

TOPOLOGY MANAGE WITH CELLULAR AD HOC SITES ALONG WITH COOPERATIVE COMMUNICATIONS.

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ABSTRACT:

Cooperative connection has acquired incredible attention regarding wi-fi systems. Nearly all active performs with cooperative communications usually are dedicated to link-level actual physical layer concerns. Consequently, the influences involving cooperative communications with network-level top layer concerns, including topology handle, direction-finding along with circle volume, usually are mainly overlooked. In this posting, we all offer any Capacity-Optimized Cooperative (COCO) topology handle plan to enhance the circle volume with MANETs through collectively thinking of equally top layer circle volume along with actual physical layer cooperative communications. By way of simulations, we all display that will actual physical layer cooperative communications get substantial influences around the circle volume, along with the pro-posed topology handle plan can substantially improve the circle volume with MANETs having cooperative communications..

Index Terms: MANET, Wifi communications, MIMO, COCO, Topology Control

INTRODUCTION:

Your need regarding rate within wifi communities is usually continuously growing. Not too long ago, cooperative wifi communication provides gotten great pursuits just as one untapped method for improving the functionality associated with information indication operating over the ever-challenging wifi channel. Cooperative communication provides blossomed to be a brand new dimension associated with diversity to help emu-late the techniques created for many antenna devices, due to the fact a radio mobile device might not be in a position to service many broadcast antennas on account of sizing, expense, or perhaps electronics limits [1]. Through taking advantage of the transmitted character on the wifi funnel, cooperative communication allows single-antenna radios to share the antennas to any personal antenna variety, while offering substantial functionality improvements. This kind of ensuring method has become

regarded as from the common, and is also likely to end up being integrated into 3 rd Age group Relationship Task (3GPP) Long term Development (LTE) multihop mobile communities [2].

Although some functions are already performed about cooperative devices, the majority of present functions tend to be dedicated to link-level bodily level concerns, like outage possibility as well as outage ability [3, 4]. As a result, your effects associated with cooperative devices about network-level higher level concerns, like topology handle, direction-finding as well as multilevel ability, tend to be generally dismissed. Indeed, the vast majority of current functions about wire-less cpa networks attempt to generate, adapt, as well as man-age some sort of multilevel over a maze associated with point-to-point non cooperative instant backlinks. Like architectures can be seen as complex cpa networks associated with basic backlinks. Nevertheless, current advancements inside cooperative devices will offer you several rewards inside overall flexibility around regular strategies. Cooperation reduces specific networking difficulties, like accident decision as well as direction-finding, as well as provides for less complicated cpa networks associated with more complex backlinks, as an alternative to complex cpa networks associated with basic backlinks [5].

As a result, quite a few uppr layer aspects of cooperative sales and marketing communications worth even more study, electronic. gary the gadget guy., your influences in topology handle and also net-work capacity, specially within cell phone random net-works (MANETs), which can generate a dynamic multilevel with no fixed infrastructure. Some sort of node within MANETs can certainly perform each to be a multilevel router with regard to course-plotting packets from the different nodes and as a new multilevel coordinator with regard to sending and also obtaining info. MANETs usually are in particular helpful every time a trusted fixed or maybe cell phone infrastructure seriously isn't offered. Immediate meetings among note-book LAPTOP OR COMPUTER people, armed service programs, urgent situation businesses, along with other secure-sensitive businesses are important programs associated with MANETs due to their quick and

easy deployment.

Due to the insufficient centralized command, MANETs nodes closely with each other to accomplish a common objective. The particular significant actions involved in self-organization usually are neighbour breakthrough discovery, topology organization, and also topology reorganization. Circle topology identifies your on the web connectivity info of the total circle, like the nodes inside circle and also the internet connections between all of them. Topology command is critical for the overall performance of the MANET. For instance, to keep up the best circle on the web connectivity, nodes throughout MANETs may possibly just work at the utmost airwaves power, which usually leads to substantial nodal degree and also very long web page link long distance, however a lot more interference will be launched in to the circle and much less throughput per node can be had. Utilizing topology command, a node care-fully decides on some it is others who live nearby to establish reasonable information inbound links and also dynamically adapt it is transmit power as a result, so that you can gain substantial throughput inside circle though trying to keep the force usage minimal [6].

On this page, contemplating the two higher stratum system volume as well as real stratum cooperative devices, all of us analyze the actual topology control issues within MANETs together with cooperative devices. All of us suggest the Capacity-Optimized Cooperative (COCO) topology control structure to boost the actual system volume within MANETs by means of collectively optimizing tranny setting collection, communicate node collection, as well as disturbance control within MANETs together with cooperative devices. By means of simulations, all of us demonstrate that will real stratum cooperative devices get significant influences on the system volume, as well as the pro-posed topology control structure can easily drastically help the system volume within MANETs together with cooperative devices.

The remainder from the content is actually organized the following. All of us add cooperative devices as well as the topology control problem within MANETs. Circle volume as well as the offered COCO topology control structure are usually introduced. All of us supply the simulation results as well as discussions. Eventually, all of us determine this specific analyze.

MOBILE AD HOC NETWORKS WITH COOPERATIVE COMMUNICATIONS

In this section, we first introduce cooperative communications. Then the topology control problem in MANETs with cooperative communications is presented.

COOPERATIVE COMMUNICATIONS

Cooperative transmission generally describes a process where by people share and also work well his or her assets to improve the details transmitting excellent. This can be a

generalization from the inform transmission, during which many options additionally serve because relays for each and every additional. First analyze involving relaying complications looks in the info theory community to improve transmission involving the origin and also getaway [7]. Recent incredible pursuits with cooperative marketing and sales communications are generally a result of the increased comprehension of the main advantages of many antenna programs [1]. While multiple-input multiple-output (MIMO) programs are actually broadly identified, it's complicated for a few wi-fi mobile devices to back up many antennas a result of the sizing and also price tag limitations. Recent reports present which cooperative marketing and sales communications enable single-antenna equipment to be effective with each other to help exploit the spatial range and also reap the main advantages of MIMO programs for example amount of resistance to help falling, large throughput, small sent energy, and also resistant communities [1].

In a uncomplicated cooperative cellular multilevel type with a pair of hops, there's a supply, the location, as well as some communicate nodes. The normal perception of cooperative relaying is actually of which many nodes, that overheard the information transported from your supply node, communicate it towards location node instead of the treatment of it as disturbance. Since the location node obtains multiple on their own passed replicates of the transported data from your supply node along with communicate nodes, cooperative selection is actually attained. Relaying may very well be applied using a pair of popular methods.,

- Amplify-and-forward
- Decode-and-forward

In amplify-and-forward, the communication nodes just improve the electricity in the indication been given from the sender along with retransmit it towards receiver. Inside decode-and-forward, your communicate nodes may perform physical-layer decoding and frontward your decoding lead to your locations. In case several nodes are for sale for co-operation, the antennas can easily require a space-time value within trans-mitting your communicate signals. It's proven that will co-operation in the actual level is capable of total degrees of range comparable to a MIMO process, so because of this can easily reduce the disturbance along with boost the online connectivity involving wifi systems..

Most existing works about cooperative communications are focused on physical layer issues, such as decreasing outage probability and increasing outage capacity, which are only link-wide metrics. However, from the network's point of view, it may not be sufficient for the overall network performance, such as the whole net-work capacity. Therefore, many upper layer net-work-wide metrics should be carefully studied, e.g., the impacts on network structure and topology control. Cooperation offers a number of advantages in flexibility over traditional wireless networks that go beyond simply providing a more reliable physical layer link. Since cooperation is essentially a network solution, the traditional link abstraction used for networking design may not be valid or appropriate. From the perspective of a network, cooperation can benefit not only the physical layer, but the whole network in many

different aspects.

With physical layer cooperative communications, there are three transmission manners in MANETs: direct transmissions (Fig. 1a), multi-hop transmissions (Fig. 1b) and cooperative transmissions (Fig. 1c). Direct transmissions and multi-hop transmissions can be regarded as special types of cooperative transmissions. A direct

transmission utilizes no relays while a multi-hop transmission does not combine signals at the destination. In Fig. 1c, the cooperative channel is a virtual multiple-input single-output (MISO) channel, where spatially distributed nodes are coordinated to form a virtual antenna to emulate multi-antenna transmitters.

TOPOLOGY CONTROL

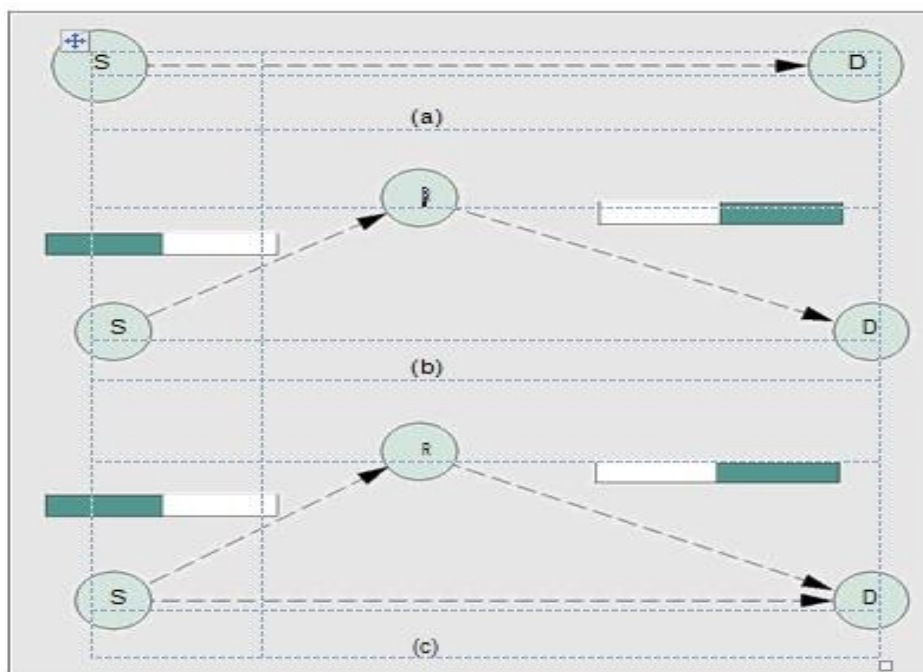


Figure 1. Three transmission protocols: a) direct transmissions via a point-to-point conventional link; b) multi-hop transmissions via a two-hop manner occupying two time slots; and c) cooperative transmissions via a cooperative diversity occupying two consecutive slots. The destination combines the two signals from the source and the relay to decode the information.

Your multilevel topology in a very MANET will be changing dynamically because of end user ability to move, visitors, node batteries, etc. In the mean time, the topology in a very MANET will be controllable through adjusting some boundaries like the indication strength, route task, etc. Normally, topology manage will be a really plan to view best places to utilize the backlinks and the way the backlinks function inside wire-less networks in order to create a fantastic multilevel topology, that'll improve the power use, the proportions from the multilevel, or perhaps end-to-end direction-finding functionality. Topology manage will be at first created with regard to cellular sensor networks (WSNs), MANETs, and cellular nylon uppers networks to relieve vitality use and disturbance. This generally ends in a less strenuous multilevel topology using smaller node amount and quick indication radius, that'll have high-quality backlinks and less contention inside choice entry manage (MAC) coating. Spatial/spectrum

recycling will end up feasible because of the small airwaves insurance. Various other properties similar to symmetry and planarity are anticipated to obtain inside resultant topology. Evenness can easily aid cellular connection and two-way handshake techniques with regard to web page link thank you while planarity raises the opportunity with regard to parallel transmissions and place recycling.

Energy manage and route manage problems are usually in conjunction with topology manage inside MANETs while these are taken care of as a stand alone usually. Although any portable node can easily impression the offered route, the item is deficient in from the setting to create network-wide selections. This thus helps make a lot more impression to carry out strength manage and route manage by way of the topological standpoint. The goal of topology manage will be next to set up interference-free contacts to reduces the maximum indication strength and how many

expected stations. It is additionally appealing to create the best multilevel topology mainly because it can lead to some rewards for your multilevel functionality.

Topology manage targets on network on the web connectivity with the website link data given by MACINTOSH and also bodily cellular layers. There are a couple elements in a very network topology: network nodes and also the interconnection hyperlinks one of them. In general, a MANET can be mapped right into a chart $G(V, E)$, exactly where Sixth is v may be the list of nodes inside network and also Elizabeth may be the advantage arranged addressing the particular instant hyperlinks. A hyperlink is often constructed from a couple nodes which can be inside tranny choice of one another throughout time-honored MANETs. The actual topology connected with this kind of time-honored MANET can be parameterized by means of many adjustable variables, which usually determine the particular existence connected with instant hyperlinks directly. With traditional MANETs without cooperative marketing communications, most of these variables can be transfer energy, antenna guidelines, and so on. With MANETs along with cooperative marketing communications, topology manage also needs to determine the particular tranny manner (i. at the., one on one tranny, multi-hop tranny, or maybe cooperative transmission) and also the inform node if cooper-ative tranny is in use.

Because topology manage can be to look for the existence connected with instant hyperlinks at the mercy of network on the web connectivity, the general topology manage issue can be depicted as

$$\begin{aligned} G^* &= \arg \max f(G), \\ \text{s.t. } &\text{network connectivity.} \end{aligned} \quad (1)$$

The problem Eq. 1 uses the original network topology G , which contains mobile nodes and link connections, as the input. According to the objective function, a better topology $G^*(V, E^*)$ will be constructed as the output of the algorithm. G^* should contain all mobile nodes in G , and the link connections E^* should preserve net-work connectivity without partitioning the net-work. The structure of resulting topology is strongly related to the optimization objective function, which is $f(G)$ in Eq. 1.

It is difficult to collect the entire network information in MANETs. Therefore, it is desirable to design a distributed algorithm, which generally requires only local knowledge, and the algorithm is run at every node independently. Consequently, each node in the network is responsible for managing the links to all its neighbors only. If all the neighbor connections are preserved, the end-to-end connectivity is then guaranteed. Given a neighborhood graph $G_N(V_N, E_N)$ with N neighboring nodes, we can define a distributed topology control problem as $G_N^* = \arg \max f(G_N)$, s.t. connectivity to all the neighbors.

The objective function $f(G)$ in Eq. 1 is critical to topology control problems. Network capacity is an important objective function. Our previous work [8] shows that topology control can affect network capacity significantly. In the following section, we present a topology control scheme with the objective of optimizing network capacity in MANETs with cooperative communications.

TOPOLOGY CONTROL FOR NETWORK CAPACITY IMPROVEMENT IN MANETS WITH COOPERATIVE COMMUNICATIONS

In this section, we first elaborate the capacity of MANETs. Then, we present the introduced COCO topology control scheme for MANETs with cooperative communications.

THE CAPACITY OF MANETS

To be a essential signal for the info supply potential, circle ability has drawn remarkable likes and dislikes since the landmark papers simply by Gupta and Kumar [9]. There are unique explanations pertaining to circle ability. 2 types of net-work ability are unveiled within [9]. The very first an example may be transport ability, which often is comparable to the whole one-hop ability within the circle. It will require length note and will depend on the sum bit-meter items. One bit-meter means that a single little have been transported to a length of 1 meter towards the vacation spot. Another kind of ability is usually throughput ability, which often will depend on the information ability of a station. Clearly, it is the sum epidermis facts successfully carried on a product occasion. It is found that this ability within wi-fi ad hoc systems is limited. With regular MANETs without cooperative sales and marketing communications, the ability is usually lowered because how many nodes within the circle raises. Asymptotically, the actual per-node throughput diminishes for you to absolutely no while how many nodes strategies to infinity [9]. On this research, we all embrace the 2nd type of definition.

The particular envisioned system ability depends upon a variety of aspects: wireless route data rate within the real covering, spatial recycle booking as well as interference within the web page link covering, topology command displayed previous, targeted traffic stability within routing, targeted traffic patterns, and so forth. In the real covering, route data rate is one of the principal aspects. Theoretically, route ability is usually extracted applying Shannon's ability solution. In practice, wireless route data rate will be collectively dependent on this modulation, route code, transmitting electrical power, falling, and so forth. Moreover, outage ability is usually used in train, which is reinforced by way of little outage probability, to signify the web link ability.

In the web page link covering, this spatial recycle is the main compound which has effects on system ability. Url interference, which in turn means this impacted nodes over the transmitting, even offers an important have an effect on system ability. Higher interference may well lessen

simultaneous transmissions within the system, thus reduce the system ability, as well as vice versa. The particular MACINTOSH PERSONAL COMPUTER functionality must steer clear of accident together with existing transmitting. It uses a spatial as well as temporary booking to ensure simultaneous transmissions do not get in the way together. Nodes within the transmitting variety of this sender should keep hushed avoiding wrecking on-going transmissions. Moreover, there are numerous aspects which prevent the route ability coming from currently being entirely utilized, such as hidden as well as exposed terminals, which in turn ought to be solved applying hand-shake methodologies or even a devoted command route within wireless sites.

Redirecting not only discovers walkways to satisfy high quality associated with assistance (QoS) specifications, and also balances targeted traffic tons within nodes avoiding sizzling destinations within the system. By balancing targeted traffic, this system may well acknowledge far more targeted traffic runs as well as increase the ability. Since many of us concentrate on topology command as well as cooperative sales and marketing communications, many of us suppose a great load stability within the system, the place that the targeted traffic tons within the system usually are uniformly dispersed towards nodes within the system.

The research within [3] ensures that cooperative transmissions do not generally outperform immediate transmissions. If you experience not any this sort of exchange that makes cooperative transmissions have got bigger outage ability, many of us somewhat transfer info straight or by way of multi-hops. Because of this, we need to decide the best web page link prohibit (Fig. 1) and the greatest exchange to optimize web page link ability. On the other hand, various other nodes within the transmitting selection have to be hushed if you want to never disturb this transmitting due to the start propagated wireless marketing. The particular impacted regions add some insurance policy coverage on the origin, this insurance policy coverage on the location, along with the insurance policy coverage on the exchange.

IMPROVING NETWORK CAPACITY USING TOPOLOGY CONTROL IN MANETS WITH COOPERATIVE COMMUNICATIONS

To enhance the actual network volume with MANETs having cooperative marketing and sales communications employing topology management, we can easily collection the actual network volume because purpose perform within

the topology management trouble with Eq. 1. So that you can gain the actual network volume in a MANET having cooperative marketing and sales communications, we need to have the hyperlink volume and also inference design whenever a particular indication approach (i. e., one on one indication, multihop indication, or maybe cooperative transmission) can be used.

As soon as regular one on one indication can be used, offered a little outage chance, the actual outage hyperlink volume may be made. Due to the fact simply a couple nodes are involved in the actual one on one indication, the actual disturbance number of a primary indication would be the marriage of coverage models from the supplier node and also the destination node. In this article, we all embrace the actual disturbance design with [9], which usually limits contingency transmissions in the vicinity of the actual transmitter and also radio. This kind of design satisfies the actual method gain access to management perform effectively (e. gary., the widely accepted 802. 11 MACINTOSH PERSONAL COMPUTER for most cellular devices with MANETs). Here, disturbance of any hyperlink pertains to some mix off coverage of nodes involved in the indication.

Multihop sign could be illustrated utilizing two-hop sign. While two-hop sign is used, a couple of occasion slot machine games are consumed. In the first slot, communications are fed through the origin on the exchange, and also the communications will probably be submitted on the vacation spot from the second slot. This outage ability of this two-hop sign could be made taking into consideration the out-age of every jump sign. This sign of every jump provides a unique interference, that happens in various slot machine games. Since the transmissions in the a couple of hops are not able to occur together playing with a couple of distinct occasion slot machine games, the particular end-to-end interference list of the particular multihop hyperlink depends upon the most in the a couple of interference packages. While cooperative sign is used, the greatest exchange should be decided on proactively before sign. With this research, many of us embrace the particular decode-and-forward relaying plan. The source broad-casts their communications on the exchange and vacation spot from the first slot. This exchange node decodes and re-encodes the particular signal through the origin, and then ahead the idea on the vacation spot from the second slot. The 2 alerts in the origin and also the exchange are decoded simply by maximum rate pairing on the vacation spot. The absolute maximum instantaneous end-to-end shared facts, outage likelihood, and out-age ability could be made [3]. For the interference model, in the broadcast period, both the

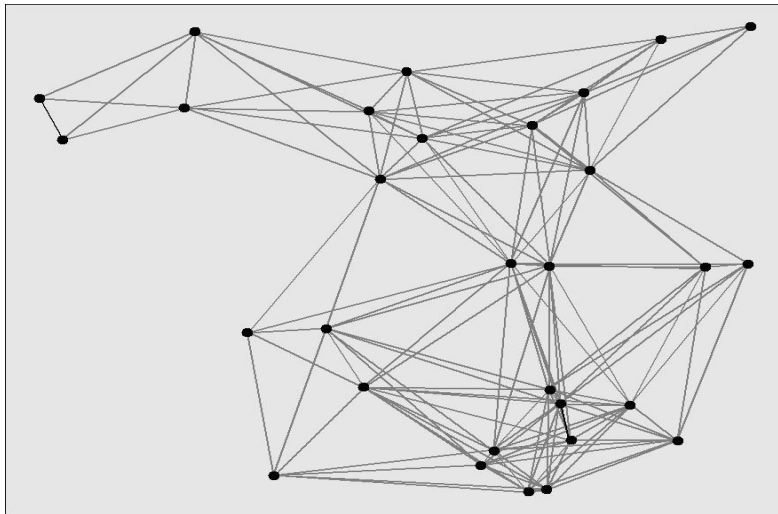


Figure 2. The original topology: a MANET with 30 nodes randomly deployed in a $800 \times 800 \text{ m}^2$ area.

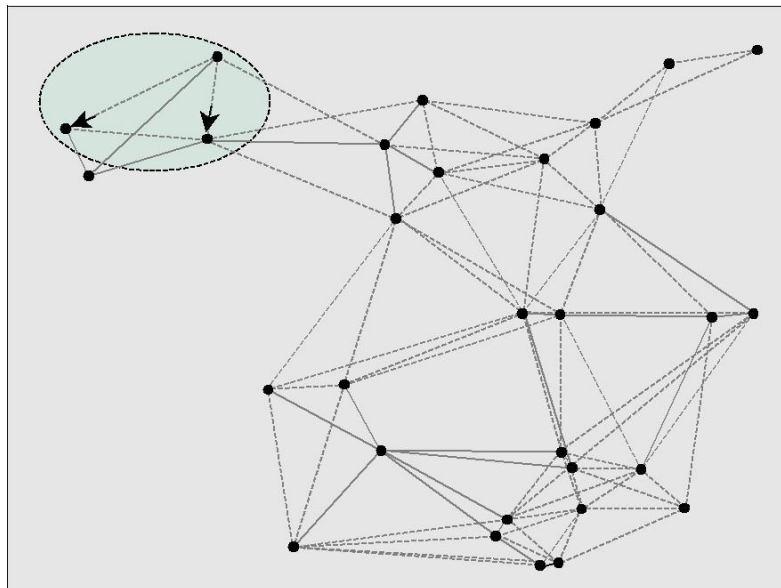


Figure 3. The final topology generated by COCO. The solid lines denote traditional direct transmissions and multihop transmissions. The dashed lines denote the links involved in cooperative communications.

covered neighbors of the source and the covered neighbors of the relay and the destination have to be silent to ensure successful receptions. In the second slot, both the covered neighbors of the selected relay and the destination have to be silent to ensure successful receptions.

Soon after getting the url ability in addition to inference versions, the actual circle ability is usually made [8] for the reason that target operate within the topology command

issue with Eq. 1. By means of thinking of strong tranny, multihop tranny, cooperative tranny, in addition to interference, the actual pro-posed COCO topology command scheme expands real layer cooperative communications through the link-level point of view to the network-level point of view with MANETs. This recommended scheme could ascertain the most effective type of tranny and the greatest communicate to enhance

circle ability.

Two constraint circumstances need to be considered within the recommended COCO topology command scheme. The first is circle online connectivity, that's the basic necessity with topology command. This end-to-end circle online connectivity can be assured by way of a hop-by-hop fashion within the target operate. Each and every node is in charge of the actual internet connections to all or any its neighborhood friends. When the many neighbor internet connections are usually assured, the actual end-to-end online connectivity within the whole circle is usually pre-served. The other feature in which can determine network ability may be the path duration. A end-to-end tranny in which traverses much more hops will certainly significance much more info packets into the circle. While path duration is mainly based on course-plotting, COCO boundaries splitting an extended url straight into too many hops in your community. This limit can be a couple of hops simply because in which simply two-hop relaying can be followed

SIMULATION RESULTS AND DISCUSSIONS

In this particular segment, the particular efficiency from the offered system will be illustrated employing personal computer simulations. Most of us think about a MANET together with thirty nodes at random used in a very 300 \times 300 m² region. The volume of nodes will be transformed inside simulations. The channels comply with any Raleigh submission. Most of us examine the particular efficiency from the offered system your of your current well-known topology handle system [10], named LLISE, that merely views classic multi-hop transmissions without cooperative marketing and sales communications and also saves the particular lowest disturbance course for each neighbor web page link in your neighborhood. Most of us additionally demonstrate the particular most severe system potential among all of the topology configurations regarding

evaluation. The main topology will be proven in Fig. two, in which backlinks are present whenever the particular associated 2 stop nodes usually are within transmitting range of the other. It's crystal clear that it topology is lacking in virtually any actual covering cooperative marketing and sales communications. Determine 3 shows the particular producing topology with all the offered COCO topology handle system. With Fig. 3, the particular reliable traces stand for classic primary transmissions and also multi-hop trans-missions, as well as the splash traces stand for backlinks involved in cooperative marketing and sales communications. Even as we could see from Fig. 3, to increase the particular system potential from the MANET, quite a few backlinks inside net-work take part in cooperative marketing and sales communications. One of them associated with two-phase cooperative marketing and sales communications will be proven inside best still left part from the amount. Determine 4 shows the particular system potential each node in a variety of topology handle schemes together with various variety of nodes inside MANET. Even as we could see from the amount, the particular offered COCO system has got the maximum system potential no matter the quantity of nodes inside network. Similar to COCO, LLISE will be implemented in every node distributedly. The idea saves all of the ends around the lowest disturbance course for each web page link inside producing topology, hence lowers the particular disturbance to further improve system potential. Nevertheless, COCO is capable of doing any more achievable system potential compared to LLISE, because LLISE merely views multihop transmissions. The efficiency achieve from the offered system originates from the particular mutual design and style associated with transmitting manner variety, inform node variety, and also disturbance minimization in MANETs together with cooperative marketing and sales communications.

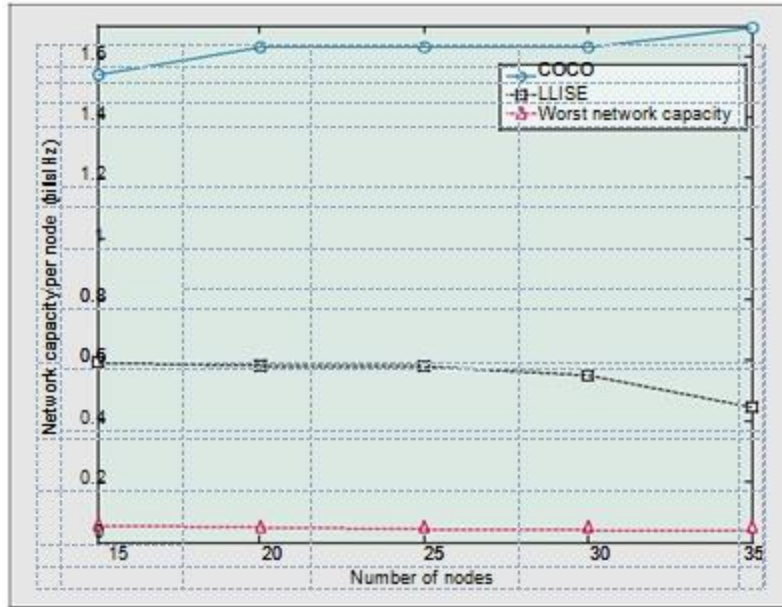


Figure 4. Network capacity versus different numbers of nodes in the MANET.

CONCLUSIONS AND FUTURE WORK

In the following paragraphs, we have released actual level cooperative devices, topology command, as well as system ability throughout MANETs. To enhance the actual system ability regarding MANETs with cooperative devices, we have offered any Capacity-Optimized Cooperative (COCO) topology command plan that will views both equally upper level system ability as well as actual level inform collection throughout cooperative devices. Simulation benefits have shown that will actual level cooperative devices approaches have got important impacts around the system ability, and the pro-posed topology command plan can easily substantially improve system ability throughout MANETs with cooperative devices. Potential do the job was in advancement to contemplate vibrant targeted traffic habits from the offered plan for boosting the actual efficiency regarding MANETs with cooperative devices

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