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Power Management in Multi- Relay MIMO- CNs

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Abstract: *In recent years, co- operative networking has received substantial interest from the wireless networking and communications research communities. Many interesting problems for co- operative networks have been actively researched, such as throughput-optimal scheduling, network lifetime maximization, distributed routing, and MAC layer protocol design. Although there have been extensive studies concerning co- operative networks, most works on optimizing the performance of cooperative networks are limited by- three-node relay scheme and single-antenna systems. In co-operative networks, it is interesting to explore the idea of deploying multiple antennas at each node. With the multiple antennas, the source and the relays can multiplex independent data streams by exploiting the inherent independent spatial channels. In this paper, we consider the power allocation at the source and each relay to maximize the end-to-end achievable rate of multi relay MIMO-CN.*

Keywords: *AF, DF, Cooperative network, Relay.*

I. Introduction

Many Interesting problems for co-operative networks (CNs) have been actively researched such as throughput optimal scheduling [1]; network Maximization [2] distributed routing [3] and MAC layer protocol design [4]. Cooperation alleviates certain networking problems, such as collision resolution and routing, and allows for simpler networks of more complex links, rather than the complicated networks of simple links. Therefore, many upper layer aspects of the cooperative communications merit further research, e.g., the impacts on topology control and network capacity, especially in mobile ad hoc networks (MANETs), which can establish a dynamic network without a fixed infrastructure. Cooperative communications typically refers to a system where users share and coordinate their resources to enhance the information transmission quality. It is a generalization of the relay communication, in which multiple sources also serve as the relays for each other.

Early study of relaying problems appears in the information theory community to enhance the communication between the source and destination the basic three node relay scheme is shown in the Figure.1, where the message is retransmitted from source S to destination D is relayed by node R, which can overhear the message. A Common cooperative approach in this situation in relaying assignment i.e. we choose only one of the neighboring nodes as relay for which the three node relay scheme can be applied, now further improvement the system performance as shown in Figure 2.

In current scenario on cooperative networks with MIMO enabled nods remain limited. In cooperative networks, it is interesting to explore the idea of deploying multiple antennas at each node. Figure 2 indicates that all single antennas relay R1…., Rm as single virtual relay node with "M" antennas. Cooperative diversity is a cooperative multiple antenna technique for improving or maximizing the total network channel capacities for any given set of bandwidths which exploits user diversity by decoding the combined signal of the relayed signal and the direct signal in wireless multi hop networks.

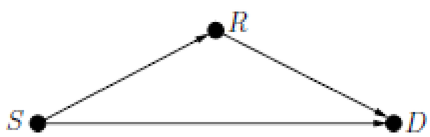

Figure 1: The basic three-node relay scheme

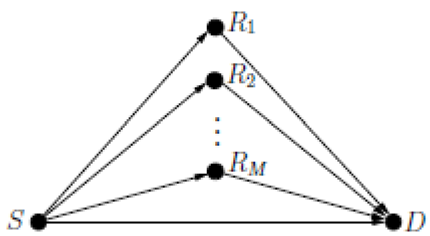

Figure 2: A cooperative network with multiple relays

Note that the user cooperation is another definition of cooperative diversity. User cooperation considers an additional fact that each user relays the other user's signal while the cooperative diversity can be also achieved by multi-hop relay networking systems. Actually we investigate that consideration the optimal power allocation at the source and each relay to maximize the end-to-end achievable rate of multi relay MIMO- CN. Now let us focus on the various relaying strategies like Amplify forward (AF) and Decode and forward (DF). In amplify 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. RELATED WORK

In [5], the authors first considered the optimal relay amplification matrix for the basic three-node MIMO-CN under the assumption that the source-relay channel state information (CSI) is unknown. Their main conclusion is that when the direct link between the source and the destination is not present (i.e., pure relay), then the optimal amplification matrix adopts a “matching” structure. In [6], the authors independently arrived at the same conclusion via a different proof technique. Later in [7], the authors generalized the matching result to the three-node MIMO-CN network where the source has full CSI. In [8], the authors studied MIMO-CN with multiple AF relays, which is similar to our setting. However, their work differs from ours in that they assumed a sum power constraint across all the relay nodes, which is usually not realistic since each relay has its own power budget. Thus, a per node power constraint on each relay is more appropriate.

III. PROPOSED METHOD

In Proposed method we use Cooperative diversity. It is a cooperative multiple antenna technique for improving or maximizing the total network channel capacities for any given set of bandwidths which exploits user diversity by decoding the combined signal of the relayed signal and the direct signal in wireless multi hop networks. A conventional single hop system uses a direct transmission where a receiver decodes the information only based on the direct signal while regarding the relayed signal as interference, whereas the cooperative diversity considers the other signal as contribution. The modules in the proposed system are:

- Three-node relay transmission
- Network Constraints
- Relaying Strategies
- Cooperative Communications & Optimal Power allocation
- Multi-hop Transmission

A. Three-node relay transmission

With physical layer cooperative communications, there are three transmission manners- 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. The cooperative channel is a virtual multiple- input Multiple-output (MIMO) channel, where spatially distributed nodes are coordinated to form a virtual antenna to emulate multi-antenna transceivers.

B. Network Constraints

Two constraint conditions need to be taken into consideration in the network connectivity, which is the basic requirement in the topology control. The end-to-end network connectivity is guaranteed through a hop-by-hop manner in the objective function. Every node is in charge of the connections to all its neighbours. If all the neighbour connections are guaranteed, then the end-to-end connectivity in the whole network can be preserved. The other aspect that determines the 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 the routing, MIMO – CN limits dividing a long link into too many hops locally. The limitation is two hops due to the fact that only two hop relaying are adopted.

C. Relaying Strategies

There are 2types of relaying strategies:

1. Amplify-and-forward (AF)
2. Decode-and-forward (DF)

In amplify-and-forward (AF), the relay nodes simply boost the energy of the signal received from the sender and retransmit it to the receiver. In decode-and-forward (DF), the relay nodes will perform physical-layer decoding and then forward the decoding result to the destinations. If multiple nodes are available for co- operation, their antennas can employ a space-time code in transmitting the relay signals. It is shown that co- operation at the physical layer can achieve full levels of diversity similar to a MIMO system, and hence can reduce the interference and increase the connectivity of wireless networks.

D. Cooperative Communications & Optimal Power allocation

Co- operative transmissions via a cooperative diversity occupying two consecutive slots. The destination node combines the two signals from the source and the relay to decode the information. Co- operative 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 the multiple antennas due to the size and cost constraints. Recent studies show that co- operative 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.

E. Multi-hop Transmission

Multi-hop transmission can be illustrated 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 node in the second slot. The outage capacity of this two hop transmission can be derived considering the outage of each hop transmission.

IV. Conclusion

Co- operative communication has derived an interest for wireless network. Co- operative communication typically refers to a system where users share and coordinate their resources to enhance the information transmission quality. It is a generalization of the relay communication, in which the multiple sources also serve as relays for each other. In Proposed system we use Cooperative diversity. It is a co- operative multiple antenna technique for improving or maximizing total network channel capacities for any given set of bandwidths which exploits user diversity by decoding the combined signal of the relayed signal and the direct signal in wireless multi hop networks.

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