ABSTRACT

The significant requirements of wireless networks are high spectral efficiency, link reliability and extended coverage. Multiple Input Multiple Output (MIMO) technology meets all these requirements as it combats fading and interference. As the size constraint of the mobile terminals imposes a restriction on the number of antenna to be placed on them, the concept of relays is introduced in wireless networks for extended coverage and link reliability. The principle of Wireless Relay Network (WRN) comprises of two phases namely phase I and phase II. In phase I, the source node transmits an information signal to relay node through a broadcast channel. The relay node receives the signal and applies Amplify and Forward (AF) relaying strategy which uses limited power and spectral resources to improve the coverage. In phase II, the processed signal is forwarded towards the destination node. This thesis mathematically portrays performance of WRN employing AF relaying strategy by considering the channel estimation as a significant issue and ergodic capacity and Bit Error Rate (BER) as prime performance metrics.

In AFWRN, Channel State Information (CSI) is estimated at the destination node. Many algorithms have been reported for channel estimation in AFWRN. But, most of the methods are based on Least Squares (LS) and
Minimum Mean Square Error (MMSE) which reduce the mean square error to a significant extent but does not result in minimal variance. Further, the complexity of MMSE estimator increases exponentially as the number of samples grow. In this thesis, a Best Linear Unbiased Estimator (BLUE) based channel estimation algorithm is proposed for AFWRN. Analytical expression for the MSE of the proposed algorithm and Cramer-Rao Lower Bound (CRLB) are derived. The simulation and theoretical results show better MSE performance than LS and MMSE estimators. Further, the proposed algorithm is also extended to AFWRN which employs multiple antennas at source, relay and destination nodes. It is proven by theoretical MSE derivation and simulation that the proposed algorithm shows better MSE performance than the traditional LS and MMSE estimators.

Ergodic capacity of AFWRN yields an information theoretic bound on the achievable rate for reliable communication over fading channels. Since the perfect CSI cannot be estimated in practice, ergodic capacity analysis with imperfect CSI gains utmost significance. A mathematical framework for analyzing the ergodic capacity performance of AFWRN, using the CSI estimated by the proposed channel estimation algorithm, is developed.

With perfect CSI, beamforming can be used to improve the spectral efficiency and link reliability. But, in practice, CSI at the transmitter is obtained through a feedback channel from the receiver. In this thesis, the
concept of proposed channel estimation algorithm is extended to relay assisted multiuser downlink transmission. The BER and ergodic capacity performance of AF relay assisted multiuser downlink transmission are also analyzed. The simulation results show that the proposed algorithm shows better performance than the conventional systems.