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DESIGN OF ENERGY EFFICIENT MULTICAST ROUTING PROTOCOL FOR MANETs

N.Kamal

Professor & Head Dept.of IT, Sri Venkateswara College Of Engg. & Tech., Chennai

Abstract — A mobile ad-hoc network (MANET) is an autonomous network which has multi-hop light weighted nodes with dynamic structure. 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 multicast routing protocol which is energy efficient and 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 presented 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.

Keywords

Mobile ad-hoc networks, multicast communication, Zone topology, shared trees

I. INTRODUCTION

Dynamic multi-hop autonomous network without any intervention which makes any infrastructure is called an ad-hoc network. Due to its broadcast capability, Multicast has more impact on the mobile networks. By sending through multiple unicast, it takes more links and its costs too high for communication process. Instead of that, multicast is used for the communication purpose because it utilizes less link consumption, and sender and router processing, communication costs and delivery delay will be reduced. 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 can be splitted due to low battery. To overcome the disadvantages of the mobile network like overhead, latency, more energy

usage here we propose a new novel based approach for MANET environment that is to be used. 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.

1.1 Motivation

A network should have good communication with the adjacent nodes. In the mobile network the link will be broken. So, when the communication is going there should not be any link breakage. The network should have the power consumption by reducing the bandwidth and battery usage. The location finding of a node should be easier which reduces the energy consumption.

1.2 Our Contribution

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. As a contribution, here 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: Background, Section 4: Research Methodologies, Section 5 describes about the proposed Methodology, Section 6: Implementation and Validation, Section 7: Conclusion of the work

2. RELATED WORK

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 makes a network with less usage. To avoid this condition here we propose a new novel based approach that is used in the MANET system to avoid the link breakages that are happened because of low battery energy level.

A. Shared Tree with Backup Root

The network is a shared tree structure which makes the entire node in one Tree format. This makes communication easier. The source node has a Backup node which has all the information of the source node. This is used when the source node get failure, backup node will take up the charge.

B. Zone building

To be aware of the neighboring node and to reduce the overhead in the network the Zone is built.

C. Physical Location of Mobile Nodes

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.

D. Novel Based data structure

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.

2.1 Multicast Protocols

Multicast protocols can be categorized in tree based and mesh based protocols. Multicast network structures are frail therefore need to be readjusted and repaired continuously as the connectivity changes. Multicast protocols have to produce multihop routes under bandwidth scarcity, limited battery power and dynamic topology due to nodes' unpredictable mobility. Even in wired networks, building optimal multicast trees and maintaining group membership information is challenging which becomes predominantly challenging in mobile ad hoc networks. In multicast routing the shared tree is constructed for the multicasting the protocols to the entire group in the multicast. Involving only the group members the AM Route protocol is used in the bidirectional multicast tree. Between the tee members the link has been formed in the unicast protocol. AM protocols is depends on the unicast protocol is the great disadvantage.

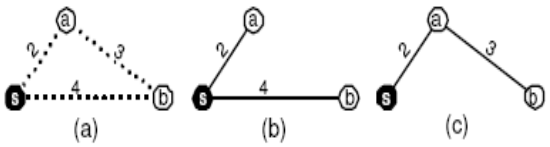

Fig.2.1 (a) illustrates an example deployment of wireless ad hoc networks consisting of 3 nodes and with link cost specified.

Fig.2.1 (b) and Fig.2.1(c) are two multicast trees connecting the source and destinations.

For finding the route the LAM protocol uses Temporally-Ordered Routing Algorithm (TORA) algorithm and doesn't operate independently. When LAM is connected the amount of overhead

reduces for finding the route which makes tight coupling with TORA. Creating of Mesh provides the higher forwarding overhead and that makes the robustness in finding the path. The main disadvantage of Mesh network is even the overhead occurs, it forward the packets.

2.2 Zone Routing

The routing in the network takes place when the location of the nodes is well known to the source node. This makes the reduction of searching of node to transmit the data. Thus, all the nodes are made to different zone that makes the source and destination is described in different hops.

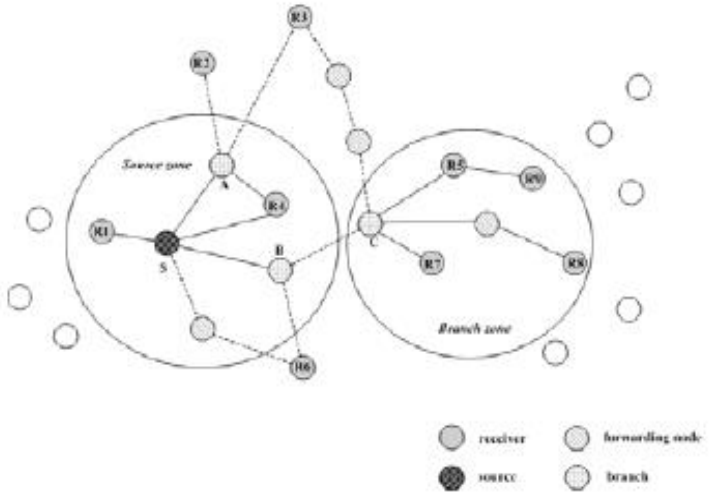

Figure (2.2) describes how the Zone is built within the nodes

3. BACKGROUND

Multipath routing has been explored in several different contexts. In alternate path routing, each source node and destination node have a set of paths (or multipaths) which consist of a primary path and one or more alternate paths. It was proposed in order to decrease the call blocking probability and increase overall network utilization. In alternate path routing, the shortest path between exchanges is typically one hop across the backbone network; the network core consists of a fully connected set of switches. Well known alternate path routing schemes such as Dynamic Nonhierarchical Routing and Dynamic Alternative Routing are proposed and evaluated in Multipath routing has also been addressed in data networks which are intended to support connection-oriented service with QoS. Using a crank back process, the alternate routes are attempted until a connection is completed. Alternate or multipath routing has typically lent itself to be of more obvious use to connection-oriented networks; call blocking probability is only relevant to connection oriented networks. The drawback of this approach is that the cost of storing extra routes at each router usually precludes the use of multipath routing.

3.1 Dynamic Source Routing

DSR is an on-demand routing protocol for ad hoc networks. Like any source routing protocol, in DSR the source includes the full route in the packets' header. The intermediate nodes use this to forward packets towards the destination and maintain a route cache containing routes to other nodes.

3.1.1 Route Discovery and Maintenance

When a node has a data packet to send but does not know the routing path to the destination, it initiates the route discovery procedure by broadcasting a control packet, called route request (RREQ). When an RREQ reaches the destination, it prepares another control packet, called route reply (RREP), and replies back to the source with the complete route information. Upon receiving an RREP, the source saves the route information in its local memory, called route cache, for later uses. Since nodes move randomly in a MANET, link errors occur and route information that includes a broken link becomes obsolete. When a node detects a link error during its data transmission, it sends another control packet, called route error (RERR), to the source and deletes the stale route from its route cache.

3.2 Ad Hoc On-demand Distance Vector

AODV is an on-demand routing protocol for ad hoc networks. However, as opposed to DSR, which uses source routing, AODV uses hop-by-hop routing by maintaining routing table entries at intermediate nodes.

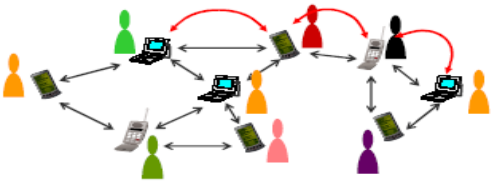

Figure 3.2 describes about the Multi-hop ad hoc network.

4. METHODOLOGIES

In MANET network, a new novel based approach that is used for low energy consumption, latency avoidance and avoiding of network splitting and sharing of the energy from the neighbors etc. The methods to evaluate this proposed model is described below.

(A) 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.

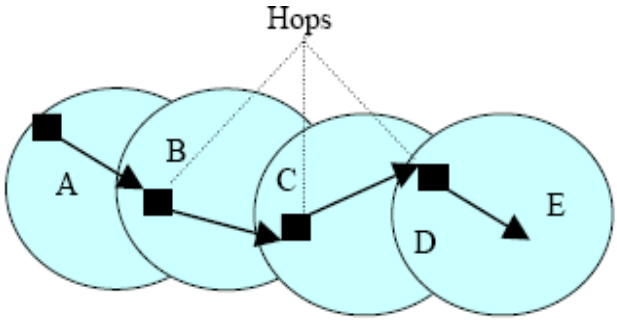

Figure 4. a (Describes about the number of hops in Zones)

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.

(B) 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.

(C) 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 4 (b).

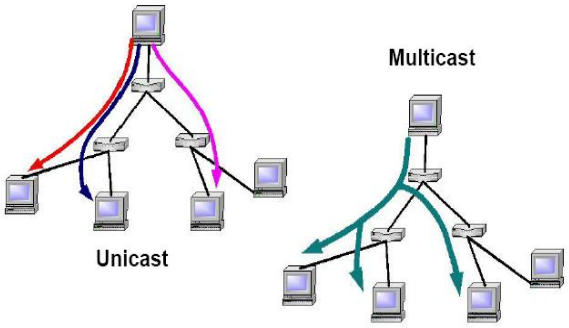

Figure 4. b (Describes about the unicast & Multicast tree structure)

(D) 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.

5. NOVEL BASED METHOD

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.

I. In the mobile network all the nodes will not be in a position. If a node has a packet with it wants to send it to the neighbor node which has the good energy to receive and send it. So a node should be aware of the neighboring node. So that, Global Positioning System (GPS), is used for the location information. GLS has 2 tables to indicate the node. First are the location table and another one is score card table. This makes a node to avoid energy in searching of a neighbor node. Then, well known Location Aided Routing is used of locating the node to send the packet in below algorithm

```
Algorithm: 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 + + ;
                                                call BNNSA ();
                                        }
                        }
        }
```

Figure 5. The Routing Algorithm

II. In shared tree network, the tree should be updated and prevented from network splitting. So, the battery power of a node is examined periodically. If any node found to be low power the particular node should share the energy with its neighbor node. Thus, the energy utilized by finding the new path is minimized.

III. By sharing the energy, there will be no link breakage, no energy loss and no network splitting.

6. IMPLEMENTATIONS AND VALIDATIONS

This section discusses other design issues and implementation details of proposed novel based Technique for the MANET. It also discusses the implementation of this technique in java with a performance in comparison to the proposed technique. The performance is evaluated using java network simulator which simulates node mobility, a realistic physical layer, radio network interfaces, and the proposed protocol. Since our evaluation is based on the simulation of 25 mobile nodes located in an area of 1500 _300m2. The radio transmission range is assumed to be 250 m, and the two-ray ground propagation channel is assumed with a data rate of 2 Mbps. The data traffic simulated is constant bit rate (CBR) traffic.

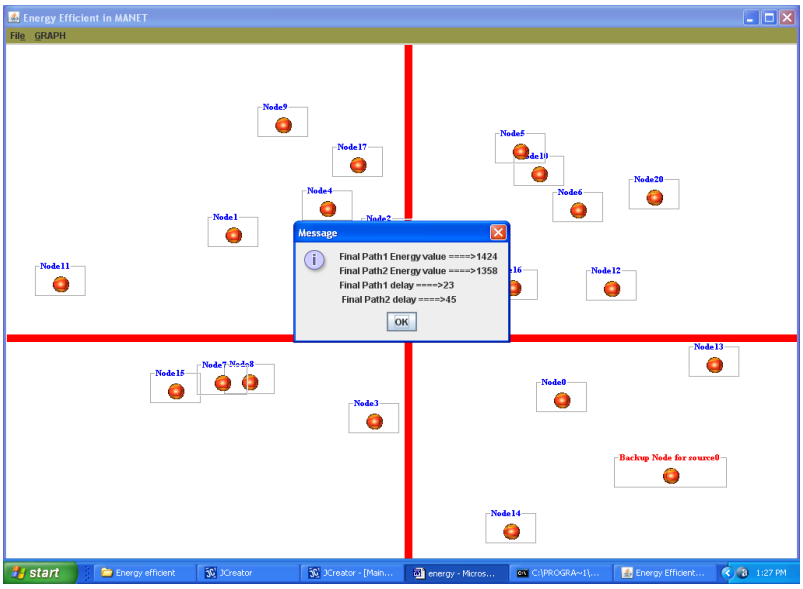

Figure 6(a) shows the Simulation screen

The metrics used for performance evaluation were: (i) Consumption of power of the nodes in the network. (ii) Average end-to-end delay of data packets - this includes all possible delays caused by buffering during route discovery, queuing delay at the interface, retransmission delays at the MAC, propagation and transfer times. Figures compare the performance of proposed novel based approach with that of MAODV as a function of no. of receivers.

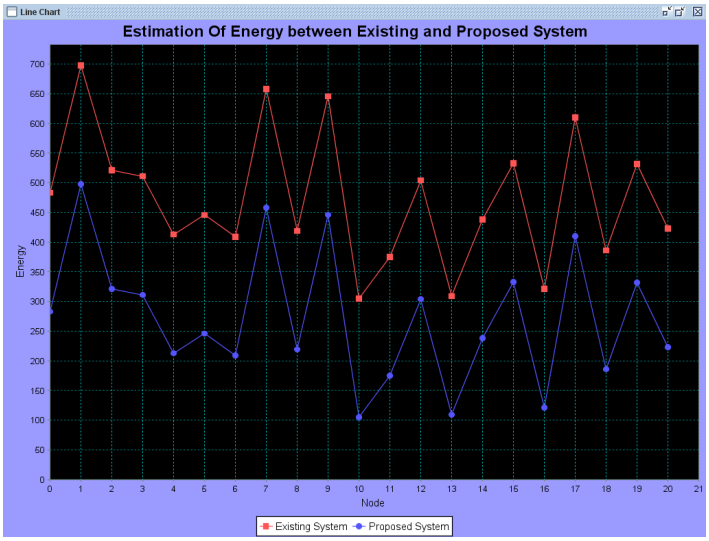

Figure 6(b) Performance Evaluation of the Power Consumption in MANET for the existing and the proposed Mechanism

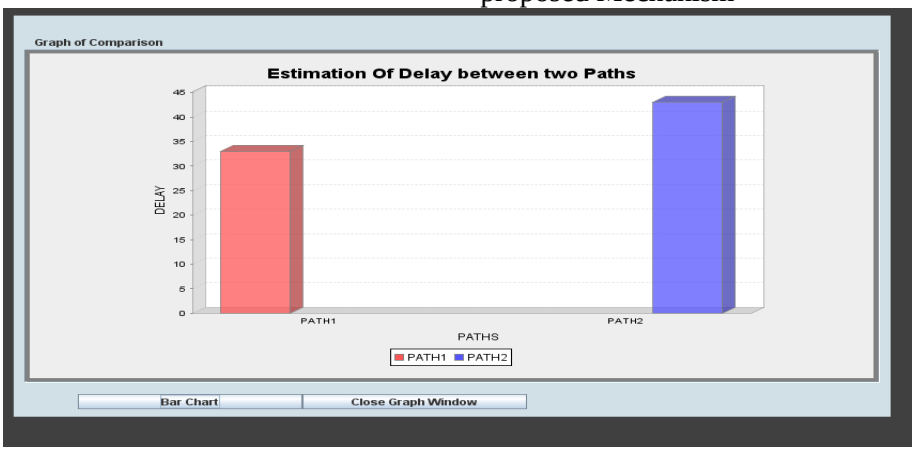

Figure 6(c) Performance Evaluation of the Delay Estimation in MANET

7. CONCLUSION

To control the overhead of the network and to minimize the utilization of energy in the MANET, the novel based approach is used. Instead of using 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 power of battery, overhead and ensures good reduction in latency when the network splits and it prevents the network from splitting and locating a node became the small process. It have 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 get failure. Thus the energy is balanced in each and every delivery of data by sharing energy when node fails.

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Dr.Kamal.N received his B.E Degree in Computer Science & Engineering from Madras University and M.E Degree in Computer Science & Engineering from Sathyabama University. He has completed his PhD from St.Peter's University. He is working as a Professor and Head in the Department of Information Technology, in Sri Venkateswara College of Engineering & Technology, Thiruvallur Chennai. His research interests include Mobile Ad-hoc networks, Vehicular Ad-hoc networks, Sensor Network.