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Mobile Ad-Hoc Networks Capacity Optimized Cooperative Communications

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Abstract: Cooperative communication has received tremendous interest for wireless networks. Most existing works on cooperative communications are focused on link-level physical layer issues. Consequently, the impacts of cooperative communications on network-level upper layer issues, such as topology control, routing and network capacity, are largely ignored. In this article, 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.

I. ABOUT THE PAPER

The demand for speed in wireless networks is continuously increasing. 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 emerged as a new dimension of diversity to emulate the strategies designed for multiple antenna systems, since a wireless mobile device may not be able to support multiple transmit antennas due to size, cost, or hardware limitations. By exploiting the broadcast nature of the wireless channel, cooperative communication allows single antenna radios to share their antennas to form a virtual antenna array, and offers significant performance enhancements.

This promising technique has been considered in the IEEE 802.16j standard, and is expected to be integrated into Third Generation Partnership Project (3GPP) Long Term Evolution (LTE) multi-hop cellular networks. Although some works have been done on 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. However, recent advances in cooperative communications will offer a number of advantages in flexibility over traditional techniques.

Cooperation alleviates certain networking problems, such as collision resolution and routing, and allows for simpler networks of more complex links, rather than complicated networks of simple links. Relaying could be implemented using two common strategies,

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

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.

II. EXISTING SYSTEM

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.

Deficiency of the existing system

- Decreasing outage probability and increasing outage capacity, which are only link-wide metrics
- Poor impacts factor of cooperative communications on network-level upper layer issues.

III. PROPOSED SYSTEM

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.

Advantages of the proposed system

- 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
- Flexibility
- Improve the network capacity

Network models

As further developed in the sequel, we consider cooperative communications within two wireless network models. We focus the discussion on how the cooperative groups are activated and supported. Although this perspective is insouciant to claim that we specify an entire architecture, it does suggest tradeoÆs between centralized and decentralized architectures as well as complexity among the physical, link, medium access, and network layers of the protocol stack infrastructure, in which cooperative transmission is centrally activated and controlled by the cluster Access Points (AP). All terminals communicate through a cluster AP, 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.

The message providing cooperative gains compared to the single gateway solution. Better links translate into better network connectivity compared to multi-hop solutions. Relying on existing techniques to determine the clustering structure, our objective is to describe how the AP can select the cooperative nodes by means of matching algorithms The nodes recruited in this cluster can rely on the synchronization data available in the source packet.
ELEMENTS OF COOPERATIVE COMMUNICATIONS

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They can be ignorant of the codes chosen by the other nodes, but the resulting cooperative gains are close to those of a centralized scenario in which codes are explicitly assigned to the nodes. A small cluster of nodes can act as a source and recruit additional nodes to form a larger cluster, and so forth, to create multi-stage cooperation First, we show that, as in a traditional channel access problem, multi-stage cooperative access can be randomized although not quite in the same way as traditional random access. Second, we demonstrate in multicast applications that multi-stage cooperative access requires up to 50% less power compared to multi-hop solutions.

As we will see, the new ingredient of cooperative communications suggests a rethinking of the link abstraction and creates many opportunities and challenges from the physical layer to higher layers. In the clustered architectures, more work at the network layer is necessary in order to support cooperation. In the distributed approach we describe, the brunt of the work lies in the physical layer.

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 Maximize in Cooperative Communication (MSRCC). With the assumption that the traffic loads are uniformly distributed in CC and it does not out perform direct transmission.

In the first hop, the messages being the transmission from the node to the relay and in the second hop messages transmit 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 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.

IV. CONCLUSION

In this article, we have introduced physical layer cooperative communications, topology control, and network capacity in MANETs. To improve the network capacity of MANETs with cooperative communications, we have proposed 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 proposed topology control scheme can substantially improve the network capacity in ANETs with cooperative communications. Future work is in progress to consider dynamic traffic patterns in the proposed scheme to further improve the performance of MANETs with cooperative communications.