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A Reliable Energy Conservation Approach for Routing in Wireless Ad Hoc Network

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Abstract - Wireless ad hoc network has been one of the major research topics in current trend of networking. The major constraint in
this network is, it does not have prolonged battery lifetime. This paper, propose two major energy-sensitive protocols least energy cost reliable routing and least energy reliable routing protocol. These protocols consider major requirements of wireless ad hoc network necessary to have effective network such as: dependability, energy-efficiency, sustaining network lifetime and efficient routing. Energy consumption and remaining battery energy is taken into consideration for reliable energy routing algorithm which finds the routes by reducing the total energy required for end-to-end packet traversal. The proposed schemes can be applied for either end-to-end or hop-by-hop packet transmissions to ensure reliability. The simulation results show that least energy cost reliable routing protocol provides less energy consumption and reliable routes. The least energy reliable routing protocol prolongs the operational lifetime of the network. The least energy cost reliable routing protocol considers information related to packet size, minimal retransmission attempts per packet, and acknowledged packet that adds up innovation to the existing scheme.
Keywords: Energy efficiency, Battery lifetime, Wireless ad hoc network, Least energy cost reliable routing protocol and Least energy reliable routing protocol

I. INTRODUCTION

The collections of wireless mobile nodes that are accoutered with wireless radio and positioned in a special domain are the wireless ad hoc network. This is a self-configuring, dynamic network and nodes are free to move sometimes. This network does not have pre-existing infrastructure. Each node takes part in routing by forwarding data for other nodes. The determination of nodes to forward data is made dynamically based on network connectivity and the routing algorithm in use [9]. The wireless ad hoc network places a major role in several fields such as controlling military activities, healthcare, home security and many more. The wireless ad hoc network plays a bridge between the virtual world of information technology and real physical world. The Fig. 1 represents the set up for Wireless Ad hoc Network [8].

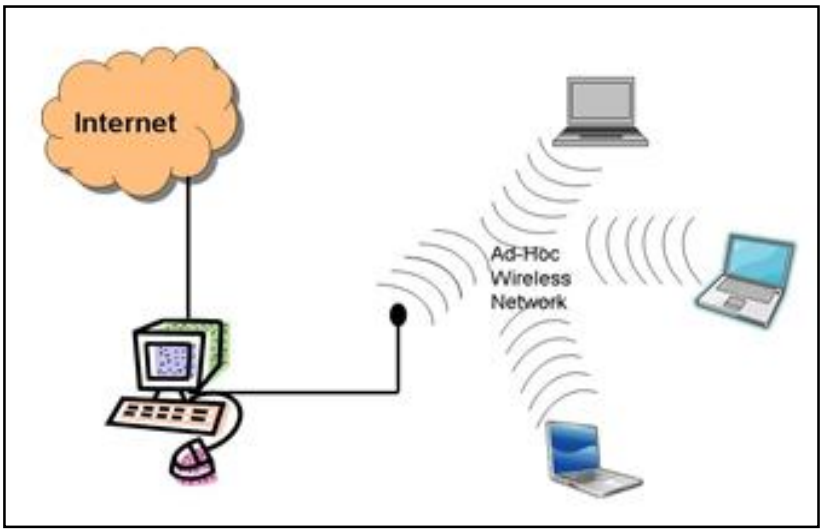


Fig. 1 Wireless ad hoc network setup

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There are several advantages of wireless ad hoc network such as performance is high in the network, it is less expensive, uses unlicensed frequency spectrum, distribution of information is faster, and signal point failure is absent. There are multiple nodes connected to multiple links in wireless ad hoc network. The node resources such as power of transmission, power of computation and memory, behavioral property such as reliability and the link properties such as interference and noise influence the link. The link should have the ability to connect and disconnect any time. The network should function properly and should also consider the factors such as scalability, robustness, efficiency and reliability [9].

The routing in wireless ad hoc networks is of three types and they are proactive routing which maintains the list of destinations and their routes intermittently distributing routing tables all over the network. The reactive routing selects the route dynamically using route request and route response packet and does not maintain any routing table. The hybrid routing considers the factors of both proactive and reactive routing [9]. The security for the network is also considered while routing packets. There are two types of attacks passive and active attack. There can be chances of attack by malicious nodes which can corrupt the data or leads to data loss. Therefore, authentication and authorization of the network is very important use the equation editor to create the equation. Then select the "Equation" markup style. Press the tab key and write the equation number in parentheses.

The wireless ad hoc network consists of hundreds, or even thousands of nodes which can be low of cost and has limited battery energy. The energy consumption plays a major role in battery lifetime of the wireless ad hoc network. The high level of energy consumption is mainly due to wireless communication. Therefore, energy efficient routing is a major concern in wireless ad hoc network for data communication. The energy consumed for end –to-end packet traversal must be taken into consideration along with the consistent route. The route should not be overused considering its reliability. Quality of service can be enhanced using consistent route. Various routing algorithm were proposed to enhance energy efficiency. The energy efficiency depends up on the network lifetime of the node. The reliable mechanism for decreasing the energy cost in forwarding the packet in wireless ad hoc network is done by energy reliable routing algorithms ([1], [2]).

In this paper, energy conservation, increased battery lifetime and reliable routing are achieved by these protocols. Least energy cost reliable routing algorithm reduces overall energy consumption of the network by finding the least energy cost route. It finds the least energy cost route where energy cost for forwarding packet from the node is less. It also maintains balance in the traffic load in the network which in turn increases network lifetime. It finds out the reliable route which reduces the number of retransmission and reduces the energy consumed for the transmission of the packets. Least energy reliable routing protocol is used for end-to-end transmission of packets. The overall energy necessary to transfer packet from source to destination is managed by this scheme.

II. RELATED WORK

Reliable and Energy-Efficient Routing for Static Wireless Ad Hoc Networks with Unreliable [6] presented that the path with the minimum expected power consumption is taken into consideration to determine the nodes for transmission. The algorithms are built to assign optimal power to every link so that the expected power consumption for transmission from the source node is lower than the power assigned. Here optimal power assignment needs algorithm to find the path with minimum expected power consumption.

Energy Efficient Routing in Wireless Ad Hoc Networks by S. M. Senouci and G. Pujolle [7] propose the shortest cost routing algorithm such as AODV. The discovery mechanism in these extensions (LEAR-AODV, PAR-AODV and LPR-AODV) uses energy consumption as a routing metric. Energy-optimal route to the destination is used to reduce the energy consumption by the nodes for packet routing. The major drawback here is battery life is not taken into consideration. The energy to find out shortest path is not considered due to which the energy from the battery is depleted.

Energy Efficient Online Routing in Wireless Ad Hoc Networks by Hanan Shpungin [4] uses the shortest path trees (SPT) for competitive online schemes for an infinite order of arbitrary routing requests and produce fundamental bounds on the expected total energy consumption and network lifetime in the optimal offline solution. Here fundamental bounds are developed for the expected optimal network lifetime and total energy consumption.

A Location Aided Energy-Efficient Routing Protocol for Ad hoc Networks [5] by Dahai Du and Huagang Xiong propose Location aided energy efficient routing(LEER) protocol which considers GPS to locate the node and implements the LEER protocol. The GPS may consume some energy but the energy consumed by LEER is very less. This algorithm is energy-efficient and increases the network lifetime. The mobility becomes the major constraint in this protocol. The mobile nodes require more energy to be

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located and drain the battery.

A Hybrid Energy Efficient Protocol for Mobile Ad Hoc Networks [3] by Niranjan Kumar Ray and Ashok Kumar Turuk proposed an energy conservation technique called Location Based Topology Control with Sleep Scheduling for ad hoc networks. It uses the feature of both topology control approach and power management approach. Like the topology control approach, it attempts to reduce the transmission power of a node, which is determined from its neighborhood location information. A node goes to sleep state based on the traffic condition as that of power management approach. But the major drawback is end-to-end delay is higher which effects the network lifetime.

III. PROPOSED WORK

Consider N number of nodes and all the nodes have same physical characteristics and communicate through shared wireless channel. The proposed algorithm, consider least energy cost path, for which it has to know the topology of the network. In case of end-to¬-end traversal ACK packet must be transmitted from the destination to the source to ensure the packets have transmitted appropriately. If not, the retransmission of packet takes place until the packet reaches the destination. But there is a termination for retransmission to prevent unnecessary transfer of packets. This termination takes place through the timer that is set. Reliable routing with minimum energy is the major objective of the proposed system which is represented in the Fig. 2. Expected energy cost can be reduced in end-to-end transmission by using least energy cost path in multihop network. The Dijikstra's algorithm can used to find the shortest path for transmission. The energy cost path can be evaluated by four steps as follows

A. Transmission count of data and ACK packets should be evaluated.
B. Energy cost for link and energy cost for retransmission must be evaluated.
C. Evaluating end-to-end reliability of the path.
D. Calculating the energy cost of the path taking energy cost of the link into consideration.

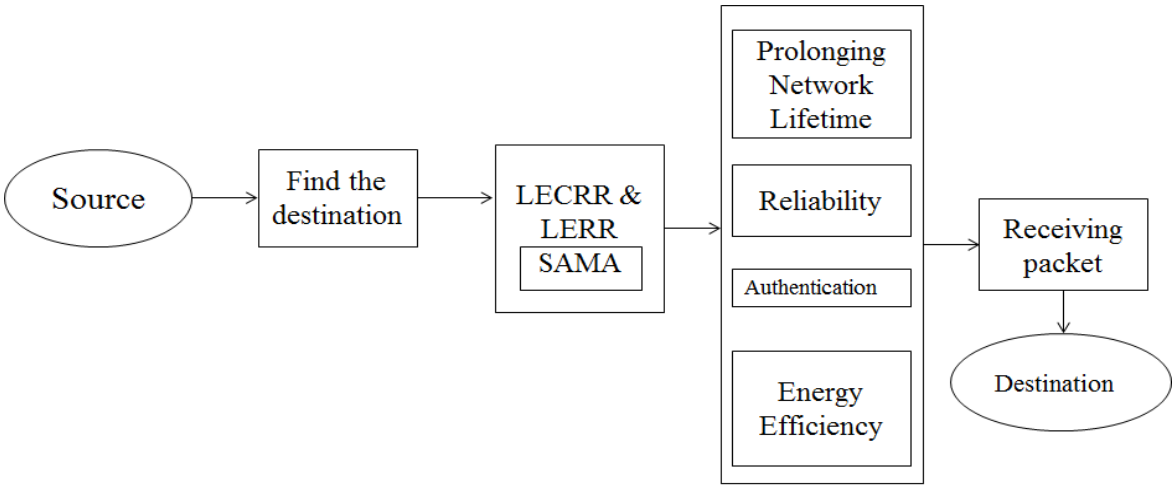


Fig. 2 System diagram for reliable routing

The Fig. 2 represents the architecture of the whole system and the way it works. In least energy routing protocol, initial energy is assigned to every node. Here, energy cost of the path is the expected amount of energy consumed by nodes to reach destination in end to end traversal. After this process, HELLO packets are sent to neighboring nodes and this continues until HELLO packets are sent to all nodes in the network. The ACK packets are received for HELLO packets. Through this ACK packet the shortest path with least energy consumption is discovered.

The energy consumption depends on the distance from one node to another. This protocol reduces overall energy consumption of end-to-end traversal by calculating the least energy consuming path. It does not consider residual energy which is why least energy cost reliable routing protocol is used. The residual energy is remaining battery energy.

In least energy cost reliable routing algorithm, nodes are assigned with the initial energy. During this process, HELLO packets are sent to the neighboring nodes and this process continues until HELLO packets reach all the nodes on the network. The shortest

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path to the destination is discovered. Least energy cost for the data traversal from the source to the destination is evaluated and here the remaining battery energy that is residual energy is considered.

Least energy cost reliable routing protocol considers four major factors of wireless ad hoc network: dependability, energy-efficiency, sustaining network lifetime and efficient routing. Here, energy cost of the path is the expected amount of energy consumed by nodes to reach destination in end to end traversal. The battery cost is taken into account with energy cost. The battery cost is residual energy in the node. The general approach for least energy reliable routing algorithm energy cost of link is defined as definite amount of energy consumed by two end nodes of links to exchange packet. In least energy, reliable routing the influence of remaining battery energy is not considered. Source Anonymous Message Authentication is one of the most effective ways to prevent unauthorized and corrupted messages from being forwarded in Wireless Sensor Networks. A scalable authentication scheme based on Elliptic Curve Cryptography is introduced to allow any node to transmit an unlimited number of messages without suffering the threshold problem and provides message source privacy. For each message the sending node generates a source anonymous message authenticator for the message. The generation is based on MES scheme on elliptic curves. Here this algorithm is used for authentication of packets.

IV. RESULTS

Numerous simulations were performed with NS2 network simulator and using following constraints. NS2 generates a trace file. The performance study includes various parameters with varied number of nodes. The performance comparison metrics are Packet Delivery Ratio and Packet Delay.

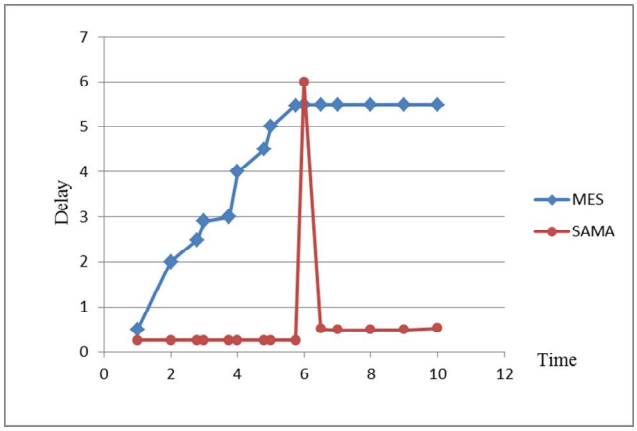


Fig. 3 Packet Delay

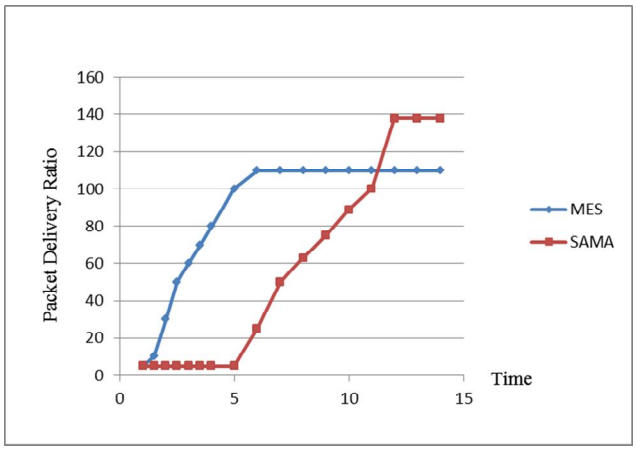


Fig. 4 Packet Delivery Ratio

From and Fig. 3 it is observed that the Delay is consistent in the start and only HELLO packets are being transmitted and the time

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of 6ms the packets transmitted are being authenticated and the transmission of actual packets takes place. This is a reason why the delay is high at the 6th millisecond and as the authentication will be done the delay decreases. Here in Source anonymous message authentication the delay is low when compared to mobile element scheduling.

From Fig. 4 it is observed that Packet Delivery Ratio initially is low as only HELLO packets are being transmitted. Then packets for communication are authenticated and they are transmitted. Here the packet delivery ratio gradually increases and at the highest point it remains consistent. In case of mobile element scheduling the packets the packet delivery ratio gradually increases and then remains constant but is less when compared to source anonymous message authentication.

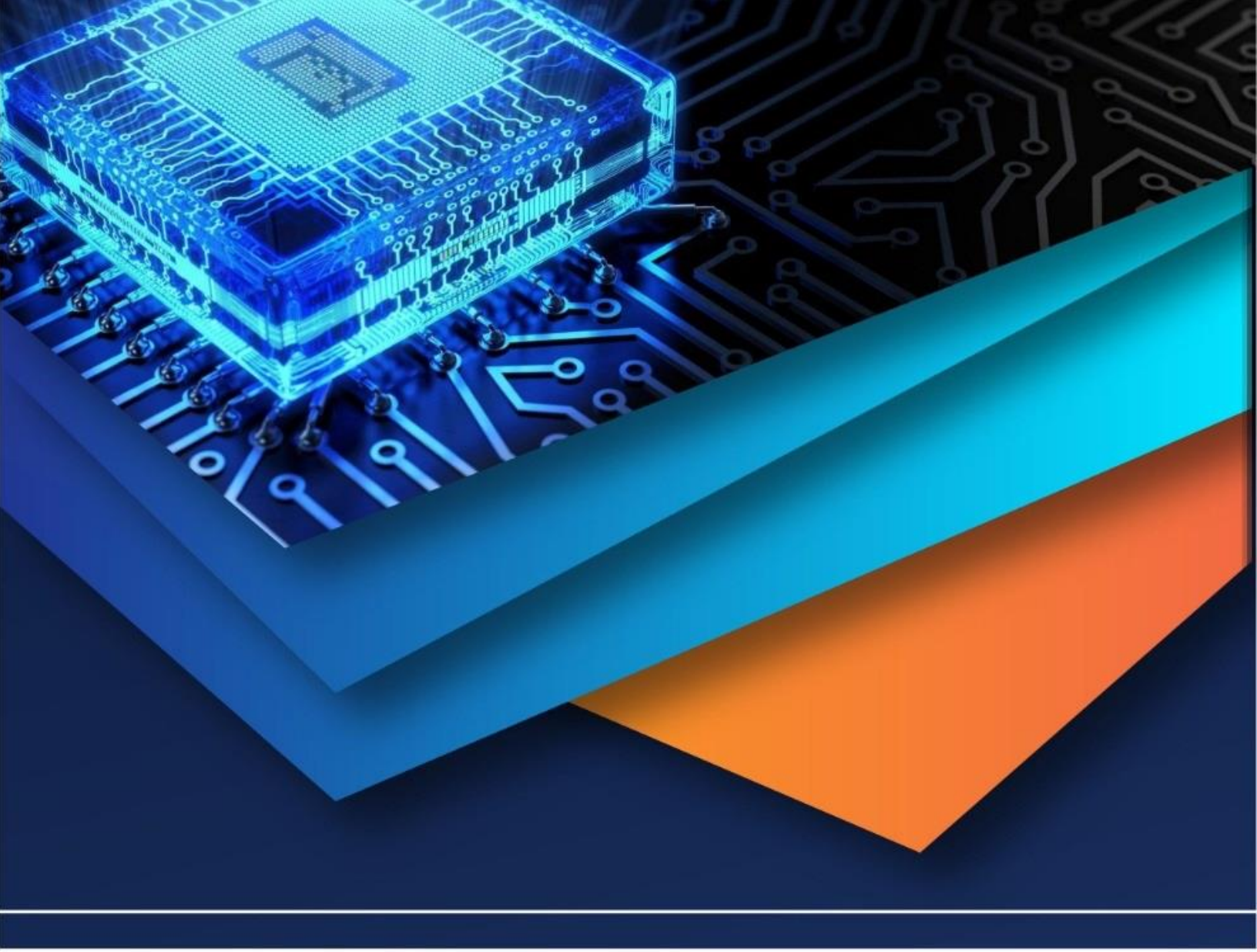
V. CONCLUSION

This paper describes the performance of the least energy cost reliable routing and least energy reliable routing protocol. After overall analysis and simulation we can say that these protocols fulfill all the three criteria's specified and they are reliability, sustaining battery lifetime and efficient route and efficient use of energy. The graph above shows that these protocols perform at their best and prolong the network lifetime which increases the efficiency of the network and improves the quality of service of the network.

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