Cooperative Communications

Link Reliability and Power Efficiency

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Academic Dissertation which, with due permission of the KTH Royal Institute of Technology, is submitted for public defence for the degree of Doctor of Technology on Thursday the 16th February 2012, at 1:00 p.m. in Sal/ Hall C1, KTH-Electrum, Isafjordsgatan 26, Kista.
Abstract

Demand for high data rates is increasing rapidly for the future wireless generations, due to the requirement of ubiquitous coverage for wireless broadband services. More base stations are needed to deliver these services, in order to cope with the increased capacity demand and inherent unreliable nature of wireless medium. However, this would directly correspond to high infrastructure cost and energy consumption in cellular networks. Nowadays, high power consumption in the network is becoming a matter of concern for the operators, both from environmental and economic point of view.

Cooperative communications, which is regarded as a virtual multi-input-multi-output (MIMO) channel, can be very efficient in combating fading multi-path channels and improve coverage with low complexity and cost. With its distributed structure, cooperative communications can also contribute to the energy efficiency of wireless systems and green radio communications of the future. Using network coding at the top of cooperative communication, utilizes the network resources more efficiently.

Here we look at the case of large scale use of low cost relays as a way of making the links reliable, that directly corresponds to reduction in transmission power at the nodes. A lot of research work has focused on highlighting the gains achieved by using network coding in cooperative transmissions. However, there are certain areas that are not fully explored yet. For instance, the kind of detectionscheme used at the receiver and its impact on the link performance has not been addressed. The thesis looks at the performance comparison of different detection schemes and also proposes how to group users at the relay to ensure mutual benefit for the cooperating users. Using constellation selection at the nodes, the augmented space formed at the receiver is exploited for making the links more reliable. Thenetwork and the channel coding schemes are represented as a single product code, that allows us to exploit the redundancy present in these schemes efficiently and powerful coding schemes can also be designed to improve the link performance.

Heterogeneous network deployments and adaptive power management has been used in order to reduce the overall energy consumption in acellular network. However, the distributed structure of nodes deployed in the network, is not exploited in this regard. Here we have highlighted the significance of cooperative relaying schemes in reducing the overall energy consumption in a cellular network. The role of different transmission and adaptive resource allocation strategies in downlink scenarios have been investigated in this regard. It has been observed that the adaptive relaying schemes can significantly reduce the total energy consumption as compared to the conventional relaying schemes. Moreover, network coding in these adaptive relaying schemes, helps in minimizing the energy consumption further.
balance between the number of base stations and the relays that minimizes the energy consumption, for each relaying scheme is also investigated.

**Key Words**
Cooperative Communications, Link Reliability, Power Efficiency, Energy Efficiency, Network Coding, Cooperative Relaying