Energy Conservation Routing in Wireless Ad Hoc Networks

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***Abstract*- Two novel energy-aware routing algorithms are proposed for wireless ad hoc networks called reliable minimum energy cost routing (RMECR) and reliable minimum energy routing (RMER). RMER is an energy-efficient and reliable routes minimizing the total energy required for end- to- end packet traversal. On the other hand, RMECR addresses three important requirements of the ad hoc networks: energy-efficiency, reliability, and prolonging network lifetime. It considers the energy consumption of the remaining battery energy of nodes as well as the quality of links to find energy-efficient and reliable routes that increase the operational lifetime of the network. Simulation studies shows that RMECR is able to find energy- efficient and reliable routes that are similar to RMER, while also extending the operational lifetime of the network. This makes RMECR an elegant solution to increase energy-efficiency, reliability, and lifetime of transceivers, limited number of retransmissions allowed for packet, packet sizes, and the impact of acknowledgement packets. This adds to the novelty of this work compared to the existing studies.**

***Keywords*- reliability, energy-efficient routing, battery-aware routing, prolonging network life time, End-to-end retransmission, hop- by- hop retransmission, wireless ad hoc network.**

I.INTRODUCTION

Energy efficient routing is an effective mechanism for reducing the energy cost of data communication in wireless ad hoc networks. Routes are discovered considering the energy consumed for end-to end (E2E) packet traversal. Nevertheless, this should not result in finding less reliable routes or overusing a specific set of nodes in the network. Energy- efficient routing in ad hoc networks is neither complete nor efficient without the consideration of reliability of links and residual energy of nodes. Finding reliable routes can enhance the quality of the service. Whereas, considering the residual energy of nodes in routing can avoid nodes from being overused and can eventually lead to an increase in the operational lifetime of the network.

The algorithms that aim at energy-efficient routes. These algorithms do not consider the remaining battery energy of nodes to avoid overuse of nodes, even though some of them address energy-efficiency and reliability together. Apart from this, many routing algorithms— including energy efficient algorithms have a major drawback. They do not consider the actual energy consumption of nodes to discover energy-efficient routes.The algorithms that try to prolong the network lifetime by finding routes consisting of nodes with a higher level of battery energy. These algorithms, however, do not address the other two aspects, i.e., reliability and energy-efficiency

The routes discovered by RMER minimize the consumed energy of the E2E packet traversal in the network. RMECR does not consider the remaining battery energy of nodes, and is used as a benchmark to evaluate energy-efficiency of the nodes, and will be used as a benchmark to evaluate energy efficiency of the RMECR algorithm.

A considerable energy efficiency and reliability gain is achieved by the RMER algorithm compared to the energy-efficient routing algorithm proposed for the HBH system and the algorithm proposed for the E2E system.on the other hand, while RMECR is not primarily an energy-efficient routing algorithm like RMER, our simulation results verify that energy-efficiency and reliability of routes discovered by RMECR are almost similar to those of RMER. Moreover, RMECR extends the operational lifetime of the network since it considers the remaining battery energy of nodes.

II.TECHNIQUES USED FOR RMECR IN WIRELESS AD HOC NETWORK

1. Distance vector algorithms

Distance vector algorithms use the Bellman-Ford algorithms. This approach assigns a number, the cost, to each of the links between each node in the network. Nodes will send information from point A to point B via the path that result in the lowest total cost (i.e., the sum of the costs of the links between the nodes used).

2. *Link-state algorithms*

When applying link-state algorithm, each node uses as its fundamental data a map of the network in the form of a graph. To produce this, each node floods the entire network with information about what other nodes it can connect to, and each node then independently assembles this information into a map. Using this map, each router then independently determines the least cost path from to every other node using a standard shortest paths algorithms such as dijkstra's algorithm. The result is a tree routed at the current node such that the path through the tree from the route to any other node is the least-cost path to that node. This tree then serves to construct the routing table, which specifies the best next hop to get from the current node to any other node.

3. *Path vector protocol*

Path vector routing is used for interdomain routing. It is similar to distance vector routing. In path vector routing we assume there is one node (there can be many). In each autonomous system which acts on behalf of the entire autonomous system. This node is called the speaker node. The speaker node creates a routing table and advertizes it to neighboring speaker nodes in neighboring autonomous system.

III. EXISTING METHODS

Existing work on increasing energy-efficiency, reliability, and the lifetime of the wireless ad hoc networks can broadly group them into three categories.

- Algorithms that consider the reliability of links to find more reliable routes.
- Algorithms that aim at finding energy-efficient routes.

Algorithms that try to prolong the network lifetime by finding routes consisting of nodes with a higher level of battery energy.

IV PROPOSED METHODS

The methods that used to overcome the problems occurred in existing system IPropose a novel energy-aware routing algorithm, called reliable minimum energy cost routing (RMECR). RMECR finds energy efficient and reliable routes that increase the operational lifetime of the network.

RMECR is proposed for networks with hop-by-hop (HBH) retransmissions providing link layer reliability, and networks with E2E retransmission providing E2E reliability.HBH retransmission is supported by the medium access control (MAC) layer (more precisely the data link layer) to increase reliability of packet transmission over wireless links. The advantages of the proposed system are Considers energy efficiency, reliability, and prolonging the network lifetime in wireless ad hoc networks. The impact of limited number of transmission attempts on the energy cost of routes
in HBH systems is considered. The impact of acknowledgement packets on energy cost of routes in both HBH and E2E systems is considered. Energy consumption of processing elements of transceivers is considered.

RMECR extends the operational lifetime of the network. It finds reliable routes.

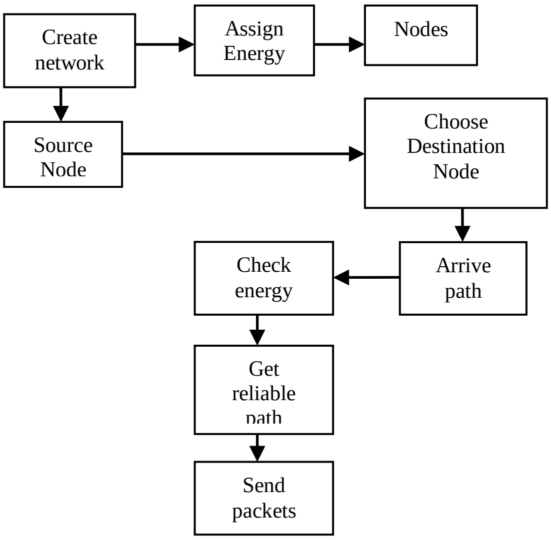

Fig: System Architecture

MODULES

- Network Model
- Energy Consumption for Packet Transmission
- Minimum Energy Cost Path
- Energy-Aware Reliable Routing

1. *Network Model*

Create topology of a wireless ad hoc networks by a graph G(V;E), where V and E are the set of nodes (vertices) and links (edges), respectively. Each node is assigned a unique integer identifier between 1 and N =|V|. Nodes are assumed to be battery powered. The remaining battery energy of node u ЄV is represented by Cu. If the battery energy of a node falls below a threshold Cth, the node is considered to be dead. Without loss of generality, we assume Cth =0. A link in the network is denoted by (u; v), in which u and v are sending and receiving nodes, respectively. The criterion for having a link from u to v is as follows: There could be a link from u to v, if the received signal strength by v is above a threshold. This threshold is usually specified in such a way that a targeted link error probability is satisfied.

2. Energy Consumption for Packet Transmission

The energy consumption for packet is given while activating the individual node in the network. This should be a constant value. Let x bit denotes the size of a packet transmitted over the physical link and E, the energy consumed by a transmitting node u to transmit a packet of length x [bit] to a receiving node v through the physical link (u; v). Let (u;v) (x)[J] denote the energy consumed by the receiving node v to receive and process the packet of length x [bit] transmitted by u. The energy consumed by nodes during packet transmission could be abstracted into two distinct parts. The first part represents the energy consumed by the transmission circuit excluding the power amplifier of the transmitter. The second part represents the energy consumed by the power amplifier to generate the required output power for data transmission over the air.

3. Minimum Energy Cost Path

The minimum energy cost path (MECP) between a source and a destination node is a path which minimizes the expected energy cost for E2E traversal of a packet between the two nodes in a multihop network. Since energy cost is an additive metric, it may seem that the Dijkstra's shortest path routing algorithm could be used to find MECP in the HBH system. However, the Dijkstra's shortest path routing algorithm is only a heuristic solution for finding MECP, but under some circumstances it could be the optimal solution.

4. Energy-Aware Reliable Routing

This module objective is to find reliable routes which minimize the energy cost for E2E packet traversal. To this end, reliability and energy cost of routes must be considered in route selection. The key point is that energy cost of a route is related to its reliability. If routes are less reliable, the probability of packet retransmission increases. Thus, a larger amount of energy will be consumed per packet due to retransmissions of the packet. It is designed energy-aware reliable routing algorithms for HBH and E2E systems. They are called reliable minimum energy cost routing and reliable minimum energy routing (RMER). In RMER, energy cost of a path for E2E packet traversal is the expected amount of energy consumed by all nodes to transfer the packet to the destination.

V. CONCLUSION

This paper proposes that 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 increase the reliability of wireless ad hoc networks. Furthermore, it is observed that RMER finds routes that their energy-efficiency and reliability high paths.

VI. REFERENCES

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