TECHNISCHE UNIVERSITÄT DRESDEN

Department of Electrical Engineering and Information Technology – Communications Laboratory – Chair of Communications Theory

RESET – Achievable Rates, Efficient Transmit Strategies and Signal Processing for the Broadcast Multihop-Network

General Project Information

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Project Details

Summary

In the future mobile communication systems cooperative transmit and receive strategies in combination with intelligent multiple antenna systems will be used to reduce transmit power and increase reliability and spectral efficiency. Within this project we optimize a typical example of a broadcast multihop network in a cross-layer approach on the physical- and MAC-layer. Therefore we use, develop and combine utilities and methods from information theory and signal processing.

For the basic element of interference networks, the interference channel, we introduce new techniques to increase the spectral efficiency: The asymmetric signaling in combination with interference-alignment holds new premises for transmit strategy optimization and resource allocation. Extended constellations in space, time and frequency offer new dimensions for system optimization. To use the gain given by these new approaches, we combine them with powerful transmit optimization tools and optimize them for an exemplary network, namely the broadcast multihop network.

The project considers the following issues:

- Asymmetric signaling
- Channel enhancement
- Rate splitting
- Beamforming and Optimization: Convex and global Optimization
- Physical layer network coding (with beamforming)
- Relay multihop strategies
- Upper and lower bounds for achievable rates
- Influence of channel state information (CSI)

Goals

The goal of the project is to examine the broadcast mutlihop network as an important network model for future mobile communication systems with new methods and concepts from information theory and signal processing. For the first time these methods will be used for the broadcast multihop network but will also be newly developed. A global approach that looks both at the physical- and MAC-layer will make sure that the gain that is promised by the information theory through asymmetric signaling and channel enhancement will be realized by intelligent usage of signal processing and resource allocation. In this project we observe the fundamental limits of such networks and analyze the influence of the new concepts on the optimal transmit strategies. Figure 1 shows the observed scenario. It consists of seven nodes. The base station on the left side transmits data to two mobile receivers on the right side over a multihop-relay network.

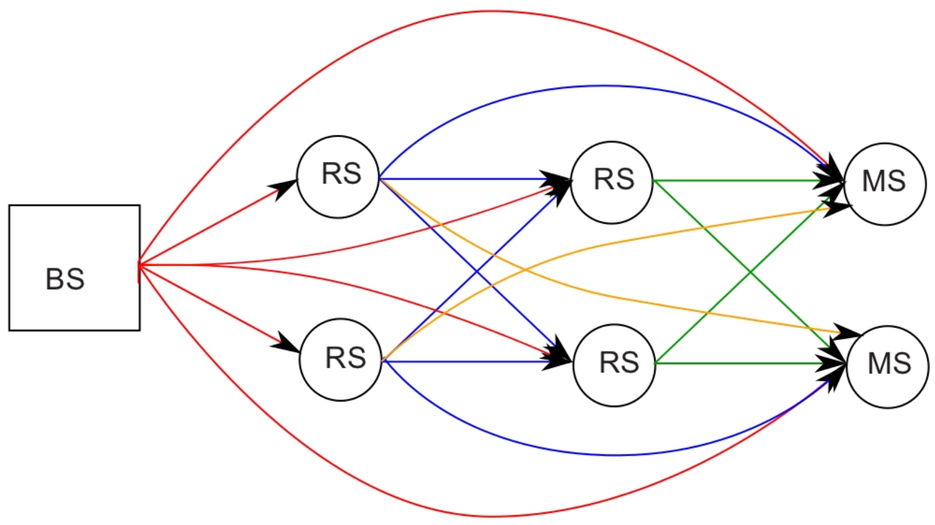

Figure 1: Broadcast multihop network

The broadcast multihop network in Figure 1 consists of all elements of network information theory (the interference channel, the relay channel, the broadcast channel and the multiple access channel). But it is not possible to divide it into these parts to work with the known capacity regions. Nevertheless to reduce the complexity we degrade the network to more basic parts and start with analyzing the inner interference channel (see also Figure 2).

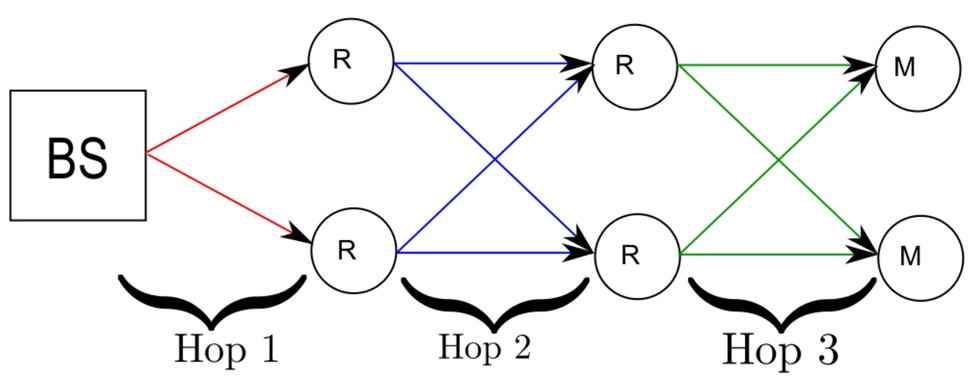

Figure 2: Degraded broadcast multihop network

The focus of the first part of the project is the multiple antenna interference channel and the application of asymmetric signaling as well as extended constellations. In the second part of the project we also take multihop issues into account. The focus lies here on the benchmark of the different relay strategies. The last part of the project observes the whole network. This is an interesting problems because of the direct links between the nodes additionally to the indirect links over the relays. That is why the method of dynamic decoding will be part of the work. The main focus also lies on the calculation of lower and upper bounds for the capacity region as well as existing channel state information (CSI) at the nodes.