ACHIEVING THE PERFORMANCE OF MANET THROUGH DEL-CMAC USING CROSS LAYER COOPERATIVE DIVERSITY APPROACH

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Abstract— A wireless communication network is rich in interference and noise which makes the communication in the network unreliable. There has been many active research on cooperative communication which helps in improving the reliability of wireless network. To enhance the spectral and power efficiency, lifetime of the network, and reduce outage probability, cooperative communications with relaying nodes are very effective. Relaying induce complicated medium access interactions, to handle these interactions and to capitalize the benefits of cooperation an efficient Cooperative MAC protocol is required . This paper proposes, Distributed Energy-adaptive Location-based CMAC protocol, namely DEL-CMAC along with effective cross layer cooperative diversity approach for MANET. Cross layer handles the interaction between higher layer and cooperative diversity is used for diversity gain in the network where relay nodes are used. The use of cooperative diversity in the network leads to increase in reliability in the network. The design objective of proposed work is to improve the network lifetime of MANET by reducing the power consumption and improving the throughput.

I. INTRODUCTION

MobileAd-hoc NETwork (MANET) is a self-configured network of mobile terminals connected by wireless links. Mobile terminals such as cell phones, portable gaming devices, Personal Digital Assistants, (PDAs) and tablets all have wireless networking capabilities. By participating in MANETs, these terminals may reach the Internet when they are not in the range of Wi-Fi access points or cellular base stations, or communicate with each other when no networking infrastructure is available.With the advantage of broadcast in wireless medium, Cooperative communication is proposed recently, which allows several nodes cooperatively transmit signals to a destination together. Researchers have shown that cooperative communication can offer significant performance enhancements in terms of increased capacity, improved transmission reliability, spatial diversity and diversity-multiplexing tradeoff. Cooperative communication typically refers to a system where users share and coordinate their resources to enhance the information transmission quality. In cooperative communication each mobile is both a user and a relay. In a cooperative communication system, each wireless user is assumed to transmit data as well as act as a cooperative agent for another user. In a relay system, sources first transmit their data to the Relay Nodes (RNs). Each RN then processes and forwards its received data information to the destination nodes following some cooperation protocols. With the received signal from the RNs, the destinations decode the data from their corresponding sources.All nodes in this networks are mobile, so energy and lifetime is one of the most important and vital issues for those ones. Many approaches have been developed in consuming the energy and also in improving the lifetime of the network. The existing CMAC protocols mainly focus on the throughput enhancement while failing to investigate the ener-gy efficiency or network lifetime. While the works on energy efficiency and network lifetime generally fixate on physical layer[10] or network layer[9]. Our work focuses is on combin-ing both the layer and its properties to form a cross layer ap-proach. Cross layer design integrates the properties of higher layer to so that both physical layer and MAC layer properties can be used together. But distributed Energy-adaptive location-based CMAC protocol (DEL-CMAC) plays an important role in finding an energy efficient route and it will improve the performance of the MANETs in terms of network lifetime and energy efficiency. This protocol will improve the network performance by using the concept of utility based best relay selection strategy and energy model. The reminder of this paper is divided as follows: In section II, Proposed System. In section III, Related work. In section IV, Experiment. In section V, conclusion.

II PROPOSED SYSTEM

Our work focuses on the MAC layer, and is distinguished from previous protocols by considering a practical energy model (i.e., energy consumption on both transceiver circuitry and transmit amplifier), with the goal to enhance energy efficiency and extend network lifetime. The tradeoff between the gains promised by cooperation and extra overhead is taken into consideration in the proposed protocol. In addition, in the previous works, very little attention has been paid to the impact brought by varying transmitting power in CC on the interference ranges, since constant transmitting power is generally used. The interference ranges alteration in both space and time will significantly affect the overall network performance .

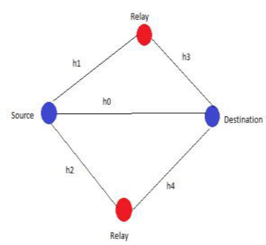


Figure 1: System Architecture.

We also address the issue of effective coordination over multiple concurrent cooperative connections with dynamical transmitting power in this system. We propose a novel distributed energy adaptive location-based CMAC protocol, namely DELCMAC, for MANETs. DEL- CMAC is designed based on the IEEE 802.11 distributed coordination function (DCF), which is a widely used standard protocol for most of wireless networks. From the perspective of information theory, higher diversity gain can be obtained by increasing the number of relay terminals. From a MAC layer point of view, however, more relays lead to the enlarged interference ranges and additional control frame overheads. We employ single relay terminal in this paper to reduce the additional communication overhead. DEL-CMAC initiates the cooperation proactively, and utilizes decode and forward (DF) protocol in the physical layer.There are two types of relay terminals are considered in this network such as routing relay terminals and cooperative relay terminals. A multi-hop Ad-Hoc network with randomly deployed mobile terminals is considered, where all terminals have the capability to relay. To come up with a reasonable system model, we assume that data connections among terminals are randomly generated and the routes are established by running Ad hoc On-demand Distance Vector (AODV) which is a widely used conventional routing protocol for Ad-hoc network. In the system model, AODV builds the route in a proactive manner by selecting the routing relay terminals firstly. When a route is established, DEL-CMAC initiates the cooperation in a hop-by-hop manner by selecting the cooperative relay terminals. In this paper, the source and destination terminals are referred to the terminals at MAC layer and the relay terminal indicate the cooperative relay terminal.

Our work is spitted into five phases: frame exchanging process, utility based best relay selection, optimal power allocation, performance analysis and cross layer optimization with cooperative diversity approach.

2.1 Frame Exchanging Process

Unlike DCF, in the proposed protocol, the RTS packet carries the residual energy of the source and relay request message with corresponding relay address for supporting cooperative communication. After receiving the RTS, the destination sends CTS back after the period of Short Inter Frame Space (SIFS). All the nodes hearing CTS will update their table about the residual energy of the destination which is carried by CTS packet. If the source does not receive CTS within Trts+Tcts+SIFS, a retransmission process will be initiated. Otherwise, after receiving CTS message from destination, the source waits for Willing to Help (WTH) message from relay. All the nodes overhearing both RTS and CTS can act as relay. If a node accepts relay request, it sends WTH message to source. Source selects one potential node as relay. Then, the source sends data packet to relay using first hop data rate and relay forwards it to the destination with second hop data rate. If the destination can decode the combined signals correctly, it sends back an ACK. Otherwise, it just lets the source timeout and retransmits. If the source fails to receive WTH packet, it performs RTS-CTS procedure again for relay request from node next lowest transmission decision factor. Comparing with IEEE 802.11 DCF, the proposed scheme needs extra fields for RTS and CTS packet to carry relay request and residual energy.

2.2 Utility based best Relay Selection

The best relay selection efficiently affects the performance of the CMAC protocol significantly. The existing elay selection schemes that incorporated into the CMAC protocols, largely depend on the instantaneous channel condition, which based on the assumption that the channel condition is invariant during one transmit session. For MANETS that deployed in heavily built-up urban environments or heavy traffic environments, this assumption is hard to guarantee. This implies that the "best" selected relay terminal according to channel condition during the route construction or handshaking period may not be the best one in the actual data transmission period. Selecting the best relay terminal based on the instantaneous location instead of instantaneous channel condition may be more reasonable for MANETs. A distributed energy-aware location-based best relay selection strategy which is incorporated into the control frame exchanging period in DEL-CMAC has been proposed. This can be through GPS or other localization algorithms. The required location information of source and destination is carried by RTS and CTS frames. Thus no additional communication overheads are involved.Using this proposed relay selection strategy, the energy consumption rate among the terminals can be balanced, and the total energy consumption can be primarily reduced.

2.3Optimal Power Allocation

First we derive the transmitting power at source in the direct transmission mode, which is calculated by the destination after it receives the RTS. Then, under the same outage probability and end-to-end data rate, the optimal transmitting power at source and relay in the cooperative transmission mode is calculated by individual relay candidates after the RTS/CTS handshake.

2.4Performance Analysis

The performance metrics are the transmitting power, total energy consumption, network lifetime, aggregated throughput and average delay.

Network Lifetime: The lifetime is defined as the duration from the network initialization to the time that the first terminal runs out of power.

Energy Consumption: The total energy consumption is the summation of the transmitting (including both transmit amplifier and circuitry) and receiving energy cost at the source, destination and relay.

Throughput: The throughput metric measures how well the network can constantly provide data to the sink. The throughput is the number of packet arriving at the destination per seconds.

End to end delay:This is the ratio of the interval between the first and second packet to total packet delivery.

2.5 Cross Layer Optimization with Cooperative Diversity

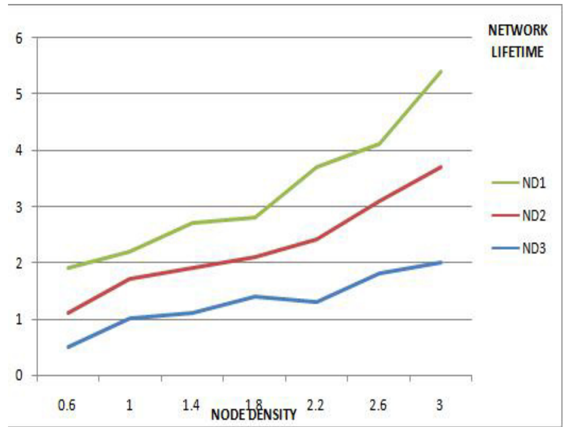
To improve the wireless links in wireless networks, the coop-erative communication is known to be very effective way of exploiting the spatial diversity. To reduce the power con-sumption and to improve the reliability of reception, coopera-tive transmission is used. It encourages that the single antenna device must share their antennas cooperatively. Understand-ing such physical-layer technique, it is very important to know how the application performance can be increased by studying the concept of performance gain of cooperative diversity at physical layer can be exhibited in the network layer. In ad-hoc networks, a severe problem of signal fading especially in case of multi-hop transmission is observed. If these issues are not considered, the signals will not be received properly. To deal with this kind of problem, the use of diversi-ty provides better way to reduce the interference produced in signal. The main use of cooperative diversity is when the re-lays are used. The routing problem can be move from physical layer, MAC layer up to the application layer. a cross-layer ap-proach has been shown to be an effective way in cooperative routing design. By using cooperative network power con-sumption is also reduced. A joint physical-MAC distributed approach and cross layer optimization for cooperative net-works are shown to be effective for power optimization. use of cooperative diversity leads to increase in reliability in the net-work as well as throughput. For this purpose a node with best link quality meaning low power, high residual energy and whose SNR ratio is above the threshold is selected. It ensures that the sender node and the relay node share the same com-munication environment so that consistent decision can be taken while cooperation. Moreover, a node which has low mobility is preferred to be the relay node. The main use of cooperative diversity is that whenever any node fails while transmission, other nodes also have the same information with whom it is cooperated. The existing DEL-CMAC gives low throughput alt-hough lifetime is increased but using effective cross layer op-timization approach along with cooperative diversity while routing increases the network lifetime as well as the through-put.

III Related Work

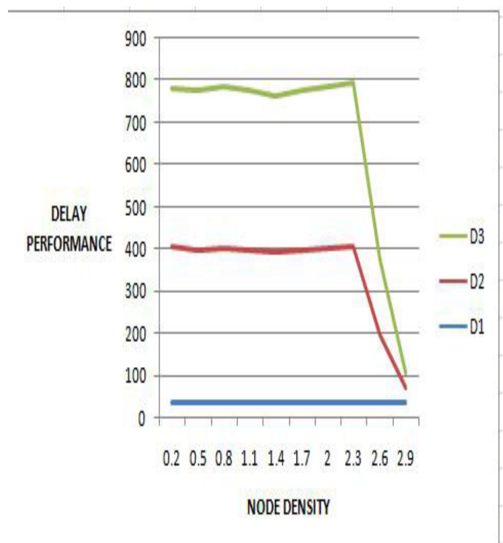
C. Zhai proposed a distributed CMAC protocol to improve the lifetime of the wireless sensor networks, but it's based on the assumption that every node can connect to the base station within one hop, which is impractical for most applications A novel distributed energy adaptive location based CMAC protocol namely, DEL_CMAC for MANETs is designed based on the IEEE 802.11 Distributed Coordination Function (DCF), which is widely used standard protocol for most wireless sensor networks. Moh et al have designed a Cmac protocol named cd-mac which lets relay transmit simultaneously with the source using the space time coding technique. Shan et al have explored a concept of cooperation region, where by beneficial cooperative transmissions can be identified. however energy consumption is not evaluated for both ofthem. By implementing the proposed protocol, the neighbouring nodes parallelly communicate with them and the status ofthe nodes will be globally updated across to all other nodes. By doing this all other nodes in the the network will beupdated with the current status of the nodes and congestion can be avoided.

IV Experiment

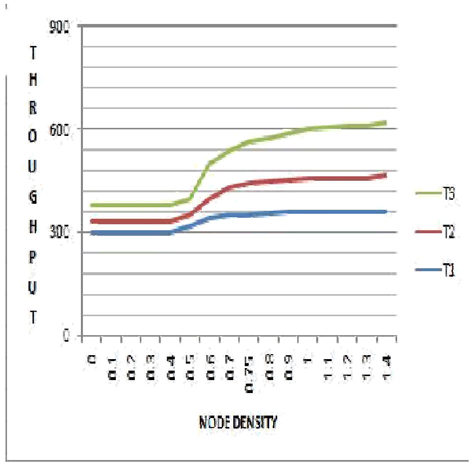
In this section, simulation evaluations are made for DEL-CMAC comparing with IEEE 802.11DCF and coop MAC. Since the purpose of our scheme is to prolong the network lifetime and increasing the energy efficiency, the evaluation metrics in this paper are the transmitting power, total energy consumption, network lifetime, aggregate throughput and average delay. The simulation is carried out using NS2 simulator. The initial energy of all the terminals are set to 1 J.The propagation channel of two-ray path loss model is adopted. Constant data rate with 1mbps is used in DEL-CMAC and DCF,while adapted data rates with1,2,5.5 mbps are used in coopMAC.



The above graph shows the increase the network lifetime with respect to the node density.This depicts that the use of cross layer cooperative diversity apparoach together with DEL-CMAC leads to increase in network lifetime of MANET. The network lifetime is increased upto 30 to 45% in the proposed work. As a result node failure will not occur and network will work for longer time.



The above graph shows the delay performance. The delay increases by atmost 5.61 and 3.93 percent in static and mobile environments,respectively. These results are expected since the additional control frame overhead is required to coordinate the cooperative transmission.



The above graph shows the throughput performance. As discussed previously use of cooperative diversity with the proposed protocol will increase the throughput of the network, the above graph shows that eventhough the node density is increased the throughput is increased upto 20% more than the earlier system. This means the system performance is increased upto 20% than the original system.

V Conclusion

In this paper, a novel distributed energy-adaptive location based MAC protocol along with effective cross layer optimiza-tion with cooperative diversity routing approach is given for MANET. By using DEL-CMAC protocol the location as well as energy can be exploited. Cross layer approach is necessary because the power allocation is done in physical layer and routing in MAC layer, so to deal with the interaction of both the layers so that the properties of both the layers can be ex-ploited, cross layer design was used. With DEL-CMAC coop-erative diversity routing plays an important role in increasing the throughput and reliability of the system. Using coopera-tive diversity, diversity gain can be achieved. Cooperative diversity plays very important role in cooperative communica-tion. As a result of combining the protocol with cross layer cooperative diversity routing approach leads to reduced pow-er consumption which in turn increases the network lifetime of MANET from 30-50 % as compared to earlier scenario. The use of cooperative diversity helps in increasing the through-put of the network. The simulation results are shown for both static and moving environment.

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