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Reduction of Topology Control Using Cooperative Communications in Manets

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ABSTRACT: *A mobile ad hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless. Most of presented works on mutual communications are focused on link-level physical layer issues. The impacts of supportive communications on network-level upper layer issues, such as routing, topology control and network capacity etc. In this, we propose a Capacity-Optimized Cooperative (COCO) topology control scheme to develop the network capacity in MANETs by mutually taking into account both upper layer network capacity and physical layer mutual communications. Though the physical layer cooperative communications have more important impacts on the network capacity, and the future topology control scheme can significantly improve the network capacity in MANETs with cooperative communications and proposed optimum relay nodes selection for cooperative communication network to reduce overall power consumption of network.*

Index Terms: *Cooperative communications (CC), topology control, Optimum relay, MANET*

I. INTRODUCTION

Now a day's rapidly increasing demand for high speed wireless networks has forced the expansion of wireless ad-hoc networks. Recently, cooperative wireless communication has received tremendous interests as an untapped means for improving the performance of information transmission operating over the ever-challenging wireless medium. Cooperative communication has come forwarded as a new aspect of diversity to follow the policies designed for multiple receiver systems, since a wireless mobile device may not be capable to support multiple transmit antennas due to cost, size, or hardware limitations. By making use of the broadcast character of the wireless channel, cooperative communication permits single antenna radios to share their antennas to form a virtual antenna array, and suggests significant performance enhancements. This capable technique has been considered in the IEEE 802.16j standard, and is predictable to be integrated into Third Generation Partnership Project (3GPP) Long Term Evolution (LTE) multihop cellular networks. Network architecture and the process of abstraction go hand in hand. For most wired networks, the notion of a link has been a useful abstraction directly tied to the physical propagation medium. For wireless networks, especially the increasingly important class of MANETs, the classical notion of a link is more nebulous than in the wired case. Even so, two constraints are often imposed on network architectures to maintain it. At various levels, many current MANET protocols attempt to adapt, create, and manage a network based on a maze of point-to-point links and multihop transmission combines several intermediate links among pairs of nodes using buffer space, power, and bandwidth to route their own data as well as data from other sources. Even though an architecture based upon the classical link abstraction leads to many advantages that should not be underestimated, a number of issues occur in a wireless medium that hinder the classical link abstraction upon which these architectures are based.

Most presented works are paying attention on link-level physical layer issues, such as outage capacity and outage probability. Therefore, the impacts of CC on network level higher layer issues, such as routing, topology control and network capacity, are largely ignored. Certainly, most of present works on wireless networks attempt to adapt create and manage a network on a maze of point to point non cooperative wireless links. On the other hand recent advances in cooperative communications will present a number of advantages in flexibility over traditional techniques. Cooperation improves certain networking problems, such as routing and collision resolution and allows for simpler networks of more complex links, slightly than complicated networks of simple links.

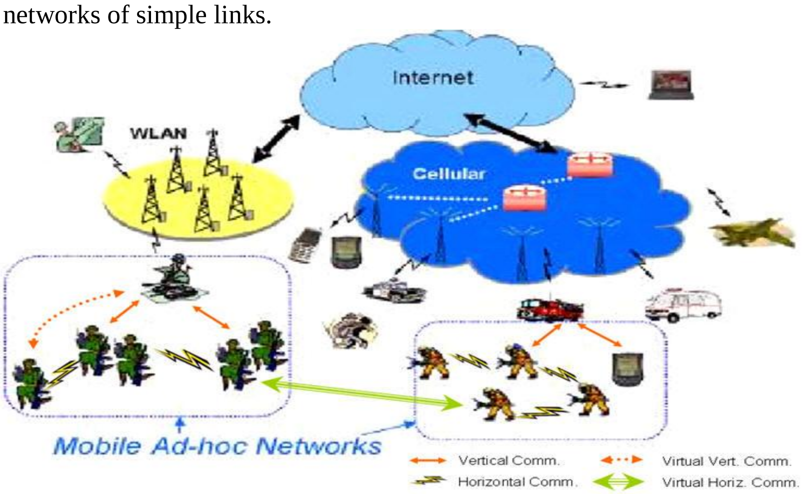


Fig.1: Mobile adhoc Networks

Due to the lack of centralized control, MANETs nodes collaborate with one another to achieve a common goal. The major activities involved in self-organization are neighbor discovery, topology reorganization and topology organization. Network topology describes the connectivity information of the entire network, including the nodes in the network and the connections between them. Topology control is very important for the overall performance of a MANET. In this presentation considering both upper layer networks capacity and physical layer cooperative communications and we study the topology control concerns in MANETs with cooperative communications. We suggest a Capacity-Optimized Cooperative (COCO) topology control scheme to develop the network capacity in MANETs by in cooperation optimizing communicate node selection, transmission mode selection and interference control in MANETs with cooperative communications. By using simulations that the physical layer cooperative communications have momentous impacts on the network capacity, and the future topology control scheme can significantly get better the network capacity in MANETs with cooperative communications.

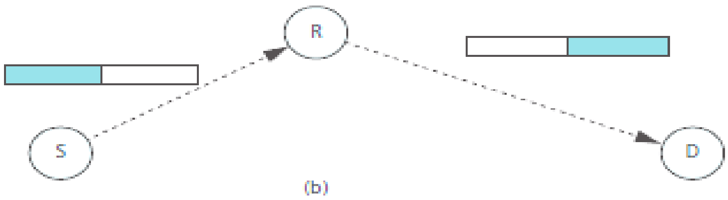
II. MOBILE AD HOC NETWORKS WITH COOPERATIVE COMMUNICATIONS

1.1. **Cooperative Communications**

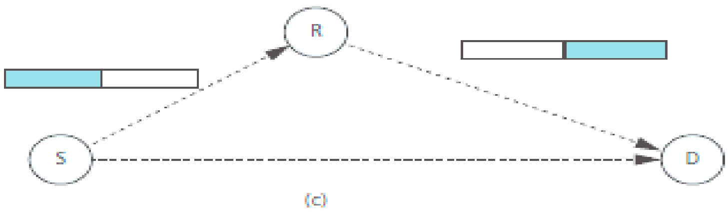
In Cooperative Communications in Existing Network Architectures, the primary network model is a MANET with an existing clustered communications, in which cooperative transmission is centrally activated and controlled by the cluster access points. All terminals communicate through a cluster access a point, which handles routing to other clusters. In the classical multihop architecture, each cluster is responsible for transmitting the message to a "gateway" node in the next cluster. In our cooperative network architecture, between clusters the access points uses multiple gateway nodes, which propagate the message providing cooperative gains compared to the single gateway solution. Better links translate into better network connectivity compared to multihop solutions. Relying on existing techniques to determine the clustering structure, our objective is to describe how the access points can select the cooperative nodes by means of matching algorithms and how this benefits the network connectivity.

Typically the cooperative communication refers to a system where users share and coordinate their resources to enhance the information transmission quality. The generalization of relay communication in which multiple sources also serve as relays for each other. At the beginning study of relaying problems appears in the information theory community to enhance communication between the source and destination. Now a day's tremendous interests in cooperative communications are due to the increased understanding of the benefits of multiple antenna system. The 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 the cooperative communications allows single antenna devices to work together to exploit the spatial diversity and reap the benefits of MIMO systems such as resistance to vanishing low transmitted power, high throughput and resilient networks. The basic idea of cooperative relaying is that some nodes which overheard the information transmitted from the source node and relay nodes the cooperative multiplicity is achieved. Communication could be implemented using two common strategies. They are Amplify and forward and Decoding and forward. In amplifying and forwarding the relay nodes simply boost the strength of the signal received from the sender and retransmit it to the receiver. In decode and forward the communicate nodes will perform physical layer decoding and then forward the decoding result to the destinations. The cooperation between multiple nodes and their antennas are employing a space time code in transmitting the relay signals. The cooperation at the physical layer can achieve full levels of diversity similar to a MIMO system and hence to reduce the interference and then increase the strength of connectivity in wireless network.

a) direct transmissions via a point-topoint conventional link;



b) multi-hop transmissions via a two-hop manner occupying two time slots



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.

Fig.2: Three transmission protocols

1.2. Topology Control

The network topology in a MANET is changing dynamically due to user mobility, traffic, node batteries, and so on. A MANET is controllable by adjusting some parameters such as the transmission power, channel assignment. Topology control is a method used in distributed computing to alter the understanding network in order to reduce the cost of distributed algorithms if ran over the new resulting graphs. Topology control is consumed mostly by the wireless Ad Hoc and sensor network research community. The main aspire of topology control is to save energy, reduce interference between nodes and extended lifetime of the network. Generally topology control is such a scheme to determine where to deploy the links and how the links work in wireless networks to form a good network topology which will optimize the energy consumption, the capacity of the network or end to end routing performance. A Mobile Ad hoc Network is self configuring infrastructure network of mobile devices connected by wireless. Every device in a MANET is free to shift independently in any direction and will therefore change its links to other devices regularly. Each must onward traffic not related to its own use, and as a result be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may work by self or may be connected to the large internet. MANETs are a kind of wireless as hoc network that usually has a routable networking environment on top of a link layer ad hoc network. The growth of laptop and 802.11/Wi-Fi wireless networking has made MANETs a popular research topic. Power control and channel control issues are coupled with topology control in MANETs while they are treated separately traditionally. Even though a mobile node can sense the available channel, it lacks of the scope to make network-wide decisions. Therefore it makes more sense to conduct power control and channel control via the topological viewpoint. Aim of topology control is then to set up interference- free connections to minimize the maximum transmission power and the number of required channels. The topology control focus on network connectivity with the link information provided by MAC and physical layers. In general a MANET can be mapped into a graph G(V,E), where V is the set of nodes in the network and E is the edge set representing the wireless links. As topology control is to determine the existence of wireless links subject to network connectivity, the general topology manage problem can be expressed as $G^*=\arg\max f(G)$, (1) 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 network connectivity without partitioning the network.

III. TOPOLOGY CONTROL FOR NETWORK CAPACITY IMPROVEMENT IN MANETS WITH COOPERATIVE COMMUNICATIONS

3.1 The capacity of MANETs

There are dissimilar definitions for network capacity. There areTwo types of network capacity are introduced. The first one is transport capacity, which is parallel to the total one-hop capacity in the network. It acquires distance into deliberation and is based on the sum of bit-meter products. One bit-meter shows that one bit has been transported to a distance of one indicator toward its destination. One more type of capacity is throughput capacity, which is based on the information capacity of a channel. Clearly, it is the amount of all the data effectively transmitted during a unit time. It has been exposed that the capacity in wireless ad hoc networks is restricted. The routing not only discover paths to meet quality of service (QoS) necessities but also balances traffic load in nodes to keep away from hot spots in the network. When balancing traffic, the network may disclose more traffic flows and maximize the capacity. Since we center of attention on topology control and cooperative communications, assume an ideal load balance in the network, wherever the traffic loads in the network are uniformly distributed to the nodes in the network.

3.2. Improving Network Capacity Using Topology Control in MANETS with Cooperative Communications

We can improve MANETs network capacity with cooperative communications using topology control, we can set the network capacity as the objective function in the topology control problem in Eq.1. When cooperative network is used, a best communicate needs to be selected proactively before transmission. In this study, we agree to decode and forward relaying scheme. The source broadcasts its message to the relay and destination in the first slot. They communicate node and destination in the first slot. The relay node decodes and re-encodes the signal from the source and then forwards it to the destination in the second slot. The maximum instantaneous end to end communal information, outage probability, and outage capability can be derived. The interference model in the broadcast period of both the covered neighbors of the source and the covered neighbors of the relay and the destination have to be silent to ensure successful reception

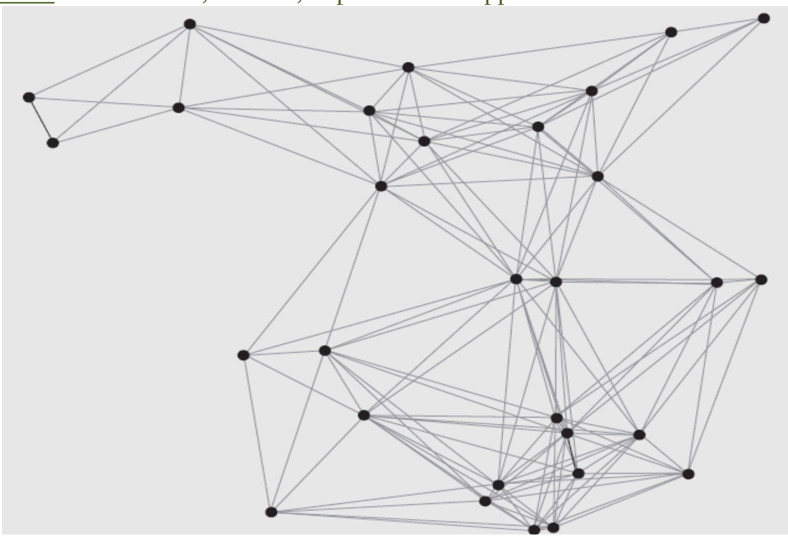


Fig.3: The original topology: A MANET with 30 nodes randomly deployed in 800 x 800 m2area

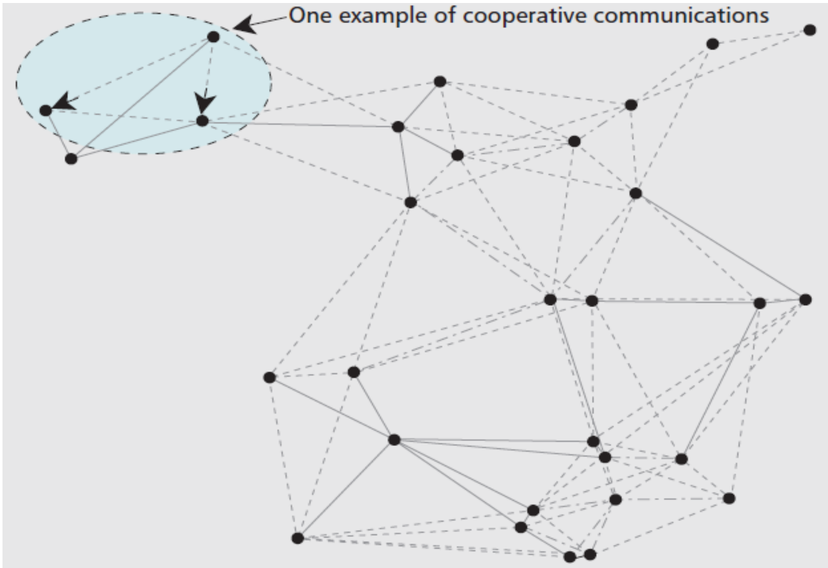


Fig.4: The final topology generated by COCO. The solid lines denote traditional direct Transmissions and multihop transmissions. The dashed lines denote the links involved in Cooperative communications

IV. PERFORMANCE ANALYSIS

In a performance analysis assume a MANET with 30 nodes randomly deployed in a 800 x 800 m2 area. The number of nodes is changed simultaneously. We evaluate the performance of the projected scheme with that of an existing well known topology control scheme called LLISE, which simply considers conventional multi-hop transmissions without cooperative communications and preserves the minimum interference path for each neighbor link locally. we furthermore show the worst network capacity between all the topology configurations for evaluation. The novel topology is shown in Fig. 3, where links exist at any time the associated two end nodes are within transmission range of each other. It is obvious that this topology lacks any physical layer cooperative communications. Fig.4. shows the resulting topology by means of the projected COCO topology control scheme. In Fig.4 the solid lines indicate links involved in cooperative communication. We can observe from Fig.4. to get the most out of the network capacity of the MANET, various links in the network are involved in cooperative communication. The example of two-phase cooperative communications is shown in the peak left corner of the outline. The Fig.4 shows the network capacity per node in different topology control schemes with different numbers of nodes in the MANET. 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. Nevertheless COCO can achieve a much higher network capacity than LLISE, since LLISE only considers multi hop transmission. The gain performances of this proposed scheme comes from the joint design of relay node selection, transmission mode selection, and interference minimization in MANETs with cooperative communication.

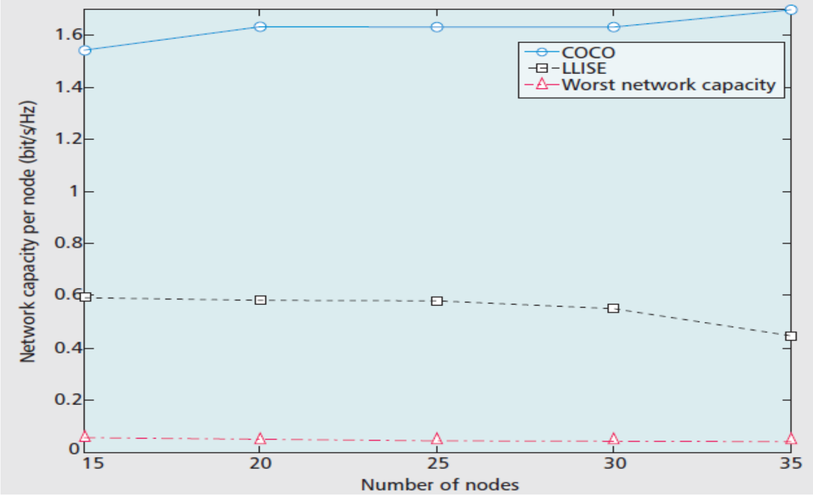


Fig.5: Network capacity versus different numbers of nodes in the MANET.

V. CONCLUSIONS AND FUTURE WORK

In this we have initiated physical layer cooperative communications, network capacity, and topology control network capacity in MANETs. To improve the network capability of MANETs with cooperative communications, we have projected a Capacity- Optimized Cooperative (COCO) topology control scheme that considers both upper layer network capacity and physical layer relay selection in cooperative communications. Simulation results have shown that physical layer cooperative communications techniques have significant impacts on the network capacity, and the projected topology control scheme can significantly get better the network capability in MANETs with cooperative communications. Prospect work is in development to consider dynamic traffic patterns in the proposed scheme to further improve the performance of MANETs with cooperative communications.

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