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# COCO: A Novel Topology Scheme To Improve Network Capacity In MANET's

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## Abstract

*Cooperative commutation plays an important role in wireless networks. These are totally based on links which are present in physical layer. These are based on topology structure, routing techniques and type of networks .in mobile ad hoc networks the connectivity is varied with the capacity of different networks. In previous techniques which are related to topology models there is lack of connectivity and capacity .we propose a highly capable and sustainable capacity optimized cooperative topology scheme. By this we are going to improve connectivity among various users with in MANETS. This increases the capacity and improves communication. An optimistic conclusion indicates that topology control with stable node degree renders the capacity not to decrease with the increase of the number of nodes present in the network.*

***Keywords** MANET, Interference, network connectivity, network lifetime, overhead.*

## 1. Introduction

As an optimization problem, the objective function is the most paramount component. In COCO, the objective function is set to reject the state of network capacity. As concluded in [1], the up-bound of network capacity is determined by various factors. On the one hand, link capacity is one of the main factors. Study in [2] shows that cooperative transmissions do not always outperform direct transmissions. If there exists no such a relay that makes cooperative transmissions have larger outage capacity, we rather transmit information directly or via multi-hops. On the other hand, other nodes in the transmission range have to be silent in order not to disrupt the transmission due to the open shared wireless media .The affected nodes include the neighbors of the source, the neighbors of the destination, as well as the neighbors of the relay. A Capacity-Optimized Cooperative (COCO) topology control scheme to improve the network capacity in MANETs by jointly optimizing transmission modeselection, relay node selection, and interference control in MANETs with cooperative communications. Through simulations, we show that physical layer cooperative communications have significant impacts on the network capacity, and the proposed topology control scheme can substantially improve the network capacity in MANETs with cooperative communications. Most existing works are focused on link-level physical layer issues, such as outage probability and outage capacity. Consequently, the impacts of cooperative communications on network-level upper layer issues, such as topology control, routing and network capacity, are largely ignored. Indeed, most of current works on wireless networks attempt to create, adapt, and manage a network on a maze of point-to-point non-cooperative wireless links. Such architectures can be seen as complex networks of simple links. We propose a Capacity-Optimized Cooperative (COCO) topology control scheme to improve the network capacity in MANETs by jointly considering both upper layer network capacity and physical layer cooperative communications. Through simulations, we show that physical layer cooperative communications have significant impacts on the network capacity, and the proposed topology control scheme can substantially improve the network capacity in MANETs with cooperative communications.

### 1.1 Mobile Ad Hoc Networks (MANETs)

Mobile ad-hoc network is an independent system of mobile nodes connected by wireless links forming a short, live, on-the-fly network even when access to the Internet is unavailable. Nodes in MANETs generally operate on low power battery devices. These nodes can function both as hosts and as routers. As a host, nodes function as a source and destination in the network and as a router, nodes act as intermediate bridges between the source and the destination giving store-and-forward services to all the neighbouring nodes in the network. Easy deployments, speed of development, and decreased dependency on the infrastructure are the main reasons to use ad-hoc network.

### 1.2 The topology control problem in MANET

In mobile ad hoc wireless communication, each node of the network has a potential of varying the topology through the adjustment of its power transmission in relation to other nodes in the neighborhood. In contrast, wired networks have fixed established pre-configured infrastructure with centralized network management system structure in place. Therefore, the fundamental reason for the topology control scheme in MANET is to provide a control mechanism that maintains the network connectivity and performance optimization by prolonging network lifetime and maximizing network throughput. A MANET topology can depend on uncontrollable factors such as node mobility, weather, interference, noise as well as controllable factors such as transmission power, directional antennas and multi-channel communications.

A bad topology can impact negatively on the network capacity by limiting spatial reuse capability of the communication channel and also can greatly undermine the robustness of the network. Where network capacity means the bandwidth and ability for it to be used for communication. A network partitioning can occur in a situation where the network topology becomes too sparse. Similarly, a network which is too dense is prone to interference at the medium access (MAC) layer, the physical layer of the network. So the network should neither be too dense nor too sparse for efficient communication amongst nodes to take place.

### 1.3 Problem Definition

The problem identified in contemporary research literature pertaining to topology control in MANET is that most of the topology control algorithms do not achieve reliable and guaranteed network connectivity.

## 2. RELATED WORK

### 2.1 Transmission in MANETs:

With physical layer cooperative communications, there are three transmission manners in MANETs: direct transmissions, multi-hop transmissions and cooperative transmissions. 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 multiantenna transceivers.

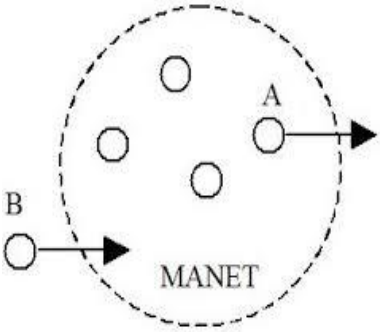

Fig 1: Transmission in MANETs

### 2. 2 Network Constraints:

Two constraint conditions need to be taken into consideration in the proposed COCO topology control scheme. One is network connectivity, which is the basic requirement in topology control. The end-to-end network connectivity is guaranteed via a hop-by-hop manner in the objective function. Every node is in charge of the connections to all its neighbors. If all the neighbor connections are guaranteed, the end-to-end connectivity in the whole network can be preserved. The other aspect that determines network capacity is the path length. An end-to-end transmission that traverses more hops will import more data packets into the network. Although path length is mainly determined by routing, COCO limits dividing a long link into too many hops locally. The limitation is two hops due to the fact that only two-hop relaying is adopted. In amplify-and-forward, the relay nodes simply boost the energy of the signal received from the sender and retransmit it to the receiver. In decode-and forward, the relay nodes will perform physical-layer decoding and then forward the decoding result to the destinations. If multiple nodes are available for cooperation, their antennas can employ a space-time code in transmitting the relay signals.

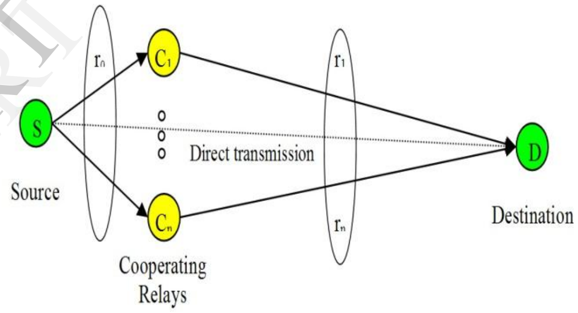

Fig 2: Architecture

### 2.3 Cooperative Communications:

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. Cooperative communications are due to the increased understanding of the benefits of multiple antenna systems. Although multiple-input multiple-output (MIMO) systems have been widely acknowledged, it is difficult for some wireless mobile devices to support multiple antennas due to the size and cost constraints. Recent studies show that cooperative communications allow single antenna devices to work together to exploit the spatial diversity and reap the benefits of MIMO systems such as resistance to fading, high throughput, low transmitted power, and resilient networks. Multi-hop transmission can beillustrated using two-hop transmission. When two-hop transmission is used, two time slots are consumed. In the first slot, messages are transmitted from the source to the relay, and the messages will be forwarded to the destination in the second slot. The outage capacity of this two-hop transmission.

## 3. ANALYSIS

A node may increase its transmission power to attain larger SINR and higher data rate at receivers. On the contrary, they cause greater interference to each other, which may do harm to the overall network capacity. On the other hand, although low transmission power causes less interference and increases the spatial reuse, it may reduce channel capacity. Considering only transmission power assignment, the capacity ratio is given by ( _ P_ P)−2/α with C1 given by (10) and by ( _ P_ P)1−2/α with C2 given by (12) respectively. Numerical results are plotted in Fig. 1 to illustrate the capacity ratio for different transmission power ratio _ P_ P. Fig. 1 shows that, as transmission power increases, capacity gain decreases in networks without using ARA. The reverse trend is for UWB networks with ARA. Evidently, the expected capacity is maximized by adjusting the transmission power to satisfy the minimum receiving threshold due to the reduction in spatial reuse in networks without ARA. Although an increase of a Transmission power will reduce the amount of spatial reuse; it will be always compensated by the increase of the link rate for UWB networks with ARA.

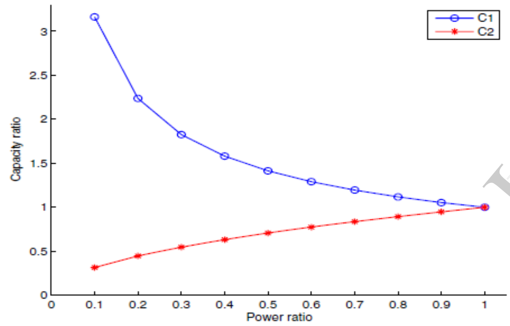

Fig 3: Impact of power control on network capacity

Conclusion 1: Transmission power in networks without ARA should be set to the minimum required power to maximize network capacity, while transmission power is set to the maximum value to optimize network capacity for UWB ad hoc networks with ARA.

Neighbor selection

Typically, topology control will change the neighborhood relations with the nodes within its maximum transmission range. Neighbors far away will often be removed from the neighbor list to achieve some performance criteria like energy efficiency or less interference. This will shorten the average link length d in (4).With Conclusion 1, the amount of spatial reuse is rewritten as M = A/πd2 for non-ARA networks. Thus,(5) implies that topology control should carefully deal with the tradeoff between shortening link length and increasing hop counts. Shorter link length increases somewhat the channel data rate while more hop count transmission consumes more network capacity. It is again shown that the link length ratio _ d_ d dominates the capacity ratio. If the link length ratio is halved, the capacity gets a gain of (6). On the other hand, it doubles the hop counts. Still, capacity ratio is doubled .As an analytical result of Section III-A, maximum allowed transmission power always yields optimal capacity for UWB ad hoc networks with ARA. The amount of spatial reuse then becomes a constant with a fixed network size. Network capacity in such a network is demonstrates the same trend about link length control for the networks with ARA and networks without ARA. When link length decreases, capacity increases, and vice versa. Capacity declines faster with increasing link length in UWBARA networks. The path loss exponent takes a typical value of 3 to 5 in this kind of network, depending on the propagation condition. Accordingly, the link length with topology control should have a higher priority in the networks with ARA than that in networks without ARA. This means that topology control is more meaningful for the indoor environment with higher path loss exponent.

## 4. IMPROVING NETWORK CAPACITY USING TOPOLOGY SUPPORTIVE COMMUNICATIONS

To improve the network capability in MANETs with supportive communications by means of topology control, we can set the network competence as the objective purpose in the topology control trouble in Eq. 1. In order to derive the network capacity in a MANET with supportive infrastructure, we want to get hold of the link ability and conclusion representation when a definite transmits approach is used.

When conventional direct communication is used, given small outage likelihood, the outage link capacity can be resultant. Since only two nodes are caught up in the direct broadcast, the intrusion set of a direct program is the union of reporting sets of the source node and the purpose node. In this article, we adopt the intrusion model in [3], which limitations synchronized transmissions in the neighborhood of the spreader and recipient. This model fits the middle access control function well (e.g., the popular IEEE 802.11 MAC in most transportable devices in MANETs). Herein, intrusion of a link is defined as some grouping of reporting of nodes occupied in the broadcast.

Multi hop transmission can be illustrated using two-hop transmission. When two-hop transmission is used, two point in time slots are obsessive. In the first slot, messages are transmitted from the foundation to the relay, and the communication will be forwarded to the purpose in the subsequent slot. The outage capacity of this two-hop transmission can be resulting bearing in mind the outage of each hop broadcast. The broadcast of each hop has its own intrusion, which happens in different slots. Since the transmissions of the two hops cannot occur concurrently but in two separate time slots, the end-to-end interfering set of the multi-hop link is resolute by the maximum of the two interference sets.

When cooperative transmission is used, a bestrelay needs to be selected proactively beforetransmission. In this study, we adopt the decodeand-forward relaying scheme. The source broadcastsits messages to the relay and destination inthe first slot. The relay node decodes and reencodesthe signal from the source, and thenforwards it to the destination in the second slot.The two signals of the source and the relay aredecoded by maximal rate combining at the destination.The maximum instantaneous end-to-endmutual information, outage probability, and outagecapacity can be derived [3]. For the interferencemodel, in the broadcast period, both thecovered neighbors of the source and the coveredneighbors of the relay and the destination haveto be silent to ensure successful receptions. Inthe second slot, both the covered neighbors ofthe selected relay and the destination have to besilent to ensure successful receptions.After obtaining the link capacity and inferencemodels, the network capacity can bederived [8] as the objective function in the topologycontrol problem in Eq. 1. By consideringdirect transmission, multihop transmission, cooperativetransmission, and interference, the proposedCOCO topology control scheme extendsphysical layer cooperative communications fromthe link-level perspective to the network-levelperspective in MANETs. The proposed schemecan determine the best type of transmission andthe best relay to optimize network capacity.

Two constraint conditions need to be takeninto consideration in the proposed COCO topologycontrol scheme. One is network connectivity,which is the basic requirement in topology control.

The end-to-end network connectivity isguaranteed via a hop-by-hop manner in theobjective function. Every node is in charge of theconnections to all its neighbors. If all the neighborconnections are guaranteed, the end-to-endconnectivity in the whole network can be preserved.The other aspect that determines networkcapacity is the path length. An end-to-endtransmission that traverses more hops will importmore data packets into the network. Althoughpath length is mainly determined by routing,COCO limits dividing a long link into too manyhops locally. The limitation is two hops due tothe fact that only two-hop relaying are adopted.

## 5. SIMULATION RESULTS AND DISCUSSIONS

In this section, the performance of the proposed scheme is illustrated using computer simulations. We consider a MANET with 30 nodes randomly deployed in a 800 × 800 m2 area. The number of nodes is changed in the simulations. The channels follow a Raleigh distribution. We compare the performance of the proposed scheme with that of an existing well-known topology control scheme [10], called LLISE, which only considers traditional multi-hop transmissions without cooperative communications and preserves the minimum interference path for each neighbor link locally. We also show the worst network capacity among all the topology configurations for comparison. The original topology is shown in Fig. 4, where links exist whenever the associated two end nodes are within transmission range of each other. It is clear that this topology lacks any physical layer cooperative communications. Figure 5 shows the resulting topology using the proposed COCO topology control scheme. In Fig. 3, the solid lines denote traditional direct transmissions and multi-hop transmissions, and the dash lines denote links involved in cooperative communications. As we can see from Fig. 3, to maximize the network capacity of the MANET, many links in the network are involved in cooperative communications. One example of two-phase cooperative communications is shown in the top left corner of the figure. Figure 6 shows the network capacity with different numbers of nodes in the MANET.

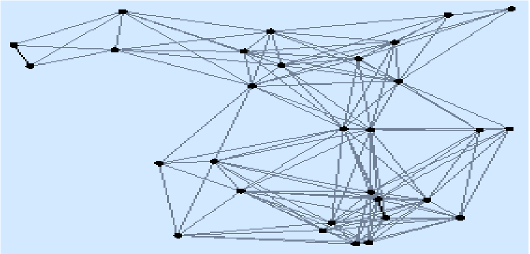

Fig 4: The original topology: a MANET with 30 nodes randomly deployedin a 800 × 800 m2 area.

As we can see from the figure, the proposed COCO scheme has the highest network capacity regardless of the number of nodes in the network. Similar to COCO, LLISE is executed in each node distributed. It preserves all the edges on the minimum interference path for each link in the resulting topology, thus minimizes the interference to improve network capacity. Nevertheless, COCO can achieve a much higher network capacity than LLISE, since LLISE only considers multihop transmissions. The performance gain of the proposed schemecomes from the joint design of transmission mode selection, relay node selection, and interference minimization in MANETs with cooperative communications.2

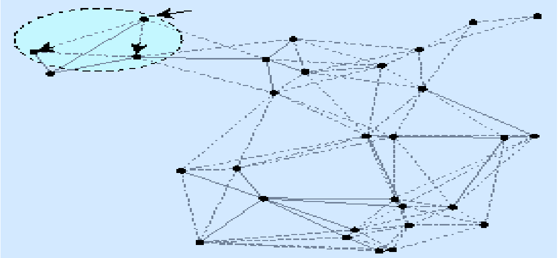

Fig 5: The final topology generated by COCO. The solid lines denote traditionaldirect transmissions and multihop transmissions. The dashed linesdenote the links involved in cooperative communications.

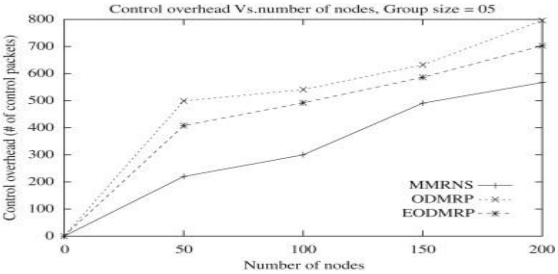

Fig 6: Network capacity versus different numbers of nodes in the MANET

## 6. CONCLUSION

In this article, we have introduced physical layercooperative communications, topology control,and network capacity in MANETs. To improvethe network capacity of MANETs with cooperativecommunications, we have proposed a Capacity-Optimized Cooperative (COCO) topologycontrol scheme that considers both upper layernetwork capacity and physical layer relay selectionin cooperative communications. Simulationresults have shown that physical layer cooperativecommunications techniques have significantimpacts on the network capacity, and the proposedtopology control scheme can substantiallyimprove the network capacity in MANETs withcooperative communications. Future work is inprogress to consider dynamic traffic patterns inthe proposed scheme to further improve the performanceof MANETs with cooperative communications.

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