IJCTA, 9(16), 2016, pp. 7817-7826

Proliferate Network Lifetime Using Manet in C-MAC

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ABSTRACT

Cooperative communication, that utilizes close extremity to relay the overhearing data to attain the range gains, features a nice potential to combine the transmittal potency at wireless network. To infict the sophisticated medium access interactions induced by relaying and leverage the advantages of such cooperation, Associate in Nursing economical Cooperative MAC (CMAC) protocol is required. During this paper, we have a tendency to propose a unique cross-layer distributed energy adaptive location-depend cooperative MAC protocol, namely DEL-CMAC, for Mobile Ad-hocnetwork .the look objective of DEL-CMAC is enhance the performance of the MANET in terms of network period of time and energy potency. A sensible energy consumption model is used during this paper that takes the energy consumption on each transceiver electronic equipment and transmit electronic equipment into consideration. A distributed utility-based best relay choice strategy is incorporated, that select the most effective relay supported location data and residual energy. Whatever is more, with the aim of enhancing the spatial recycle, Associate in Nursing innovative network allocation vector setting is provided to traumatize the variable transmittal power of the supply and relay terminals. We have a tendency to show that the planned DEL-CMAC considerably prolongs improve network.

Keywords:

1. INTRODUCTION

The Mobile Ad-hoc NETwork (MANET) could be a self-configured network of mobile terminals connected by the wireless links. Mobile terminals like cell phones, portable gaming devices, personal digital assistants, (PDAs) and tablet all have wireless networking capabilities. By collaborating in MANET, these terminalsreach the web when they don't seem to be within the vary of Wi-Fi access points or cellular base stations, or communicate with one another once no networking infrastructure is on the market. MANET may also be used within the disaster rescue and recovery delineate in [26]. One primary issue with continuous participation in MANET is that the network lifespan, as a result of the aforesaid wireless terminals area unit battery power-driven, and energy is a scarce resource. Cooperative communication (CC) [2] could be a promising technique for preserving the energy consumption in MANETs. the published nature of the wireless medium (the supposed wireless broadcast advantage) is exploited in co-operative fashion. The wireless transmission between a pair of terminals will be received and processed at different terminals for performance gain, instead of be thought-about as associate interference historically.

CC has been researched extensively from the knowledge theoretic perspective [1], [2], [3], [4], [5] and on the issues of relay best choice [19], [21], [22], [23], [24]. Recently, to the work on CC with relation to cross-layer style by considering cooperation in each physical layer and raincoat layer attracts additional and additional attention. while not considering the MAC layer interactions and communication overhead attributable to cooperation, the performance gain through physical layer cooperation might not improve end-to-end performance.

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Cooperative mac into (CMAC) protocol considering the practical side of CC is important have planned a CMAC protocols named Co-operative MAC [7] to use the multi-rate capability and aimed toward mitigating the out turn bottleneck caused by the low rate nodes, so that the out turn are often exaggerated. With the similar goal, Zhu and Cao [8] have planned a CMAC protocol or wireless ad- hoc network. However, useful cooperation considering signalling overhead isn't addressed in [7] and [8]. A busy tone-based cross-layer Cooperative MAC protocol [9] has been designed to use busy tones to assist avoiding collision in the cooperative situation at the value on sending power, spectrum, and implementation quality. A reactive network cryptography aware CMAC protocol has been proposed by Wang et al. [10], during which the relay node will forward the information for the supply node, whereas delivering its own knowledge at the same time. however the network time period isn't addressed in [10].

The existing CooperativeMAC protocols primarily target the throughput sweetening whereas failing to research the data potency or network period. whereas the works on energy potency and network period usually fixate on physical layer [20] or network layer [19]. Our work focuses on the raincoat layer, and is distinguished from previous protocols by considering a sensible energy model (i.e., energy consumption on each transceiver electronic equipment and transmit amplifier), with the goal to boost energy potency and extend network period. The exchange between the gains promised by cooperation and further overhead is taken into consideration within the projected protocol. additionally, in the previous work, little or no attention has been paid to the impact brought by variable sending power in CC on the interference ranges, since constant sending power is generally used. The interference ranges alteration in each space and time can considerably have an effect on the general network performance. we have a tendency to conjointly address the difficulty of effective coordination over multiple coincidental cooperative connections with self-propelled sending power during this paper.

In this paper, we tend to propose a unique distributed energy adaptive location-based CMAC protocol, specifically DELCMAC, for MANET. DEL-CMAC is meant supported the IEEE 802.11 distributed coordination operate (DCF), which is a wide used commonplace protocol for many of the wireless network. DEL-CMAC contains a relay-involved acknowledgement process, a cross-layer power allocation theme, a distributed utility-based best relay choice strategy, and an innovative Network Allocation Vector (NAV) setting. From the angle of data theory, higher diversity gain are often obtained by increasing the quantity of relay terminals. From a mackintosh layer purpose of read, however, more relays cause the enlarged interference ranges and extra control frame overheads. we tend to use single relay terminal in this paper to scale back the extra communication overhead. DEL-CMAC initiates the cooperation proactively, and utilizes the decrypt and forward (DF) protocol [1] within the physical layer. we tend tosummarize our contributions as follows. we tend to propose DEL-CMAC that focuses on the network lifetime extension, that may be a less explored aspects within the connected work. By considering the overheads and interference because of cooperation, as well because the energy consumption on each transceiver circuitry and transmit electronic equipment, DEL-CMAC will significantly prolong the network life time.

For a desired outage chance demand, a cross-layer optimum transmission power allocation scheme is meant to conserve the energy whereas maintaining sure at the output level. To agitate the presence of relay terminals and dynamic transmission power, we offer Associate in Nursing innovative NAV setting to avoid the collisions and enhance the spatial utilize. intensive simulation results reveal that DEL-CMAC can considerably extend the network lifespan underneath various eventualities at the value of comparatively low throughput and delay degradation, compared with IEEE normal DCF and throughput-aimed theme Cooperative MAC [7]. The remainderof the paper is organized as followsWe present preliminaries and model in Section two. In Section three, we describe the projected DEL-CMAC protocol. In Section 4, we tend to additional elaborate the detail of the DEL-CMAC, including the simplest relay choice strategy, the cross-layer power allocation theme and also the NAV setting. Simulation results and discussions are addressed in Section five. Conclusions are drawn at Section six.

1.1. System and Energy Models

A multi-hop Eduard Manet with every which way deployed mobile terminals is taken into account, wherever all terminals have the potential to relay to return up with an affordable system model, we have a tendency to assume that knowledge connections among terminals square measure every which way generated and therefore the routes are established by running unplanned On-demand Distance Vector (AODV) [16], that may be a wide used typical routing protocol for MANET. There square measure 2 styles of relay terminals in our network, i.e.,routing relay terminals and cooperative relay terminals. within the system model, AODV builds the route during a proactive manner by choosing the routing relay terminals first of all. once a route is established, DEL-CMAC initiates the cooperation during a hop-by-hop manner by choosing the cooperative relay terminals. In this paper, the supply and destination terminals square measure referredto the terminals at waterproof layer, and therefore the relay terminals indicate the cooperative relay terminal.

For convenience, we use term supply, relay and destination within the remainder of the paper to denote the supply terminal, relay terminal and destination terminal severally. it affordable to assume that the energy

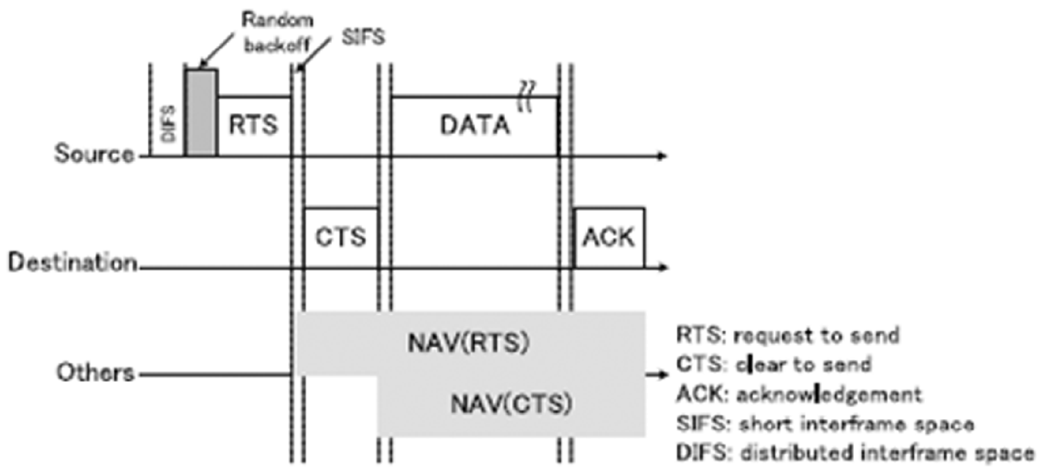

Figure 1: IEEE 802.11 DCF.

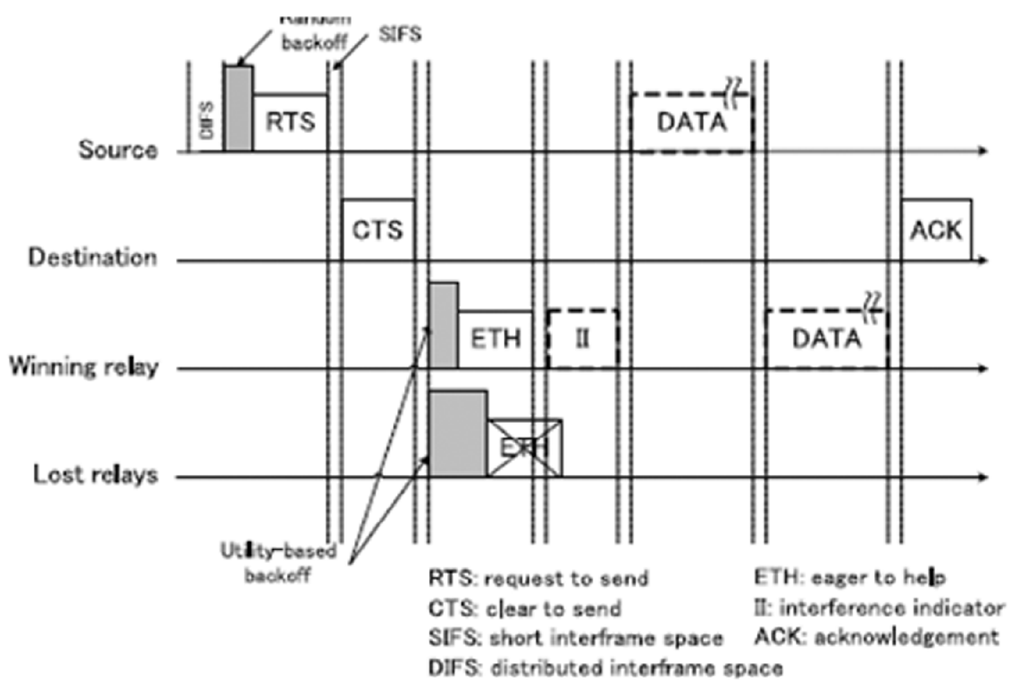

Figure 2: The frame exchanging process of DEL-CMAC.

is consumed each on sending and receiving the info, similar energy consumption model is used in previous work, e.g., [28]. To transmit a packet, the energy price is Ct ¼ ðP þ P0ÞT. And to receive a packet, the energy price is atomic number 24 ¼ P0T. P refers to the facility consumption at transmit electronic equipment (also denotes as sending power during this paper), and P0 refers to the facility consumption at transceiver electronic equipment. to check the result of energy consumption on transceiver electronic equipment, the cases P0 = P ¼ 0: 5; 1; a pair of square measure usually examined. Low P0 = P quantitative relation indicates that the energy consumption on transmit electronic equipment accounts for excellent proportion of the overall energy consumption. And high P0 = P quantitative relation indicates the high electronic equipment energy consumption case.

2. THE PROJECTED DEL-CMAC PROTOCOL

In this section, with the target of prolonging network lifetime and increasing the packet potency, we have a tendency to gift a novel CMAC protocol, particularly DEL-CMAC, for multi-hop MANET. once cooperative relaying is concerned, at the channel reservation must be extended in each house and time so as to coordinate transmissions at relay. To deal with the relaying and dynamic transmittal power, besides the standard management frames RTS, CTS and ACK.it extra management frames arneede,. DEL-CMAC introduces new management frames to facilitate the cooperation, i.e., Eager-To-Help (ETH) and Interference-Indicator (II).

The ETH frame is employed for choosing the most effective relay during a distributed and lightweight manner, that is distributed by the winning relay tell the supply, destination and lost relays. In this paper, the most effective relay is outlined because the relay that has the maximum residual energy and needs the minimum transmitting power among the capable relay at candidates. The II frame is used to confirm the interference vary of allotted transmission power at the winning relay, in order to boost the abstraction utilize. Among all the frames, RTS, CTS, ETH and ACK ar transmitted by mounted power. And the transmission power at for the II frame and knowledge packet ar dynamically allotted.We denote time durations for the transmission of RTS, CTS, ETH, ACK and II frames by TRTS, TCTS, TETH, TACK and TII , severally.

2.1. Protocol Description

The frame exchanging method of DEL-CMAC almost like the IEEE 802.11 DCF protocol, the RTS/CTS shake is employed to order the channel at first. As we know, the cooperative transmission isn’t necessary within the case that the sending power is tiny[6], as a result of the extra overhead for coordinative the relaying overtakes the energy saving from diversity gain. Those inefficient cases ar avoided by introducing a transmitting power threshold record. In DEL-CMAC, upon receiving the RTS frame, the destination computers the required sending power for the transmission mechanism PDs (given in Section four.2). There are 2 cases relying on the calculated metallic elements.

Case (i): The destination sends a CTS frame with flag field (FLAG_P) adequate zero, which suggests that the transmission mechanism is adequate. Thus, when the sending power for the transmission mechanism is sufficiently low, DEL-CMAC is reduced to the DCF protocol and so has backward compatibility with at the heritage 802.11 customary.

Case (ii): FLAG_P within the CTS frame is ready to 1,that indicates that the cooperative relaying is desired. All the terminals having overheard RTS and CTS, and not interfere with different current transmissions are thought-about because the relay node candidates.

2.2. Operations at the Destination

Upon receiving of the RTS, the destination send a CTS back when SIFS. The CTS contains the placement information of the destination, the FLAG_P, and the sending power for the transmission mechanism PDS (in the shape of decibel m, occupying four bytes), which is employed for the doable relay competition.

i. within at the case that FLAG_P is one, if the destination has not detected any ETH among TmaxBackoff þ TCTS þ will be performed and waits for the information packet from the supply.

ii. Otherwise, the destination waits for the information packets from the supply and winning relay. If the destination can rewrite the combined signals properly, it sends back AN ACK. Otherwise, it simply lets the source time out and transmit.

2.3. Further Discussions

Compared with the IEEE 802.11 CSMA/CA, the projected DELCMAC has extra management message overhead within the case that the FLAG_P is one and also the capable relay candidate area unit absent. The length of this overhead may be a constant time equal to TmaxBackoffþ alphabetic character þ SIFS. it'sundesirable however inevitable if we tend to attempt to coordinate multiple connections with cooperative relaying and opt for the most effective relay during a distributed fashion. However, notice that the chance of no capable relay candidate exists is sort of little given a general node density readying (addressed in Section four.3). additionally, this overhead length is comparatively short comparison with the payload transmission length. From the simulation results provided in Section five, we tend to observe that the performance of out turn and delay solely decreases by around 5 percent, which can be acceptable once considering the significant increase within the prolong network life.

Another issue in DEL-CMAC is that the hidden terminal problem attributable to the terminal quality. take into account a state of affairs as follows. once the exchanges of RTS, CTS and ETH, a terminal located outside the transmission vary originally moves into the vary. attributable to the dearth of NAV setting, this terminal might interfere with the continuing transmission, leading to a collision. However, the hidden terminal issue caused by the terminal quality isn't distinctive for our DELCMAC, and it already exists within the original IEEE 802.11 DCF. During this paper, we tend to take into account the chance that hidden terminal issue happened is significantly low, and that we leave it as our future work.

3. DETAIL AND SUPPLEMENT OF DEL-CMAC

In this section, we tend to elaborate the detail and also the supplement of the planned DEL-CMAC. Specifically, we tend to address the optimal power allocation theme, the utility-based best relay choice strategy, and also the NAV setting within the following sections.

3.1. Utility-Based Best Relay choice

Selecting the most effective relay distributed and with efficiency affect the performance of the CMAC protocol considerably. The existing relay choice schemes that incorporated into the CMAC protocols, for the most part rely on the instant channel condition, that supported the idea that the channel condition is invariant throughout one transmit session. For MANET that deployed in heavily settled urban environments or significant traffic environment, this assumption is tough to ensure [25]. this suggests that the "best" chosen relay terminal in step with channel condition during the route construction or acknowledgement amount, may not be the most effective one within the actual information transmission of period.

3.2. Optimal Power Allocation

Optimal power allocation indispensable for a cross-layer CMAC protocol that aims at increasing energy potency. In this section, we have a tendency to address the ability allocation for CC and direct transmission beneath the given outage likelihood. We start with demythologizing the sending power at supply within the direct transmission mode, that is calculated by the destination after it received the RTS. Then, beneath an equivalent outage probability and end-to-end rate, the best transmitting power at supply and relay within the cooperative transmission mode is calculated by individual relay candidates after the RTS/CTS handshaking.

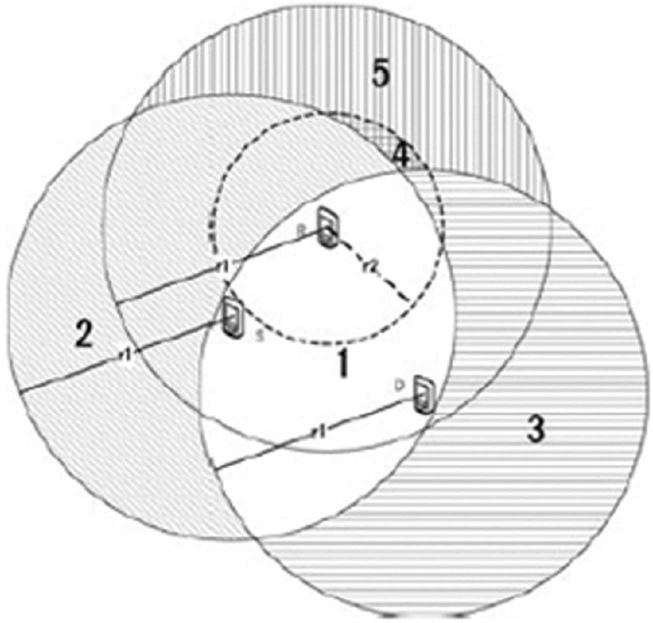

Figure 3: An illustration for the NAV setting ranges.

3.3. Spatial Reuse Enhancement

As the involvement of relaying and varying transmitting power, the interference range in DEL-CMAC are changing during one transmit session. so as to avoid the interference and conserve the energy, delicate NAV setting is required. NAV limit the utilization of physical carrier sensing, thus conserve the energy consumption. The terminals listening on the wireless medium browse the length field in the mack frame header, and set their NAV on however long they must defer from accessing the medium. Taking IEEE 802.11 DCF for example, the NAV is about victimisation RTS/CTS frames (see Fig. 2). No medium access is allowable throughout the blocked NAV durations. Comparing with the straightforward NAV setting in DCF, the setting in DEL-CMAC must be significantly changed. The presence of relay can enlarge the interference ranges and also the dynamic transmission power makes the interference ranges vary throughout one transmit session.Impropriate NAV setting induces energy waste and collisions. Specifically, setting the NAV length too short will awaken the terminal timely, which ends up in energy waste because of medium sensing. On the opposite hand, setting it too long can cut back the spatial potency, which results to the performance degradation in terms of throughput and delay. Thus, effective NAV setting is important and crucial. sadly, most of the previous works doesn’t address the NAV setting issue in CC [9], [13], to not mention the one with variable transmission power. during this paper, we have a tendency to divide the transmission ranges for the supply, destination and relay to 5 completely different regions (see Fig. 4). Since completely different transmission power lead to completely different transmission ranges, there exist 2 ranges for the relay.in figure , the solid circle denotes the transmission vary for fastened transmission power (with radius r1), and also the broken circle denotes the transmission vary for the allotted transmission power (with radius r2). Notice that it’s not necessary to think about the transmission vary with allotted transmission power at the supply, since all the terminals lie within the solid circle of the supply can interfere with the ACK.Then the terribly finish of the entire session. within the following, we have a tendency to address the specific NAV setting for our DEL-CMAC from the angle of different regions.

4. PERFORMANCE ANALYSIS

In section, we tend to assess DEL-CMAC via in depth simulations comparing with IEEE 802.11 DCF and Cooperative MAC [7]. Since the aim of our theme is to prolong the network lifetime and increasing the energy potency evaluation metrics during this paper are the sending power, total energy consumption, network period, aggregated out turn and average delay. The sending power denotes the facility consumed at transmits amplifier (without the facility consumed at transmit circuit). The total energy consumption is that the summation of the sending (including each transmit electronic equipment circuitry) and receiving energy value at the supply, destination and relay. The period is outlined because the period from the network data formatting to the time that the primary terminal runs out of power. To validate the performance improvements in DEL-CMAC, we tend to utilize each the single hop scenario and also the multi-hop multi-connection situation. The simulation is disbursed in QualNet network simulator [15]. The initial energy of all the terminals set to 1 J. The propagation channel of two-ray path loss model is the adopted. Constant rate with one Mbps is employed in DEL-CMAC and DCF, whereas custom-made information rates with 1; 2; 5:5 Mbps are employed in CMAC. The mounted sending power used for management frames is about to ten dBm and, the mounted sending power used for information border Coop-MAC is about to fifteen dBm as result at the high rate (the sending power for the info frame in DEL-CMAC and DCF is dynamically allocated). The simulation settings and parameters.

4.1. Single-Hop situations

We initial compare our DEL-CMAC with the IEEE 802.11 DCF in a single-hop state of affairs that solely consists of 3 terminals (one supply, one destination and one relay), to indicate the variations between cooperative and non-cooperative communication on data consumption. As shown in Fig six, the distance between supply and destination changes from five to 30 m, and angles ffSDR and ffDSR keep at arccosð2=3Þ. Fig. seven shows the variance of the sending power to satisfy completely different outage likelihood necessities, when the distance between supply and destination is twenty m.

4.2. Multi-Hop Multi-Connection situations

Next, we tend to illustrate the performance of DEL-CMAC in a very realistic multi-hop multi-connection state of affairs at the side of IEEE 802.11 DCF and Coop MAC. This advanced state of affairs takes the interference and collision caused by totally different connections into consideration. As shown in Fig. 9,

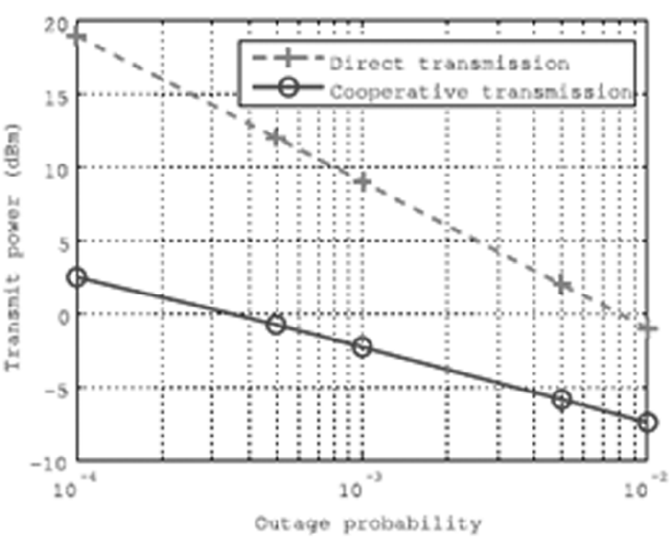

Figure 4: Transmitting power versus outage probability.

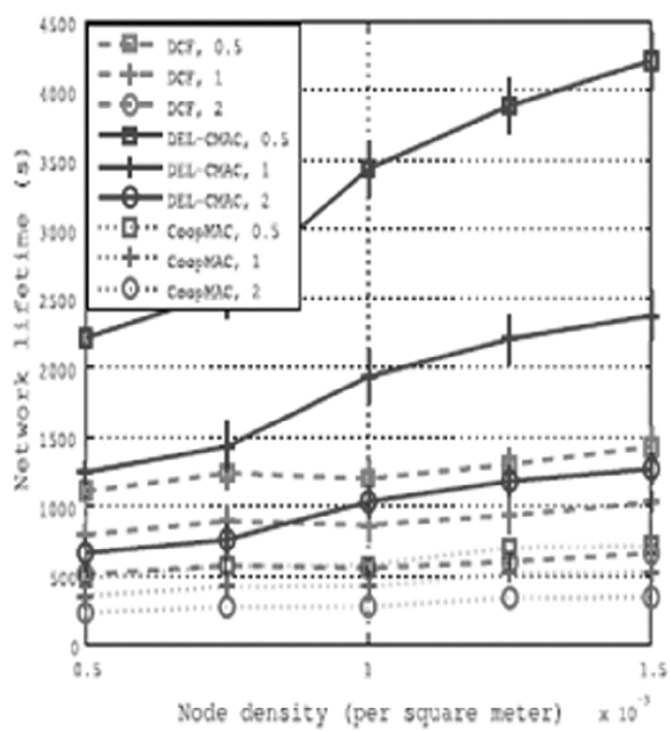

Figure 5: Network lifetime versus the node density in mobile environment (with 95 percent confidence interval).

terminals are indiscriminately placed in a very sq. area of two hundred two hundred money supply. The broken lines indicate that each one the terminals belong to the same subnet. The five solid lines indicate that five Constant Bit Rate (CBR) connection, during which sources (nodes one; 11; 21; 31; 41) transmit UDP-based on traffic at 1 packet per one hundred milliseconds to the destinations (nodes 20; 30; 40; 50; 10) through multi-hop. the information payload length is ready to 1;024 bytes (unless expressed otherwise). AODV [16] routing protocol is employed to determine the routing paths, that is wide utilized in MANET.The different routing protocol as DSR or energy aware routing protocol can also be used, the performance of the planned waterproof layer theme is freelance of network layer scheme. We vary the quantity of terminals within the space from twenty to 60 whereas keeping the quantity of CMB to five. In Fig. 10, we compare the network period of time of DEL-CMAC with IEEE 802.11 DCF and Coop MAC in a very static prolong network.

The performance gain of DEL-CMAC over DCF and CoopMAC raises because the variety of terminals will increase. The reason can be explained from the subsequent 2 aspect. First, if the node density is low, some terminal need to play the role because the supply and cooperative relay alternately. This additional relay energy price is predicted to impact the performance negatively. The growing availableness of relay candidates leads to balanced energy consumption. To be more specified, if the node density is high enough, the terminal having their own knowledge to send or serving as routing relay, area unit seldom chosen because the cooperative relay for other connections. as a result oftheir residual energy is lower than the others. Second, the upper the node density is, the higher the chance that relay candidates area unit located within the ideal positions for the present source-destination at pairs. Thus, high node density results in a transmittal power reduction for each supply and relay by our optimal power allocation theme.To be specific, at least 2:2 and 3:9 times period of time enhancements for case P0=P ¼ 0:5, and 1:4 and 2:4 times period of time enhancements for cases P0=P ¼ a pair of, are often obtained by DEL-CMAC overDCF and CoopMAC, severally.

Finally, thirteen and fourteen depict the aggregative turnout and average delay for the 3 schemes each in static and mobile environment. The Coop MAC out performs the two others in each turnout and delay thanks to the utilization of multiple knowledge rates. and therefore the performance of Coop MAC decreases significantly within the mobile state of affairs,since the table-based proactive relay choice might not adapt to moving network. For DEL-CMAC, the turnout of the network decreases by at the most seven.89 p.c in static setting and, 4.04 p.c in mobile setting, compared to DCF. and therefore the delay will increase by at most 5.61

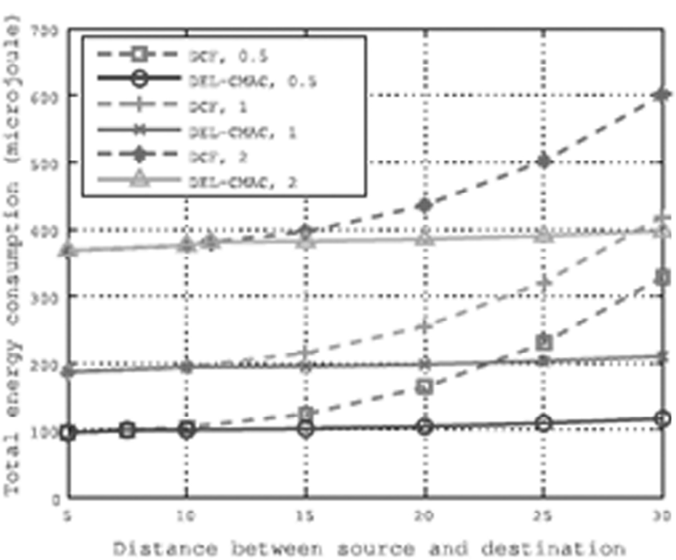

Figure 6: Energy consumption versus s-d distance.

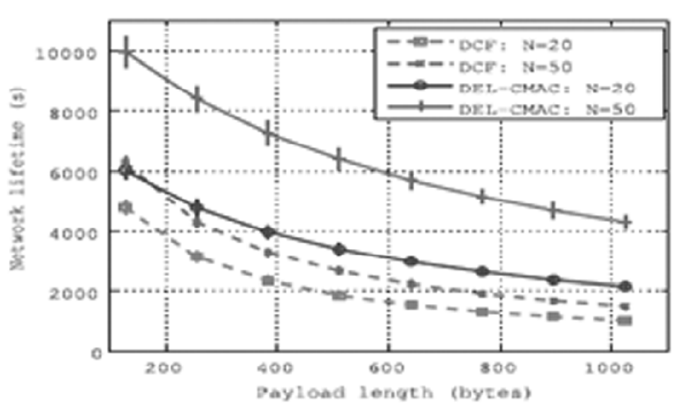

Figure 7: Network lifetime versus data payload size (*P/P* = 0.5 and with 95 percent confidence interval).

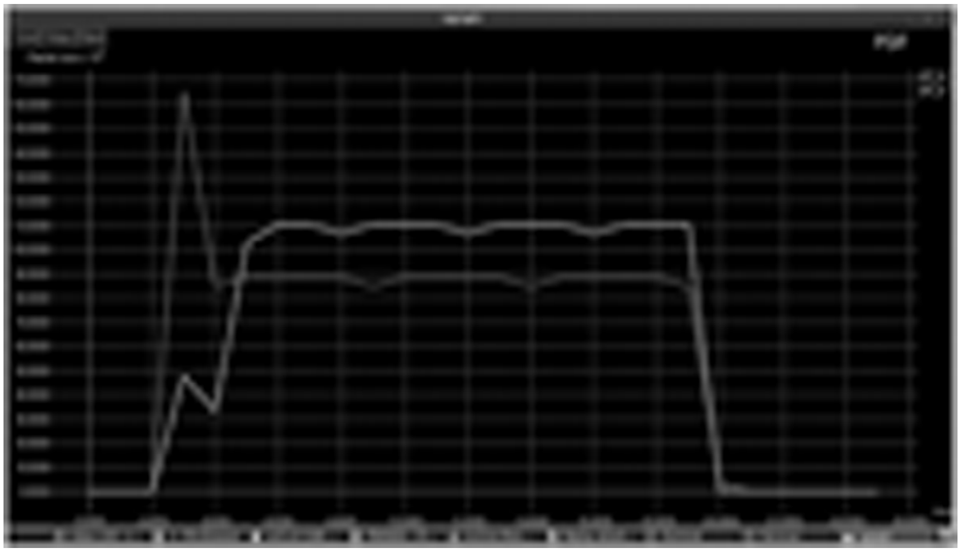

Figure 8: Pdf comparison

and 3.93 p.cin static and mobile environments, respectively. These results ar expected since the additional management frame overhead is needed to coordinate the cooperative transmission. Besides, the utility based backoff used for selecting the simplest relay, and the enlarged interference vary by relaying additionally have an effect on the throughput and delay negatively. However, examination to the network period of time gain, we tend to think about that the performance reduction around five p.c in turnout and delay is appropriate. Notice that Coop MAC enhances the throughput and delay at the value of significantly network lifetime degradation. The planned theme is especially suitable for the MANETs during which the network period of time is the primary demand, e.g., the MANETs used within the disaster rescue. for example, once Associate in Nursing earthquake hits some place, to go looking for survivors, an out sized range of small robots, equipped with varied sensors and a camera, can be deployed everywhere the trash. The robot kind a MANET to forward the sensing knowledge to the bottom stations and to coordinate their movements in order that the complete space is searched. so as to maximize the possibility of finding survivors, the network period of time is far a lot of necessary than the turnout and delay during this quite application.

5. CONCLUSION

In this paper, we have projected a completely unique distributed energy adaptive location-based cooperative mack protocol for MANET. By introducing DEL-CMAC, each energy advantage and location advantage will be exploited therefore the network lifetime is extended considerably. we have conjointly proposed an efficient relay choice strategy to decide on the best relay terminal and a cross-layer best power allocation scheme to line the sending power. Moreover, we have increased the spatial reprocess to reduce the interference among completely different connections by exploitation novel NAV settings. We have incontestable that DEL-CMAC will significantly prolong the network period examination with the IEEE 802.11 DCF and Coop MAC, at comparatively low throughput and delay degradation value.

As a future work, we will investigate our DEL-CMAC for larger size scale network size and with high quality response. We will also deliberate to develop an efficient cross-layer cooperative MAC diversity-aware routing rule along with our DEL-CMAC to conserve energy whereas minimizing the throughput and delay degradation.

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