# Maximizing Network Capacity with Topology Control in Cooperative Communication

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*Abstract*— **Cooperative Communication become apparent as a new scheme of diversity in Mobile Ad hoc Networks. Topology control and Network capacity are important upper layer issues in considering the performances of a MANETs in Cooperative communication. In this article , we put forth the concern of topology control with aspiration of maximizing the network capacity by proposing a scheme called MSRCC(Spatial Reuse Maximizer in Cooperative Communication).We are going to perform the simulation using NS2.It combines both the Spatial Reuse Maximizer (MaxSR) that focuses on converging to an operating point minimizing network capacity and Capacity Optimized Cooperative Topology Control method that focuses on improving the network capacity by considering both physical layer cooperative communication and upper layer argument such as network capacity and topology control.**

***Index Terms*— COCO, Topology Control, MaxSR, Network Capacity**

## I. INTRODUCTION

Network capacity is one of the scarce resource which has to be used in efficient ways to occupy a large number of paths or links which has to provide outstanding throughput . Network capacity is the measurement of the occupancies of the number of links or paths that can be occupied to transfer the data from one node to another node in the network .In cooperative communication, it allows the single antenna device to attain the spatial diversity, harvest the utilities of MIMO system such as fade resistant, large throughput, network connectivity and lower power consumption. Power controlling and channel maintaining are issues which are jointly considered with topology control in a network. Controlling the network topology is important along with the appropriate use of network capacity. In this paper, we propose a MSRCC scheme to enhance network capacity in the cooperative communication. Through the simulation results, the expected output performs better than the existing topology control schemes. The chapter is structured as below. We first introduce Capacity-Optimized topology control scheme in cooperative communication and the spatial reuse maximizer in MANETs. Then we propose the MSRCC topology control method to enhance network capacity and the simulation results shows that the proposed method performs better than the other topology control schemes.

## II. CAPACITY OPTIMIZED TOPOLOGY CONTROL IN COOPERATIVE COMMUNICATION (COCO):

Cooperative communication is the principle of relay communication, where several sources acts as a relays to one another. The COCO Topology scheme is proposed to improve the topology control problem in the Cooperative communication by considering link level issues in physical layers and upper layer issues such as network capacity . In cooperative communication, there are three types of transmission manners in its physical layer of MANETS, such as ,direct transmission, multi hop transmission and cooperative transmission. There are two must conditions are taken into account in COCO scheme. First is network connectivity, which is basic ingredient in topology control and end-to-end network connectivity is mandatory via hop-by-hop model in objective function. For cooperative communication in MANETS, the topology control expression will be given as

$$G^{*}=\arg\max f(G) \qquad (1)$$

where G represents original network topology that has mobile nodes along with link connection as their input. Based on the network capacity function ,the most desirable topology can be derived from the algorithm output. The two different types of network capacity are, transport capacity and throughput capacity as proposed by Gupta and Kumar [9].

The transport capacity makes note of distance while throughput capacity will dependent on channel's information capacity. Here we assume the network capacity as a main function in topology problem statement in eg.1.For the estimation of network capacity, we need to calculate the link capacity and inference model with the specified process in the physical layer.In direct transmission process which involves only two nodes, the link capacity can be estimated with a given outage probability.The interference model in direct transmission consists of union set of source node and destination node ,we adopt inference model in [9] to calculate. In the case of multi hop transmission system, it has two-hop transmission in which dual time slots are derived.

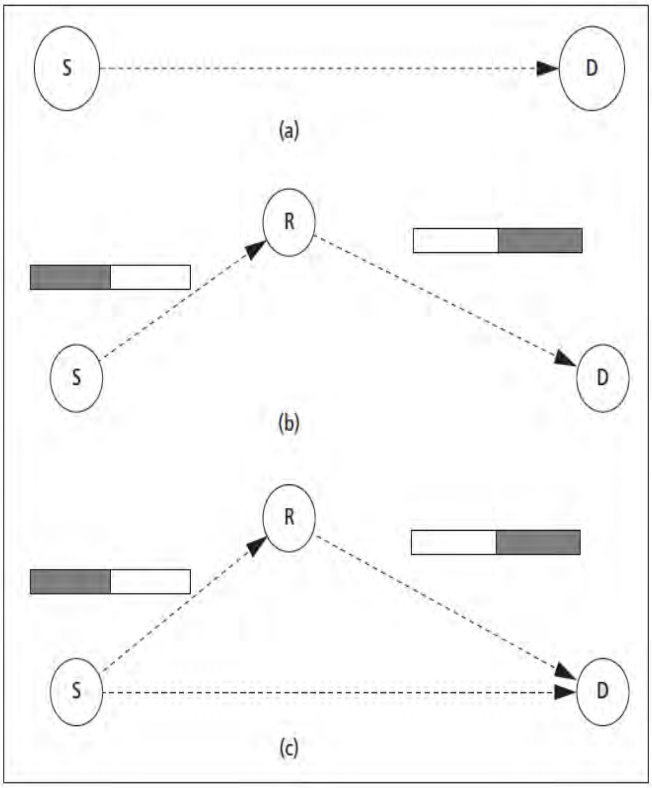


Figure 1:(a)Direct transmission(b)multihop transmission (c)cooperative transmission.

In the first hop, the messages being the transmission from the node to the relay and in the second hop messages transmits from the relay to the destination. The link capacity and interference of each hop is calculated separately. Since they do not occur at the same time, the end to end multihop interference set is calculated by the maximum among them.

When cooperative communication is used, the relay must be selected proactively prior to transmission. There are two types of relaying techniques used commonly, they are Amplify-and-forward and Decode-and-forward. In the Amplify-and-forward, the relay node increase the energy acquired from the transmitter and retransmit them to the receiver. While in Decode-and-forward, they will perform decoding in the physical layer and then the decoded result will be forwarded to the destination.

Obtaining the results of link capacity and interference in them, the network capacity was derived as in eq.1. By comparing with one another, the COCO method as a better control over the topology in cooperative communication by determining best transmission methodology and most appropriate relay to maximize the network capacity best transmission methodology and most appropriate relay to maximize the network capacity.

## III. Spatial Reuse Maximizer (MaxSR):

To obtain the capable topology control in physical model , a centralized access , called the Spatial Reuse Maximizer which is algorithm consisting of two algorithm as T2P and P2T.As per the concept, the node increases the transmit power to increase SINR at receiver instead of utilizing the minimum achievable power to reach its farthest neighbor and providing a tolerable interference. If the node operates at high transmit power ,the interference perceived by other nodes tends to increase. The MaxSR opts to maintain a balance in between the SINR and controls interference to an agreeable level.

T2P is for assigning the transmission power to a fixed topology where by means of optimization the transmit power assigns itself to minimize the aggregate interference level . P2T which is obtained by the power obtained made in T2P, a method for topology to minimize the interference degree .

Spatial reuse is the possibility of the network to take in concurrent transmission. There is no proper way to express metrics to characterize its level. Most topology control algorithm takes node degree into account with the assumption that the low node degree will have high spatial reuse. Here they use a interference degree throughout the network. In Spatial Reuse Maximiser, it is proposed to optimize Pt and T until it reaches the convergence point.To prove the statement of MaxSR , we require set of node V and coordinates {X,Y} ,the sum of interference degree with T and Pt.With the algorithm , it reaches to a operational point which minimum interference among all of the other algorithms.

## IV. SPATIAL REUSE MAXIMIZER IN COOPERATIVE COMMUNICATION:

In Cooperative communication, the major factors affects the network capacity will be spatial reuse in link layer producing a high interference. Higher the interference ,its affects the network capacity more.To avoid interference and to improve the network capacity ,we propose a method called Spatial Reuse Maximiser in Cooperative Communication(MSRCC). With the assumption that the traffic loads are uniformly distributed in CC and it does not outperform direct transmission, we must optimize best relays.In COCO, *G* (*V*, *E*), represents a graph in wireless networks. *V* represents the set of nodes and *E* represents edge points.

Let (X,Y) be the Euclidean coordinates v Є*V* .i.e.,v(x,y) xЄX, yЄY respectively. *Pt* denotes the transmission power and *gij* denotes the channel gain.$d_{i,j}$ represents the distance between the two nodes ($v_i$,$v_j$). Two factors are important for transmission,they are SINR(signal to interference and noise ratio) and receive sensitivity. *RXmin* be threshold & $\beta$ be the SINR threshold. A successful receive and decode must satisfy

$$pr(i,j) = \frac{gi,j \cdot pt(i)}{d_{i.j}^{\alpha}} > RX_{min} \qquad (2)$$

$$SINR_{i.j} = \frac{g_{i.j} \cdot p_t(i).d_{i.j}^{-\alpha}}{N+I_j} \geq \beta \qquad (3)$$

The three nodes in cooperative communications are (S,R,D) Є V represents the link representation.The link outage capacity and interference set links are are taken from [5]. The factor optimizing the network capacity is ,

$$f(\boldsymbol{\gamma}(\boldsymbol{\theta})) = \sum_{j\in VN} \frac{C\varepsilon(\gamma(\theta j))}{|I(\theta j)|} \qquad (4)$$

. Where $C\varepsilon(\boldsymbol{\gamma}(\theta j))$ represents the link outage capacity and $I(\theta j)$ represents the interference set in Capacity optimized cooperative communication. The ability of the network to accommodate concurrent transmission is known as spatial reuse.In the link layer, the concurrent transmission may lead to interference with ongoing transmission.Increasing the transmission power may increase the tolerance against interference with ongoing process but it increases the interference relative to position of transmitter and receiver. The interference node to link $(v_i, v_j)$ represented as $I(\beta_k(i,j))$ [4].

Interference node to the link is that a node transmitting power resulting in collision or blocked within the transmission.er p(k),then they do not took place simultaneously. and they are not decoded at the receiver. Channel competition will degrade network capacity becomes unbearable when high interference degree covers on multiple nodes.

The T2P assigns a power assignment to increase the spatial reuse in the fixed topology .It results in different power assignments ,so we add one more component P2T which will be generating an optimal topology for the fixed power.To optimize $P_t$ and T , we alternatively use both T2P and P2T until we converge to an optimum point sum of interference degree $I(P_t^{(n)}, T^{(n)})$.Then the optimized network capacity is calculated from eq(4) and it shows a better improved network capacity over the other topology control in cooperative communication.

## V. SIMULATION RESULTS AND DISCUSSION:

In the section ,we carry simulation analysis to evaluate the achievement of MSRCC with COCO ,other topology control schemes such as LLISE ,worst case network capacity in NS2 simulation. With the study, we get to investigate about Interference Degree, Network connectivity, Throughput capacity by considering MANETS with 30 nodes and 500x500 $m^2$.For each node, we assign MSRCC deriving network capacity and power assignment along with interference model. The graph shows the network capacity in each node with different topology control schemes. From the graph ,it is clear that the network capacity in higher in MSRCC compared to COCO,LLISE and worst case network capacity. They represents themselves with low interference, thereby maximizing the network capacity in cooperative communication. The achievement of the proposed scheme is obtained with the link connectivity, increased network capacity, lower interference and relay node selection with cooperative communication in MANETS.

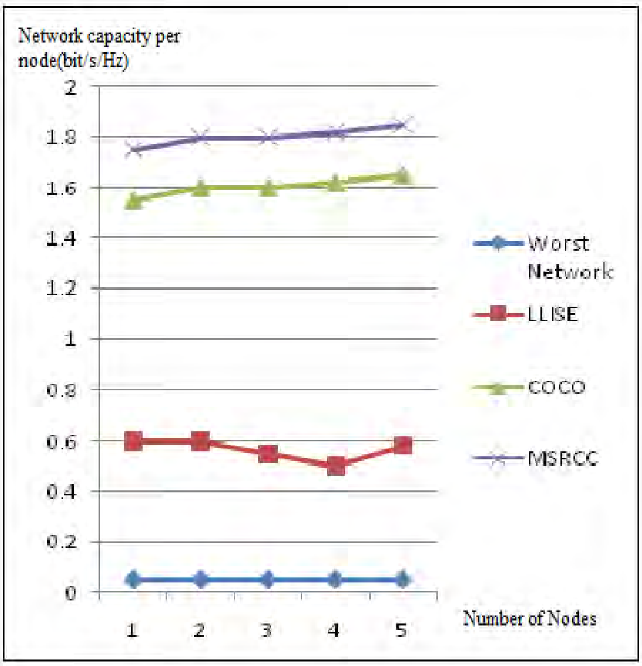


Figure.2.Network capacity Vs Number of nodes

## VI. CONCLUSION:

To improve the network capacity in cooperative communication, we propose MSRCC topology control scheme which has proved to perform better than the existing topology control schemes. Simulation results have shown that the scheme has improved the network capacity .Hence ,this topology control scheme is efficient and performs good with cooperative communication in MANETs.

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