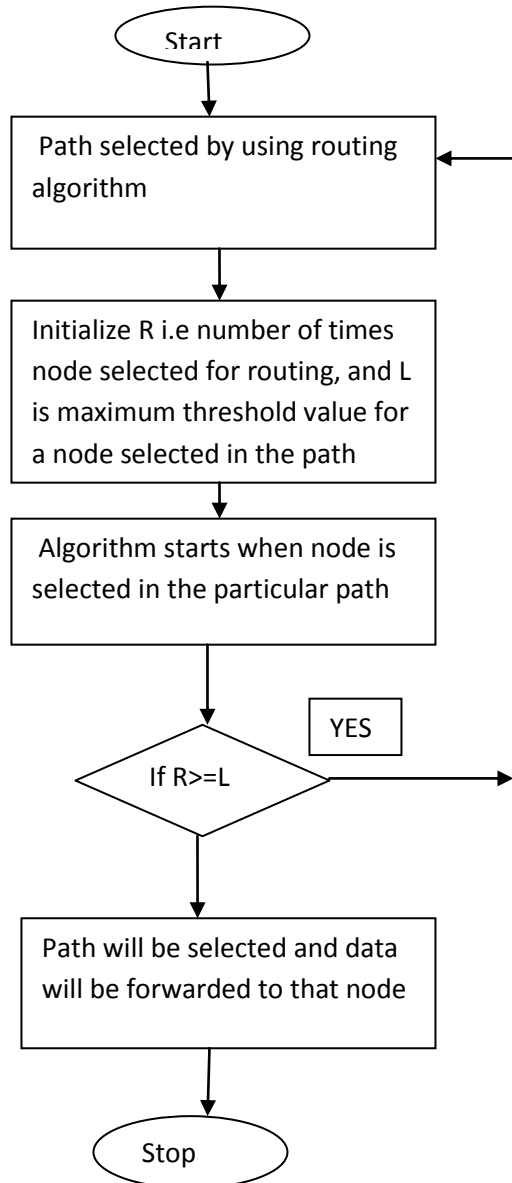
```
        ┌──────────────┐
        │    Start     │
        └──────┬───────┘
               │
  ┌────────────▼─────────────┐ ◄───────┐
  │ Path selected by using   │         │
  │ routing algorithm        │         │
  └────────────┬─────────────┘         │
               │                        │
  ┌────────────▼─────────────┐         │
  │ Initialize R i.e number  │         │
  │ of times node selected   │         │
  │ for routing, and L is    │         │
  │ maximum threshold value  │         │
  │ for a node selected in   │         │
  │ the path                 │         │
  └────────────┬─────────────┘         │
               │                        │
  ┌────────────▼─────────────┐         │
  │ Algorithm starts when    │         │
  │ node is selected in the  │         │
  │ particular path          │         │
  └────────────┬─────────────┘         │
               │           ┌──────┐     │
               ▼           │ YES  │     │
           ◇───────◇       └──────┘     │
           │If R>=L│────────────────────┘
           ◇───┬───◇
               │
  ┌────────────▼─────────────┐
  │ Path will be selected    │
  │ and data will be         │
  │ forwarded to that node   │
  └────────────┬─────────────┘
               │
        ┌──────▼───────┐
        │    Stop      │
        └──────────────┘
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Fig 3: flow diagram of proposed work

IV. CONCLUSION

Paths are maintained. By means of a certain probability, paths are chosen. It depends on how low the consumption of energy of each path can be achieved. At different time by selecting different routes, Any single route's energy will not deplete so quickly. With this scheme, the network degrades gracefully as energy is dissipated more equally amongst all nodes. By using the proposed algorithm, we can balance the energy consumption in our MANET network. By restricting the node selection in the routing path, through fixing the maximum threshold, we distribute the energy consumption in the network. So overall it increases the lifetime of the network.

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