Enhancement of Energy and Network Lifetime of MANETs through EC-MAC Protocol

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Abstract: ***A MANET is an ad hoc network that can change locations and configure itself. Because MANETS are mobile ad hoc network, they use wireless connections to connect various networks. The performance of network in Mobile Ad Hoc Networks (MANETs) is improved using Energy Conservation-MAC Protocol along with DEL-CMAC Protocol. This is to enhancement of energy and network of MANETs in terms of energy efficiency and network lifetime. The relay selection strategy is incorporated, which selects the best relay based on residual energy and location information. To improve the spatial reuse and an innovative NAV (network allocation vector) setting is provided to deal with the varying transmitting power of the source and relay terminals. It provides the best relay selection algorithm to select the cooperative node with better channel condition, best relay and more balanced energy consumption and higher transmission rate.***

Keywords: Network Lifetime, Residual Energy, Best Relay, Transmission rate, EC-MAC protocol.

1. Introduction

A MANET stands for "Mobile Ad Hoc Network." A MANET is a mobile network that can change locations and configure, they use wireless connections. This is a standard Wi-Fi connection, or another medium, such as a satellite or cellular transmission. Some types of MANETs are not connected to a local area network of wireless devices, while other types of manets are connected to the Internet. The natures of MANETs are not always secure.

A mobile ad hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless network. An Ad hoc is a Latin name "for this purpose". Each device in a MANET is free to move independently in any direction in any network. The primary challenge in building a MANET is equipping each device to continuously maintain the information of manets, required to properly route traffic. A MANETs is a kind of Wireless ad hoc network that usually has a routable networking environment on top of a logical Link Layer in ad hoc network. The emerging technology of 802.11/Wi-Fi wireless networking has made MANETs a popular research in technologies.

2. Existing Method

The MAC (Media Access Control) layer is a sub layer of the data link layer which is responsible for providing reliability to upper layers for the point-to-point connections established by the physical layer. The MAC sub layer interfaces with the physical layer and is represented by protocols that define how the shared wireless channels are to be allocated among a number of mobiles.

2.1 CMAC Protocol

In MANETs in order to enhance the network life time, the usage of relays been employed. Relays helps in the transfer of packets from source to destination which can be separated by some considerable distance. Usage of relays can help in the reduction of overhead caused by the complications involved in MAC. The transmission efficiency of nodes will be thus enhanced. The existing work only focuses on the enhancement of throughput without considering the reduction in power, energy efficiency and network life time.

2.2 DEL-CMAC Protocol

The DEL-CMAC focuses on the network lifetime extension. By considering the overheads and interference due to cooperation, as well as the energy consumption on both transceiver circuitry and transmit amplifier, DEL-CMAC can significantly prolong the network lifetime. A distributed energy-aware location-based best relay selection strategy is incorporated, which is more reasonable for MANETs comparing with the existing schemes based on channel condition. For a desired outage probability requirement, a cross layer optimal transmitting power allocation scheme is designed to conserve the energy while maintaining certain throughput level Extensive simulation results reveal that DEL-CMAC can significantly extend the network lifetime under various scenarios at the cost of relatively low throughput and delay degradation.

2.3 Working Principle

The main aim in usage of this protocol is to increase the network life time. In order to deal with the dynamic transmitting power and the relays, we use some control frames. The following represents the control frames.

- RTS – Request to Send control frame is used before sending a packet by a sender node in order to avoid collision.
- CTS – Clear to Send is an indicator generated by the receiver node to every node within the transmission range,

so as to avoid collision.

- ACK- Acknowledgement frame acknowledges the packet received.
- ETH- Eager To Help is used for selecting the best relay in a distributed and light weight manner, send by the winning relay to inform the source, destination and the lost relays.
- II- Interference Indicator is used to enhance the spatial reuse by reconfirming the interference range.

The existing CMAC is enhanced to DEL-CMAC by adding two selection strategies.

- Utility based best relay selection
- Spatial Reuse Enhancement using NAV

2.4 Utility Based Best Relay Selection

The existing scheme methodology uses instantaneous channel condition. This scheme can't be used in the high traffic environment since the mobile devices are many. The DEL CMAC scheme uses the distributed energy-aware location-based relay scheme. The location information can be obtained by the usage of GPS. This can be incorporated into the existing scheme by adding a control frame exchanging period in DEL CMAC. DEL CMAC chooses the best relay mechanism by using the utility-based back off scheme.

$$BU_r = \tau \min\left(\frac{E}{E_r}, d\right) * \frac{P_T^C}{P_S^D/2}$$

3. Proposed Method

The EC-MAC (Energy Conserving-Medium Access Control) protocol, on the other hand, was developed with the issue of energy efficiency as a primary design goal. The EC-MAC protocol is defined for an infrastructure network with a single base station serving mobiles in its coverage area. This definition can be extended to an ad hoc network by allowing the mobiles to elect a co-coordinator to perform the functions of the base station. At the start of each frame, the base station transmits the frame

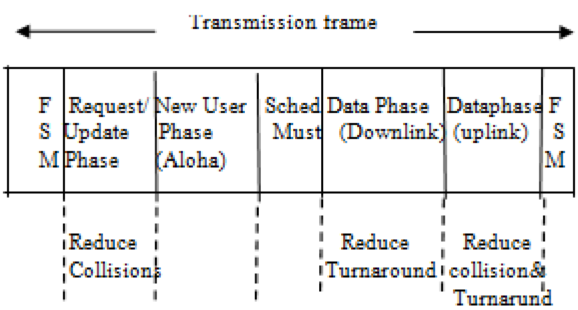

Figure 1.EC-Mac Protocol Frame

Synchronization message (FSM) which contains synchronization information and the uplink transmission order for the subsequent reservation phase. During the request/update phase, each registered mobile transmits new connection requests and status of established queues according to the transmission order received in the FSM. In this phase, collisions are avoided by having the BS send the explicit order of reservation transmission. New mobiles that have entered the cell coverage area register with the base station during the new-user phase. Here, collisions are not easily avoided and hence this may be operated using a variant of Aloha. This phase also provides time for the BS to compute the data phase transmission schedule. The base station broadcasts a schedule message that contains the slot permissions for the subsequent data phase. Downlink transmission from the base station to the mobile is scheduled considering the QoS requirements. Likewise, the uplink slots are allocated using a suitable scheduling algorithm.

Energy consumption is reduced in EC-MAC because of the use of a centralized scheduler. Therefore, collisions over the wireless channel are avoided and this reduces the number of retransmissions. The mobile receivers are not required to monitor the transmission channel as a result of communication schedules. The centralized scheduler may also optimize the transmission schedule so that individual mobiles transmit and receive within contiguous transmission slots. The priority round robin with dynamic reservation update and error compensation scheduling algorithm described in provides for contiguous slot allocation in order to reduce transceiver turnaround. Also, scheduling algorithms that consider mobile battery power level in addition to packet priority may improve performance for low-power mobiles.

The frames may be designed to be fixed or variable length. Fixed length frames are desirable from the energy efficiency perspective. The power allocation is important in the proposed scheme, and hence optimal power allocation can be done. The above scheme can be done by using;

- Direct Transmission
- Cooperative Transmission

The direct transmission is done mainly by using the equation

$$P_S^D = \frac{(2^R - 1) N_0 d_{sd}^{\alpha}}{\ln(1 - P_O^D)}$$

4. Energy Consumption Sources and Conservation Mechanism

4.1 Sources of Energy Consumption

The main sources of power consumption, with regard to network operations, can be classified into two types: communication related and computation related.

Communication involves usage of the transceiver at the source, intermediate and destination nodes. The transmitter is used for sending control, route request and response, as well as data packets originating at or routed through the transmitting node. The receiver is used to receive data and control packets – some of which are destined for the receiving node and some of which are forwarded.

4.2 LZW Compression Scheme

A data compression technique is used along with EC-MAC protocol. Source node compress the sending data using LZW compression technique for example 100 mb data is compressed to 70mb, which results in fastest delivery of high bits of data in short span of time that seems to increase the node energy level. By using compression technique packets loss is reduced. The compressed data is delivered to destination with the short span of time. The destination uses an EC- MAC LZW decompression technique to decompress the received original data. For example 70 mb is decompressed to 100mb. As a result the destination gets the original data without any loss in the fastest and safest delivery. So the nodes use lesser energy level to transmit the data and gains more energy.

4.3 Design Concept

In the proposed system LZW data compression technique is used along with the EC- MAC protocol, which is the extension of DEL-CMAC protocol. Source node compress the sending data using LZW compression technique, which results in fastest delivery of high bits of data in short span of time that seems to increase the node energy level. After the completion of data transmission process, it decompress the data and retrieve the original data, and each node calculates its remaining energy level and energy consumption, by analyzing those energy levels; we can evaluate the performance of the network life time.

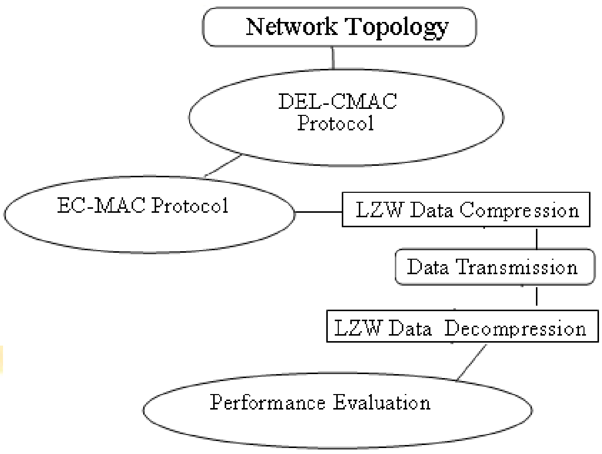

Figure 2:Block Diagram

5. Performance Evaluation

Figure 3 shows the performance evaluation of both del cmac and ec mac. In the proposed scheme, ec mac, the cost effective routing is done.

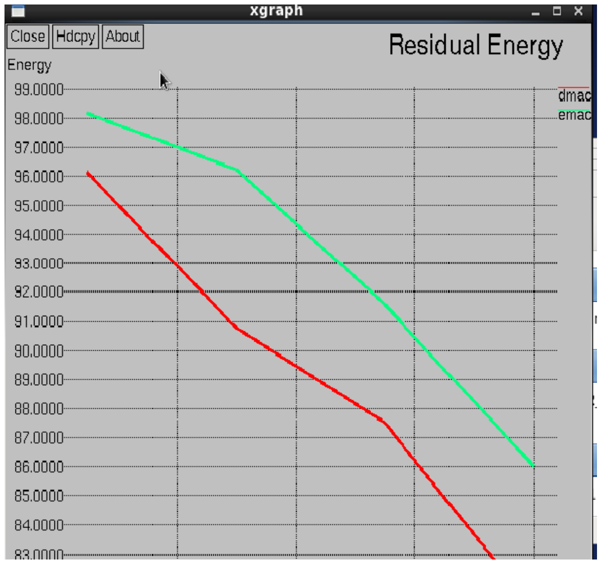

Figure 3: Residual Energy with Time

The residual energy versus time is plotted in the graph. The enhancement of the energy is plotted.

6. Conclusion

In this paper, a distributed technique is used to improve the network life time. We extend the existing EC MAC protocol and include the power allocation scheme. The power allocation can be done either by direct transmission or by cooperative transmission. The data when sending from source to destination will be compressed using the LZW compression scheme and send. The usage of relays increases energy efficiency and network life time. The usage of ec mac protocol enhances the performance and residual energy.

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