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Energy Efficient Reliable Routing Algorithms for Wireless Ad-hoc Network

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ABSTRACT: To address the problem of energy efficient reliable routing in wireless networks in the presence of unreliable communication links or devices or lossy wireless link layers by integrating the power control techniques into the energy efficient routing. This work deals with the problem of energy-efficient reliable wireless communication in the presence of unreliable or loss wireless link layers in multi-hop wireless networks. Reliable Minimum Energy Routing (RMER) and Reliable Minimum Energy Cost Routing (RMECR) are proposed for networks in which either hop-by-hop or end-to-end retransmissions ensure reliability. In mobile ad hoc networks, due to unreliable wireless media, host mobility and lack of infrastructure, providing secure communications is a big challenge in this type of network environment. In present work to ensure the security in unreliable wireless communication the cluster based topology scheme is used, to obtain confidentiality and authentication of nodes hash function and MAC (Message Authentication Code) techniques are used.

KEYWORDS: Energy-aware routing, end-to-end and hop-by-hop retransmission, reliability, wireless ad hoc networks

I. INTRODUCTION

MANET (Mobile Ad-Hoc Network) is a special type of wireless network in which a collection of mobile network interfaces may form a temporary network without aid of any established infrastructure or centralized administration. Ad Hoc wireless network has applications in emergency search and-rescue operations, decision making in the battlefield, data acquisition operations in hostile terrain, etc. It is featured by dynamic topology (infrastructure less), multi-hop communication, limited resources (bandwidth, CPU, battery, etc.) and limited security. These characteristics put special challenges in routing protocol design. The one of the most important objectives of MANET routing protocol is to maximize energy efficiency, since nodes in MANET depend on limited energy resources.

The network throughput is usually measured by packet delivery ratio while the most significant contribution to energy consumption is measured by routing overhead which is the number or size of routing control packets. A major challenge that a routing protocol designed for ad hoc wireless networks faces is resource constraints. Devices used in the ad hoc wireless networks in most cases require portability and hence they also have size and weight constraints along with the restrictions on the power source. Increasing the battery power may make the nodes bulky and less portable. The energy efficiency remains an important design consideration for these networks. Therefore ad hoc routing protocol must optimally balance these conflicting aspects. To achieve the desired behavior, some proposals make use of clustering or maintain multiple paths to destinations (in order to share the routing load among different nodes). The majority of energy efficient routing protocols for MANET try to reduce energy consumption by means of an energy efficient routing metric, used in routing table computation instead of the minimum-hop metric. This way, a routing protocol can easily introduce energy efficiency in its packet forwarding. These protocols try either to route data through the path with maximum energy bottleneck, or to minimize the end-to-end transmission energy for packets, or a weighted combination of both. The energy optimization of a routing protocol, however, can exploit also other network layer mechanisms, like control information forwarding.

In this represent a topology of a wireless ad hoc networks by a graph G(W,IE), where W and IE are the set of nodes (vertices) and links (edges), respectively. Each node is assigned a unique integer identifier between 1 and N=W. Nodes are assumed to be battery powered. The remaining battery energy of node u is represented by C(u). If the battery energy of a node falls below a threshold Cth, the node is considered to be dead . Without loss of generality, 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

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above a threshold. This threshold is usually specified in such a way that a targeted link error probability is satisfied. Here denote the probability of error-free reception of packets of length x [bit] transmitted by u to v by p(u,v)x. In other words, p(u,v)(x) is the packet delivery ratio (PDR) of p(u,v)y for packets of size x [bit].As an essential requirement for energy-efficient routing, assume nodes support adjustable transmission power. The transmission power from node u to node v is denoted by P(u,v)x. P(u,v)y belongs to a finite set of allowable transmission powers for node u specified by S(u)={P1(u),P2(u),…….Pm(u)}, where m(u) is the number of allowable transmission powers of node u. The discrete set is due to the practical considerations that all the commercially available devices are preprogrammed with a set of power settings. Regarding the power adjustment by nodes, assume: P(u,v)is the minimum transmission power from S(u) that satisfies the targeted link error probability. By adjusting the transmission power, the data rate of the physical link does not change. In this represent a path in the network with h hops between two nodes as a set of nodes P(n1,n(h+1)={n1,n2,….n(h),n(h+1)}, where n(k) is the identifier of the kth node(k =1; . . . ; h+1) of the path. Here, n1 is the source node, n(h+1) is the destination node, and the rest are intermediate nodes which relay packets from the source to the destination hop by hop. Furthermore, (n(k),n(k+1)),IE is the kth link(k=1…….h) of the path.

Energy efficient routing is an effective mechanism for reducing energy cost of data communication in wireless ad hoc networks. 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. 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.

The first category includes algorithms that consider the reliability of links to find more reliable routes. Here introduced the notion of expected transmission count (ETX) 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. These algorithms do not consider the remaining battery energy of nodes to avoid overuse of nodes, even though some of them, namely, address energy-efficiency and reliability together. Apart from this, many routing algorithms have a major drawback. They do not consider the actual energy consumption of nodes to discover energy-efficient routes. They only consider the transmission power of nodes (the output power of the power amplifier) 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. As we will show, 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. These algorithms, however, do not address the other two aspects, i.e., reliability and energy-efficiency. Discovered routes by these algorithms may neither be energy-efficient nor be reliable. This can increase the overall energy consumption in the network. Thus, the network lifetime may even be reduced.

II. RELATED WORK

A) 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. It 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

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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. In both HBH and E2E systems, a retransmission occurs after the expiration of a timer. Assume that the duration of this timer is long enough to prevent unnecessary retransmissions.

B) Energy-Aware Reliable Routing

Our 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. By defining two different ways of computing the energy cost of routes, we design two sets of 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 Reliable Minimum Energy Routing , 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 Reliable Minimum Energy Cost Routing (RMECR), 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. Before we proceed with the design of Reliable Minimum Energy Routing (RMER) and Reliable Minimum Energy Cost Routing (RMECR), we first define the minimum energy cost path.

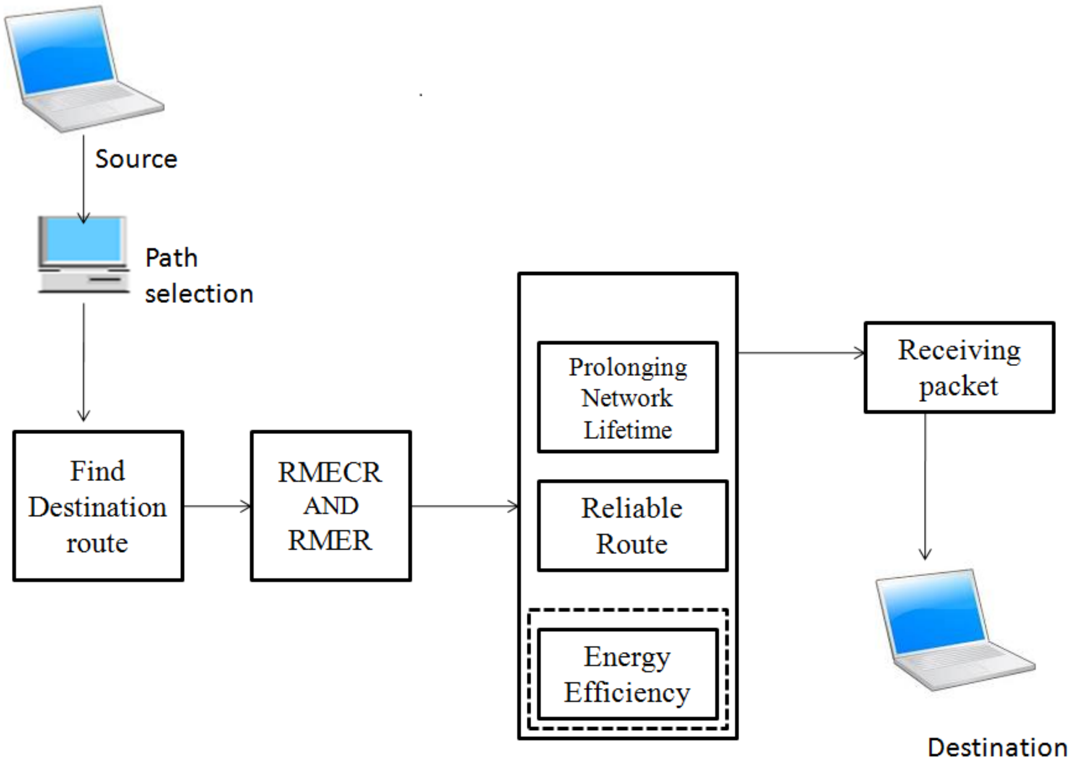

Figure 1 : System Architecture

C) 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.

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D) Security in key Distribution

Here considers a cluster-based ad hoc hierarchical network topology. A subset of the network nodes is selected to serve as the network backbone over which essential network control functions are supported. The approach to topology control is often called clustering, and consists of selecting a set of cluster heads in a way that every node is associated with a c1uster head, and c1usterheads are connected with one another directly or by means of gateways ,so that the union of gateways and c1usterheads constitute a connected backbone. Once elected, the cluster heads and the gateways help reduce the complexity of maintaining topology information, and can simplify such essential functions as routing, bandwidth allocation, channel access, power control or virtual-circuit support.

III. SYSTEM IMPLEMENTATION

A) Node Creation Phase

When the frame is loading there is no one node has created. In this phase used to create the new nodes on region. By click a mouse pointer can create nodes on the regions. Each region has five nodes, even use only one region to the operation. When the node has created that time node name has added to the node list for selecting the source node and destination node from the regions.

B) Gathering information about Nodes

When created the nodes, in this phase select the source and destination node from the regions, then ready for transmission the message to destination. When ready to transmit message click transmit button, then it carefully selecting node for gather the information about each and every node of each region like neighborhood of source node and who have highest energy in the neighborhood, etc. Gathering information is based on the shortest or neighborhood of the source node for calculating the Energy and reliable route of the nodes.

C) Find Reliable Routes

In this phase we proposed Reliable Minimum Energy Cost Routing (RMECR) for networks with hop-by-hop (HBH) retransmissions providing link layer reliability, and networks with E2E retransmissions providing E2E reliability. It considers the impact of limited number of transmission attempts on the energy cost of routes in HBH systems and also here it consider the impact of acknowledgment packets on energy cost of routes in both HBH and E2E systems. Finally considers 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.

D) 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 two different ways of computing the energy cost of routes and design two sets of energy-aware reliable routing algorithms for HBH and E2E systems. They are called Reliable Minimum Energy Cost Routing (RMECR) and Reliable Minimum Energy Routing (RMER). In Reliable Minimum Energy Cost Routing , 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 Reliable Minimum Energy Cost Routing (RMECR), 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.

E) Increase the Operational Lifetime of the Network

Energy-aware routing algorithms for wireless ad hoc networks, called Reliable Minimum Energy Cost Routing (RMECR) and Reliable Minimum Energy Routing (RMER). RMECR addresses three important requirements of ad hoc networks: energy-efficiency, reliability, and prolonging network lifetime. It considers the energy consumption and the remaining battery energy of nodes as well as quality of links to find energy-efficient and reliable routes that increase

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the operational lifetime of the network. Reliable Minimum Energy Routing , on the other hand, is an energy-efficient routing algorithm which finds routes minimizing the total energy required for end-to-end packet traversal. Reliable Minimum Energy Routing (RMER) and Reliable Minimum Energy Cost Routing (RMECR) are proposed for networks in which either hop-by-hop or end-to-end retransmissions ensure reliability. Simulation studies show that Reliable Minimum Energy Cost Routing (RMECR) is able to find energy-efficient and reliable routes similar to Reliable Minimum Energy Routing (RMER), while also extending the operational lifetime of the network.

IV. CONCLUSION

Here presented an in-depth study of energy-aware routing in ad hoc networks, Reliable Minimum Energy Cost Routing (RMECR) can increase the operational lifetime of the network using energy-efficient and reliable routes. In the design of Reliable Minimum Energy Cost Routing (RMECR),it used a detailed energy consumption model for packet transfer in wireless ad hoc networks. Reliable Minimum Energy Cost Routing (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. RMER finds routes minimizing the energy consumed for packet traversal.. However, Reliable Minimum Energy Cost Routing (RMECR) also extends the network life time by directing the traffic to nodes having more amount of battery energy. Although security issues in mobile ad hoc networks have been a major focus in the recent years, the development of fully secure schemes for these networks has not been entirely achieved till now. In this cryptographic authentication method it will provide less communication overhead for distributing the keys and provides authentication and confidentiality between nodes.

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