Considering Parameters,study of Energy Efficient Routing Protocol in Wireless Ad Hoc Network

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*Abstract-***An Energy Efficient routing algorithm which could be reliable as well can prove to be very useful in wireless Ad Hoc network as Energy and reliability are precious resource in wireless Ad Hoc network. In this paper we are proposing two Energy Efficient routing algorithms namely Reliable Minimum Energy Routing (RMER) and Reliable Minimum Energy Cost Routing (RMECR). RMER is an energy efficient routing algorithm which finds routes minimizing total energy required for End-to-End packet traversal. RMECR is another proposed algorithm which considers remaining battery energy of nodes as well as quality of links thus increases the network lifetime also. In simulation studies a comparison of RMER and RMECR on basis of Delay and Normalized routing load parameter is obtained.**

Keywords- End-to-End transmission, Wireless Ad Hoc network, Retransmission, Reliable routes.

I.   INTRODUCTION

Energy-efficient   and   reliable   routing   are   two important requirements in wireless ad hoc networks, where nodes have limited battery power and wireless links are prone to transmission errors. When nodes in the network cooperate to achieve a single goal (e.g., in wireless sensor networks), maximizing the operational lifetime of the network is also an important   requirement. While each of these requirements could be achieved separately in ad hoc networks, providing energy-efficient and reliable routing in such a way that the network lifetime is maximized is of significance.

In this paper, we are going through two energy-aware routing algorithm for wireless ad hoc networks called Reliable Minimum Energy Cost Routing (RMECR) and Reliable Minimum Energy Routing (RMER). The proposed algorithm is able to increase the network lifetime and find reliable and energy-efficient   routes   simultaneously.   RMECR   finds minimum energy cost routes, where the energy cost of packet forwarding from a node is a function of the remaining battery energy of the node, reliability of the physical link, and required energy for packet transmission.RMECR can reduce

the overall energy consumption in the network by finding minimum energy cost routes. It can also find reliable routes in which constituent links require less number of packet retransmissions due to packet loss. Furthermore, RMECR can balance the traffic load in the network and increase the network lifetime by finding routes in which nodes are likely to have more residual battery energy.

Delay and normalized routing load are the important Quality of service (Qos) parameters on which this work is focused. The rest of the paper is organized as follows: In section 2,we present some previous work. In section 3 RMER and RMECR algorithm is explained. In section 4 we go through some practical issues that are to be considered. In section 5 simulation results are been shown according to our work. Finally we conclude in section 6.

II.   PREVIOUS WORK

Up   to   now   many   routing   algorithms   have   been proposed. They can be grouped as follows: A group of algorithms that consider reliability of links to find reliable routes . D. Aguayo mentioned notion of expected transmission count(ETX) to find reliable routes. It consist of links that require 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. If there are some links more reliable than others, these links will frequently be used to forward packets. Nodes along these links will fail .

The next group includes algorithms that aim at finding energy-efficient routes. Jinhua Zhu developed minimum energy routing scheme. It do not consider actual energy consumption of nodes to discover energy-efficient routes. They only consider the transmission power of nodes neglecting the energy consumed bu processing elements of transmitters and receivers.

The other group includes algorithms that try to prolong the network lifetime. Archan Mishra and Suman Banerjee proposed MRPC, a new power-aware routing algorithm for energy-efficient routing that increases the operational lifetime

of multi-hop wireless networks. This algorithm do not consider reliability and energy efficiency.

The algorithm mentioned in this paper that is RMER considers energy efficiency for reliable routes and RMECR algorithm which extends the network lifetime by considering remaining battery energy of nodes.

III.   RMER AND RMECR

A.   END- TO-END RETRANSMISSION SYSTEM

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. Retransmission occurs after the expiration of a timer. We assume that the duration of this timer is long enough to prevent unnecessary retransmissions. We will design energy-aware and reliable routing algorithms optimized for each of the HBH and E2E systems.

B.   CONSUMED ENERGY FOR RELIABLE PACKET TRANSMISSION

The   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.

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. In 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. 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.

First analyze the energy cost of a path for transferring a packet to its destination considering the impact of E2E ACK then secondly we concentrate on algorithm for finding MECP in end-to-end system thus lastly RMER and RMECR algorithms can be derived there in.

In the E2E system, the energy cost of a path depends on the number of times that the packet and its E2E ACK are transmitted. This, in turn, depends on the E2E reliability of the path. Considering the impact of end-to-end ACK on energy cost and end-to-end reliability of path equal to 1 ,MECP can be found. According to the Dijkstra's algorithm as,

$$C(P(s,v)) = \frac{1}{P_{u,v}(L_d)\ P_{v,u}(L_e)} \times C(P(s,u)) + W(u,v)]$$

Where, $W(u,v)$ is link weight , L_d is data packet size , L_e is E2E ACK packet size.

Now when the equation for MECP is designed we concentrate on link weight . In RMECR the impact of remaining battery energy is considered while finding link weight and RMECR considers reliability of links in computing total energy cost. The general approach for RMER algorithm energy cost of link is defined as actual amount of energy consumed by two end nodes of links to exchange packet . In RMER the impact of remaining battery energy is not considered.

IV.   PRACTICAL ISSUES

For Minimum Energy Cost Path, complete image of network topology is required. This could be achieved by optimized link state routing protocol(OLSR). OLSR optimizes classic link state routing algorithm in which each node declares all links with neighbouring nodes and floods the entire network with routing messages. Each node periodically shares its view of the network topology with other nodes. This is done by the use of so-called topology control messages, which are flooded in the network. Nodes also use periodic beacons to detect their neighbouring nodes.

The deployed routing protocol is OLSR in which Hello messages are sent periodically every Thello seconds and topology control messages are transmitted every Ttc seconds.

V.   SIMULATION RESULTS

.   200 nodes are considered in simulation work. For each node u, we consider 10 levels of transmission power starting from 15 mW and increasing in steps of 15 mW up to the maximum transmission power Pmax 150 mW. The source-destination pairs are chosen randomly over the network. A square size area 350m*350m is chosen. In this paper we focus on Constant Bit Rate (CBR). The packet size is limited to 512 bytes. Each source-destination pair begins packet sending at a chosen time. Scenarios by varying number of nodes is obtained.

A.   SIMULATION PARAMETERS

TABLE I

PARAMETERS USED IN SIMULATION

Parameter	Value
Initial battery energy of each node (B)	100 [J]
Network area	350*350 [m2]
Path-loss exponent (ŋ)	3

Data rate (r)	100 [Kbps]
Power consumption of transmitter circuit (P_t)	100 [mW]
Power consumption of receiver circuit (P_r)	100 [mW]
Maximum transmission power (P_{max})	150 [mW]
Minimum transmission power (P_{min})	15 [mW]
Maximum# of transmissions in HBH system(Q_u)	7
Transmission range (d_{max})	70 [m]
Data packet size (L_d) 512 [byte]	512 [byte]
MAC ACK packet size (L_h)	240 [bit]
E2E ACK packet size (L_e)	96 [byte]
Hello packet size (L_{hello})	96 [byte]
Battery death threshold (B_{th})	0
Maximum collision probability (Pc_{max})	0.3
channel sensing time (T_{sense})	50 [µs]
K_{idle}	0.2
K_{sense}	0.4
T_{hello}	10 [s]
T_{tc}	20[s]

B. RESULTS

Several simulations are performed using NS2 network simulator and using following parameters. NS2 generates a big trace files. The performance study includes below parameters obtained by varying the number of nodes.

1.   Normalized routing load: The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission. The routing load evaluates the efficiency of the routing protocol.
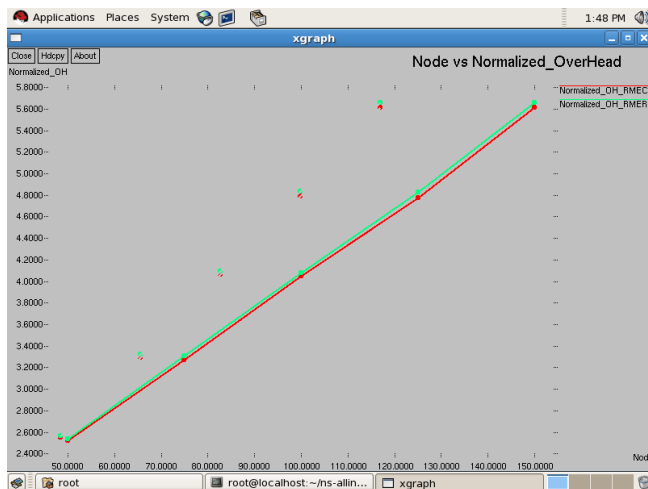

Fig. 1 Normalized routing load

2.   Average End-to-End Delay: Average end to end delay includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays and propagation and transfer times of data packets. end-to-end delay related to data packets

delivered to destination. Difference between first packet received time and last packet received time.
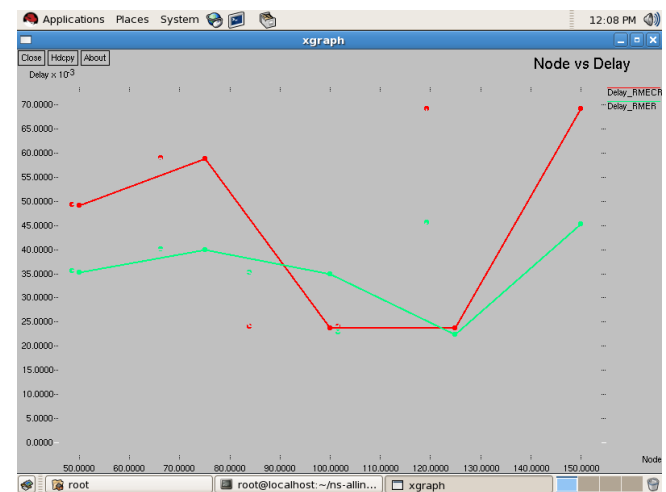

Fig. 2 Average End-to-End Delay

VI.   CONCLUSION

We studied in this paper the performance of RMER and RMECR algorithms. RMER does not consider remaining battery power of nodes. RMECR on the other hand considers the remaining battery energy of nodes while route selection. Simulation results for Average End-to-End delay and Normalized routing load is obtained. As shown in Fig. 1 OLSR gives little variation when the traffic load increases. When the traffic load increases . Routing load is higher for RMER than that of RMECR because it periodically sends routing packets in order to maintain the routing table up-to-date. However the Fig 2 says that RMER outperforms better for delay consideration as compared to RMECR. Average Energy of RMER and RMECR is the future work which will decide the network lifetime.

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