Reliable Energy Efficient Routing Algorithms In Wireless Ad Hoc Networks

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Abstract: Low Energy Adaptive Reliable Routing (LEARR) finds routes which require least amount of energy for reliable packet transfer in ad hoc networks. It defines the energy cost of packet forwarding by a node as the fraction of remaining battery energy which is consumed by a node to forward a packet. It includes the energy consumed for retransmission of the packet as well, when the packet or its acknowledgment is lost. It is found that LEARR can effectively reduce the energy consumption of nodes and balance the traffic load among them. Furthermore, LEARR is able to find reliable routes, in which constituent links require less number of packet retransmissions due to packet loss. It in turns decreases the latency of packet delivery and saves energy as well. To prolong the network lifetime, power management and energy-efficient routing techniques become necessary. Energy-aware routing is an effective way to extend the operational lifetime of wireless ad hoc networks.

Index Terms: Low Energy adaptive routing, battery-aware routing, end-to end and hop-by-hop retransmission, reliability, wireless ad hoc networks.

1 INTRODUCTION

WIRELESS ad hoc networks have been deployed at an increasingly fast rate, and are expected to reshape. For example, wireless ad hoc networks combined with satellite data networks are able to provide global information delivery services to users in remote locations that could not be reached by traditional wired networks. Meanwhile, advances in hardware technology are constantly proliferating various wireless communication terminals to an exploding user population. In many scenarios, designs of wireless ad hoc network protocols are guided by two requirements - energy efficiency and resilience to packet losses. Efficiently handling losses in wireless environments, therefore, assumes central importance. Generally, 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.

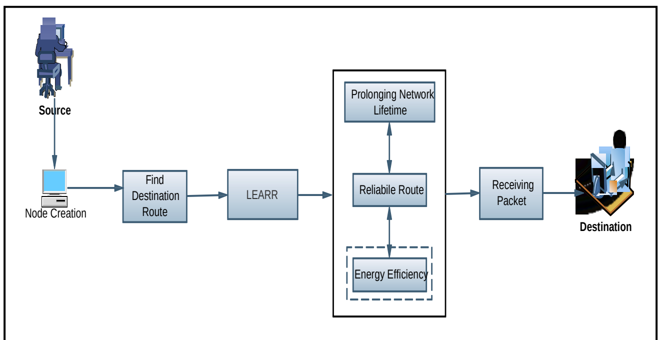

Fig. 1. System Architecture Design

Finding reliable routes can enhance 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. During the last decade, various routing algorithms have been proposed aiming at increasing energy-efficiency, reliability, and the lifetime of wireless ad hoc networks. Effectively reduce the energy consumption of nodes and balance the traffic load among them in this work, Low Energy Adaptive Reliable Routing (LEARR) is proposed which can. Furthermore, LEARR is able to find reliable routes, in which constituent links require less number of packet retransmissions due to packet loss. This in turn decreases the latency of packet delivery and saves energy as well. To prolong the network lifetime, power management and energy-efficient routing techniques become necessary.

2 LITERATURE SURVEY

We can broadly group them into three categories. The first category includes algorithms that consider the reliability of links to find more reliable routes. For instance, De Couto et al. [1] introduced the notion of ETX (Expected Transmission Count) to find reliable routes that consist of links requiring less number of retransmissions for lost packet recovery. Although such routes may consume less energy since they require less number of retransmissions, they do not necessarily minimize the energy consumption for E2E packet traversal. Furthermore, considering a higher priority for reliability of routes may result in overusing some nodes. If there are some links more reliable than others, these links will frequently be used to forward packets. Nodes along these links will then fail quickly, since they have to forward many packets on behalf of other nodes. The second category includes algorithms that aim at finding energy-efficient routes [2]-[7]. These algorithms do not consider the remaining battery energy of nodes to avoid overuse of nodes, even though some of them[4]-[7] address energy-efficiency and reliability together. Apart from this, many routing algorithms – including energy-efficient algorithms proposed [2]-[7] in has a major drawback. It does not consider the actual energy consumption of nodes to discover energy efficient routes. It only considers the transmission power of nodes neglecting the energy consumed by processing elements of transmitters and receivers. What is considered as energy cost of a path by these algorithms is only a fraction of the actual energy cost of nodes for transmission along a path. This negatively affects energy efficiency, reliability, and the operational lifetime of the network altogether. The third category includes algorithms that try to prolong the network lifetime by finding routes consisting of nodes with a higher level of battery energy. The proposed algorithms in Thus, the network lifetime may even be reduced. Our in-depth work in this paper considers energy efficiency, reliability, and prolonging the network lifetime in wireless ad hoc networks holistically. Low Energy Adaptive Reliable Routing (LEARR) finds energy efficient and reliable routes that increase the operational lifetime of the network.

3 METHODOLOGY

3.1 Network Topology

We design topology of a wireless ad hoc networks by a graph G(V,E), where V set of nodes (vertices) and set of nodes links (edges), respectively. All node is set unique integer identifier between 1 and N=|V|. Node assumed to be battery powered. Energy of node u € V is represented by C_u is remaining battery power. If battery energy of a node falls below a threshold C_{th}, node is consider to be not live no loss of generality, assume C_{th}=0. we design and represent a path in the network with h hops between two nodes as a set of nodes $\rho(n_1,n_{h+1})=\{n_1,n_2,\ldots,n_h,n_{h+1}\}$,where n_k€V is the identifier of the node (k= 1,…,h+1) of the path. It represent the source node and destination node all other rest are intermediate nodes which relay packets from the source to destination hop by hop.

3.2 Energy saving for packet sending over wireless links

Let x[bit] represent the size of a packet transmitted over the physical link and let $\varepsilon_{u,v}(x)$ represent the energy saving by a transmitted node u to transmit a packet of length x to a receiving node v through the physical link (u.v). $\omega_{u,v}(x)$ denote the energy saved by the receiving node v to receive and process the packet of length x transmitted by u. Represents the energy saved by the transmission could be abstracted into two distinct parts, circuit excluding the power amplifier of the transmitter. Power amplifier to generate the required output power for data transmission over the air. The energy saving by the receiving circuit including the low noise amplifier (LNA) of the receiver.

3.3 Hop-by-hop and End-to-end Retransmission Systems

Wireless links in ad hoc networks are usually prone to transmission errors. This necessitates the use of retransmission schemes to ensure the reliability. We can use either HBH or E2E retransmissions. In the HBH system, a lost packet in each hop is retransmitted by the sender to ensure link level reliability. An acknowledgment (ACK) is transmitted by the receiver to the sender when the receiver receives the packet correctly. If the sender does not receive the ACK (because either the packet or its ACK is lost or corrupted), the sender retransmits the packet. This continues until the sender receives an ACK or the maximum allowed number of transmission attempts is reached. If each link is reliable, the E2E path between nodes will also be reliable. In the E2E system, the ACKs are generated only at the destination and retransmissions happen only between the end nodes. The destination node sends an E2E ACK to the source node when it receives the packet correctly. If the source node does not receive an ACK for the sent packet, it retransmits the packet. This may happen either because the packet or the ACK is lost. In either case, the source retransmits the packet until it receives an ACK for the packet.

3.4 Low Energy Adaptive Reliable Routing (LEARR)

Our goal is to find reliable routes minimize the energy for E2E packet Traversal. By route selection to considered the reliability and energy cost of routes. The main key point is that energy of a route is related to its reliability. If routes are less reliable, the probability of packet retransmission increases. A larger amount of energy will be consumed per packet due to retransmissions of the packet. 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. By defining ways of computing the energy cost of routes, design sets of energy-aware reliable routing algorithms for HBH and E2E systems. They are called Low Energy Adaptive Reliable Routing (LEARR). In LEARR, 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. In LEARR, the energy cost of a path is the expected battery cost of nodes along the path to transfer a packet from the source to the destination.

4 SYSTEM IMPLEMENTATION

4.1 Network Creation

Nodes registered in the database with its name, Internet protocol Address & Port number and status and registered in the database. Each node can log in to the network through port number and its name. Each node maintain the on or off status this process is to identify whether the node is logged in or not. All node details are maintained in Main server the main server permits means the node can send the data. The Main server not in ON status means the node unable to send the data. We create the topology construction (path construction) to send the data. we send the data via intermediate nodes. For the Topology construction the user have to give weight to the source and the destination to n number of nodes. This process is to communicate via intermediate nodes. System Implementation

4.2 Gathering Information about the Nodes

As an essential requirement for energy-efficient routing, we assume nodes support adjustable transmission power. The transmission power from source node *to* destination node *is* denoted by a finite set of allowable transmission powers for source node s(*u)* specified by *S*(*u*)…,*D*(*u*) [mu] where *mu* is the number of allowable transmission powers of node s(*u)*. The discrete set is due to the practical considerations that all the commercially available devices are pre-programmed with a set of power settings. Regarding the power adjustment by nodes, we assume: (a) *Pu,v* is the minimum transmission power from *S*(*u*) that satisfies the targeted link error probability. (b) By adjusting the transmission power, the data rate of the Physical link does not change.

4.3 Minimum Energy cost Routing

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. By defining ways of computing the energy cost of routes, design sets of energy-aware reliable routing algorithms for HBH and E2E systems. They are called Low Energy Adaptive Reliable Routing (LEARR).

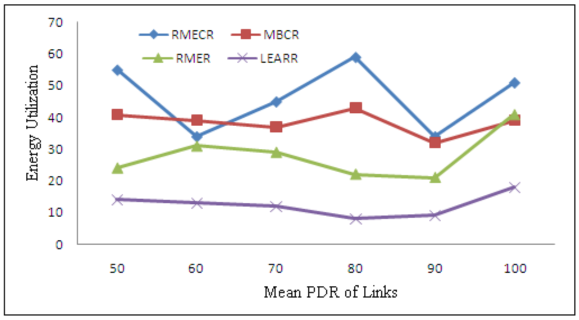

Fig. 2. Energy Utilization Factor

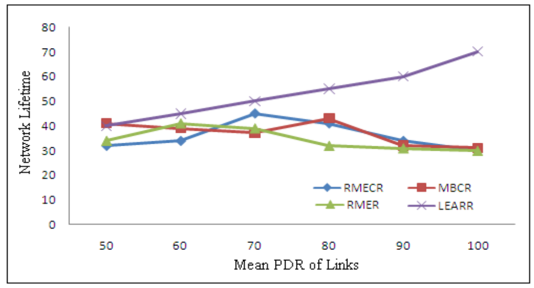

Fig.3. Average no of packets delivered to the destination while the first node failure occurs

In LEARR, 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. In LEARR, the energy cost of a path is the expected battery cost of nodes along the path to transfer a packet from the source to the destination.

4.4 Find the reliable Routes

LEARR is proposed for networks with hop-by-hop (HBH) retransmissions providing link layer reliability, and networks with E2E retransmissions providing E2E reliability. We consider the impact of limited number of transmission attempts on the energy cost of routes in HBH systems. We consider the impact of acknowledgment packets on energy cost of routes in both HBH and E2E systems We consider energy consumption of processing elements of transceivers. As mentioned earlier, underestimating the energy consumption of transceivers can severely harm reliability and energy-efficiency of routes. A detailed consideration towards various aspects of the energy consumption of nodes makes our work realistic and thus closer to practical implementations Our objective is to find reliable routes which minimize the energy cost for E2E packet traversal.

4.5 Increase the Operational lifetime of the Network

Energy Cost Routing (LEARR). LEARR can increase the operational lifetime of the network using energy-efficient and reliable routes. In the design of LEARR, we used a detailed energy consumption model for packet transfer in wireless ad hoc networks. RMECR was designed for two types of networks: those in which hop-by-hop retransmissions ensure reliability and those in which end-to end retransmissions ensure reliability. The general approach that we used in the design of LEARR was used to also devise a state-of-the-art energy-efficient routing algorithm for wireless ad hoc networks, LEARR finds routes minimizing the energy consumed for packet traversal. LEARR does not consider the remaining battery energy of nodes, and was used as a benchmark to study the energy-efficiency of the LEARR algorithm. Extensive simulations showed that not only saves more energy compared to existing energy efficient routing algorithms, but also increases the reliability of wireless ad hoc networks.

5 Conclusion

Low Energy Adaptive Reliable Routing (LEARR) for ad hoc networks includes the energy spent in potential retransmissions, is the proper metric for reliable, energy-efficient communications. First study the pure end-to-end retransmission model where none of the links guarantees per hop reliability, and then proceed to study the more general mixed retransmission model where some links may guarantee reliable delivery while the others may not. The lightweight distributed routing protocol LEARR can be used for energy efficient routing in any network configuration as well. LEARR is able to find minimum energy paths in the hop-by hop which effectively improves energy efficiency over the best known existing techniques in the general mixed model. There is a challenging question left for lifetime of the network. Further it is extent to find a routing with energy efficient, reliable and prolonging the network lifetime. LEARR can increase the operational lifetime of the network using energy-efficient and reliable routes. In the design of LEARR, detailed energy consumption model is used for packet transfer in wireless ad hoc networks. LEARR was used to also increase the reliability of wireless ad hoc networks LEARR also extends the network lifetime by directing the traffic to nodes having more amount of battery energy.

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