Abstract of the thesis:

“Network-Coded Cooperation in Wireless Networks: Theoretical Analysis and Performance Evaluation”

In today's wireless networks, there is an increasing demand for high service quality, data rates, and network coverage. However, when addressing these demands, noise, interference, fading, power constraints, and bandwidth limitation are some of the fundamental challenges. *Spatial diversity* is one way to deal with the challenges and is achieved by sending and receiving a signal using multiple transmit and/or multiple receive antennas. The use of multiple transmit and receive antennas in spatial diversity results in a technique called Multiple-Input Multiple-Output (MIMO). In practice, however, one shortcoming of MIMO is that installing multiple antennas on wireless nodes may not be feasible because of limitations in power, cost, and/or size.

When nodes are limited in the number of antennas, distributed nodes in the network can be engaged to emulate MIMO. This technique of gaining spatial diversity is called *cooperative transmission*. Information-theoretic studies have shown the potential improvements in capacity as compared to traditional point-to-point wireless networks. In recent years, network-coded cooperation was proposed as one protocol to realize cooperation in wireless networks. Most of the previous work done in this area considers error-free inter-user channels; however, this is usually not the case in wireless networks.

This thesis investigates the performance of two types of network-coded cooperation protocols under a more practical scenario of erroneous wireless channels, transmissions using orthogonal channels, and energy constraints. Specifically, we provide the analytical tool to compute the error rate bounds of these two network-coded cooperation protocols, study their outage behaviour, and show that these protocols can achieve full diversity. We then investigate the coverage area by using network-coded cooperation and study the effect of network topology on outage performance. In large networks where a source has potential partners in its surrounding to choose from, metrics that provide insight on how to select a partner are required. One option would be to select a partner that minimizes the total energy spent in the network. With energy minimization in mind, we finally analyze the energy consumption of network-coded cooperation considering transmission, reception, and processing energy at all cooperating nodes.