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Energy Aware Assistive Routing in MANET

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Abstract: **- link breaks due to fast mobility and quick exhaustion of energy are two basic problems affecting in mobile ad hoc networks (MANETs). Assistive routing in MANETs is become an appealing topic, it improves network life time and energy efficiency. The proposed assistive routing scheme helps to improve route discovery, route reply, route management, and data forwarding) Assistive routing scheme selects the route by considering energy consumption and link break probability. The proposed EAR protocol stores the topological information in the assistive table and handles the link breakage problem by managing relay nodes for data forwarding. Route selection process considers the energy consumption to determine appropriate route across network. The results shows improvement up to 50% network throughput and 30% network lifetime.**

***Keywords*- Assistive routing, energy aware, network lifetime,**

I. INTRODUCTION

Mobile ad hoc network is a collection of wireless mobile nodes, dynamically form a temporary network without using any existing network infrastructure or centralized administration.In a mobile ad hoc network, nodes are mobile and they organize themselves into temporary topology dynamically therefore the network may experience rapid and unpredictable topology changes.
A more challenging goal in MANET is to provide energy efficient routing protocols since mobile nodes will be powered by batteries with limited capacity. Power failure of a mobile node not only affect the node itself but also its ability to forward packets on behalf of others and thus the overall network lifetime.
In MANETs, the routing protocols are mainly classified using their routing strategy used and the structure of network. Based on the network structure protocols are classified as flat routing, hierarchical routing and geographic position based routing. Based on the routing strategy protocols are classified as table driven and source initiated on demand routing protocols. Table driven routing protocols uses proactive strategy to find the routes and maintain them in routing table, lots of packet routing overhead take place in finding the routes for all source-destination pair. On- demand routing protocols such as AODV[1] and DSR uses reactive strategy[2] to find path between sources – destination pair, only when it is requested by the source, so incur a less overhead of packet routing. Compared to table driven protocols, on –demand protocols utilize less bandwidth and consumes less energy. Since on-demand routing protocols such AODV (ad hoc on demand distance vector) and DSR (dynamic source routing) use the simple flooding method to find a route to the destination , the number of route request (RREQ) packet needs to rebroadcast across the network. Energy efficiency is a major issue in MANETs, processing of such RREQ packets again and again by same node consumes more power. In order to address these issues, assistive routing has received much attention for its benefits, such as lower power consumption, and route selection diversity. Although a very useful models are proposed by various authors, the following fundamental issue are no addressed.

1. A basic routing structure at the Network layer for assistive routing is overlooked. Also, selection of assistive relay node at the Network layer is unable to make the contribution, without a complete routing structure.
2. How to reduce the link breaks via assistive routing has not received much attention.
3. The lifetime of the whole network could be improved by considering the proper route selection.

Given above issues, a reactive assistive routing protocol EAR is proposed in this paper
The rest of the paper is organized as follows, Section 2 describes the Assistive Energy efficient routing protocols, and Section 3 describes the design of EAR . Section 4 explains performance measurement parameters. Section 5 discusses comparative result analysis of energy efficient routing protocols, and section 6 conclusion and Future Scope.

II. ASSISTIVE ENERGY EFFICIENT ROUTING PROTOCOLS

Research interest has increased for assistive routing at the Network layer. The authors in [3] propose a model for hierarchical routing where a node that plays a role of a relay node Intermediate nodes on a route are selected as waypoints and route is divided into segments by waypoints. Address the scalability and link failure issues by running two protocols : Intersegment DSR routing protocol and Intersegment AODV protocol.WPR maintains a hierarchy only for active routes.

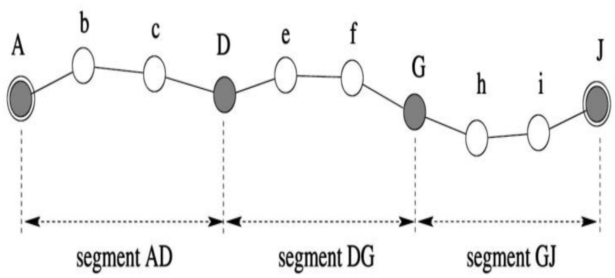

Fig 1 : Hierarchical routing in DOA [3]

For selection of the waypoint nodes a naive method is used , As waypoint nodes handles more responsibility, so energy consumption is more for such nodes. In [4] the author propose a protocol suite , composed of three protocols, offers scalability and extends network lifetime.The first protocol (FDDS) constructs a virtual backbone by finding a connected dominating set (CDS) in the network graph. The constructed Virtual Backbone takes into account the node's limited energy, mobility, and traffic pattern.The second protocol FDDS-M maintenance hierarchical structure constructed by FDDS. Third protocol FDDS-R select energy-efficient routes using fuzzy logic controller.

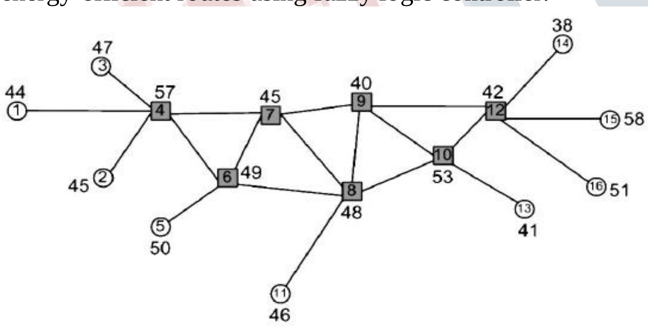

Fig 2 : Fast Distributed Connected Dominating Set [4]

The network maintenance controller has five rules that are designed to indicate what a candidate CH should have. i.e. high SQ , high RC , and high RSS. Authors selects the cluster heads who cannot be displaced from its original location by more than its own coverage area.

In [5], Authors proposed a loose-virtual-clustering-based (LVC) routing protocol for power heterogeneous (LRPH) MANETs. An LVC algorithm construct a hierarchical network and eliminate unidirectional links.To reduce the interference raised by high-power nodes, routing algorithm avoids packet forwarding via high-power nodes.

LRPH consists of two core components. The first component (Component A) is the LVC algorithm that is used to tackle the unidirectional link and to construct the hierarchical structure. The second component (Component B) is the routing, including the route discovery and route maintenance.

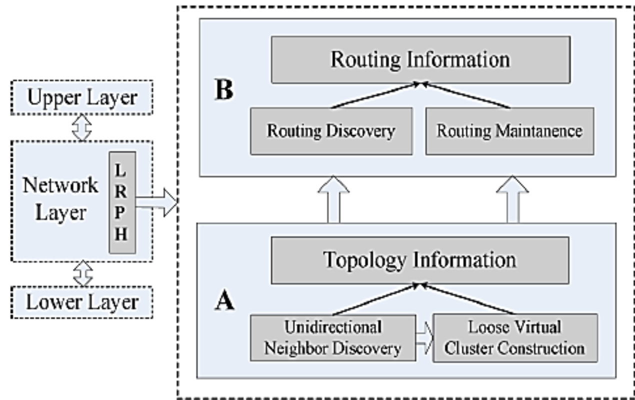

Fig 3: LRPH Mobile Ad hoc Networks [5]

To remove unidirectional links each node periodically sends a bidirectional neighbor discovery (BND) packet containing its own information (e.g., ID, type, state, etc.) and the information on its discovered neighbors. in [6] Author proposed efficient power aware routing (EPAR), a new power aware routing protocol that increases the network lifetime of MANET. EPAR identifies the capacity of a node not just by its residual battery power, but also by the expected energy spent in reliably forwarding data packets over a specific link. Using a mini- max formulation, EPAR selects the path that has the largest packet capacity at the smallest residual packet transmission capacity. The protocol is able to handle high mobility of the nodes that often cause changes in the network topology.

III. DESIGN OF EAR

EAR is a reactive routing protocol, when the data is available route will be established.

The network is divided into different sections and a local proactive repair will be performed by the assistive nodes.

The EAR is designed with following functions.

1. Route Establishment: The establishment of routing table
2. Neighbor Discovery: Establishment of assistive table

3. Route Reply: The reply to route request packets.
4. Link Breakage: Local repair of links.
4. Route Selection: Route selection metrics for energy saving

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Algorithm:

1. Let N be the neighbor addresses in each Node
2. Let NS be list of neighbors' neighbor addresses
3. for each i in N do
4. for each j in NS do
5. Record neighbors' neighbor address
6. Obtain Residual power of each node
7. for each i + 1 in N do
8. for each k in NS do
9. Find neighbors' neighbor address
10. obtain Residual power of each neighbors neighbor
11. Compare neighbors' neighbor power
12. if Power(i ,j) == Power (i+1,k) then
13. Insert a new entry in Node Table
14. Insert a entry assistive node table
15. Add Link (i, j) or Link (i+1,k) in Link table
16. else if Link (i ,j) ! = Link (i+1,k) then
17. Start the next loop*
18. continue
19. end if
20. end for
21. end for
22. end for
23. end for

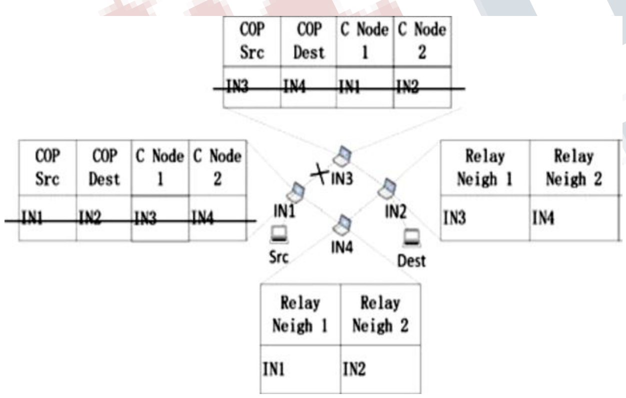

Fig 4: Tables in EAR

IV. PERFORMANCE MEASUREMENT PARAMETERS

There are number of qualitative and quantitative parameters that can be used to compare the reactive routing protocols. The following different quantitative parameters have been considered to make the comparative study.

1) Routing Overhead: This metric describes how many routing packets for route discovery and route maintenance need to be sent so as to propagate data.
2) Average Delay: This metric represents average end-to-end delay and indicate how long it took for packet to travel from source to the destination. It is measured in seconds.
3) Throughput: It can be defined as the total amount of data a receiver actually receives from sender divided by the time taken by the receiver to obtain the last packet.
4) Packet Delivery Ratio: The ratio between the amount of incoming data packets and actually received data packets.
5) Energy Consumption: This metric compares the total energy consumed by energy efficient routing protocol.

Result and discussion

Simulation Setup

Packet size: 512bytes

Simulation time: 140 second

Number of Nodes 25, 50, 100, 200

Packet rate

1. 0.02 for Increasing Number of Nodes
2. 0.5, 1.0, 1.5, 2.0 with increasing no. of nodes.

Traffic type CBR (UDP)

Mobility Model Random Way Point Mobility Model

MAC protocol IEEE 802.11

Node speed 2 m/s

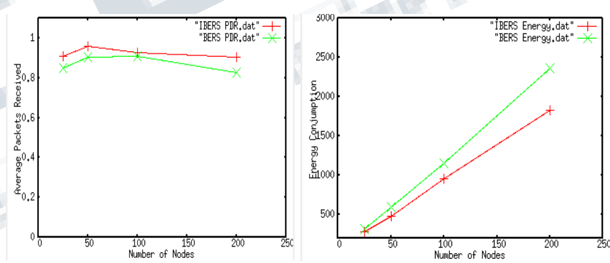

Fig: 5 PDR and Energy Consumption

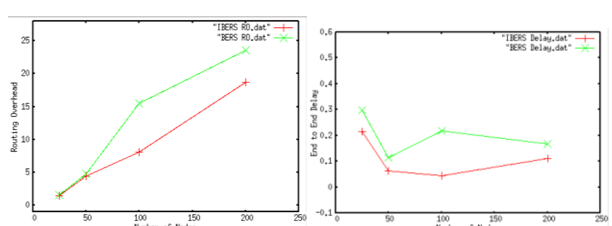

Fig: 6 Overhead and End to End dealy

We have evaluated the performance of EAR with AODV and DSR protocol. The simulation is carried out by increasing number of nodes and by varying packet rate. EAR shows the better performance in delivering the packets and consumes less energy than AODV protocol. EAR also

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overcomes the routing overhead for nodes and reduces end to end delay.

V. CONCLUSION

In our work, we have evaluated the performance of two different ad hoc routing protocols with respect to their routing overhead, packet delivery ratio, energy consumption and end-to-end delay. These performance metrics used in our evaluation represent two aspects of performance in a network. Energy consumption, end-to-end delay and packet delivery ratio addresses the reliability of the protocols. Routing overhead addresses the efficient use of network resources by the protocols. In a network, it is desirable for the protocol to be both efficient and reliable. EAR outperforms AODV and DSR, in the energy and end-to-end delay performance metrics. Both the protocols outperform in the packet delivery ratio when deployed in low mobility and high load networks. AODV shows more routing overhead compared to our developed EAR. It is therefore well suited for high capacity networks. EAR outperforms DSR in low and medium and high load networks with low node speeds. From this study, we conclude that among the protocols, EAR shows overall superior performance. It is superior in terms of routing overhead while other is also superior in terms of packet delivery ratio and end-to-end delay, our protocol consumes about 40 percent less energy and it is suitable for the increasing number of nodes. The choice of a routing protocol will depend on the intended use of the network. Factors considered in our work are the number of nodes and packet rate. Increasing number of nodes has a profound effect on the performance whereas packet rate affects the performance slowly. Finally we conclude from the performance that the proposed protocol EAR is quite adaptive for energy- efficient communication in MANETS.

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