Abstract

The advancement in wireless communication networks and pervasive computing is perhaps among the most significant developments that have marked few past decades. We are transforming towards a society where efficient transmission of digital contents is paramount in especially due to advent of high speed-services, multimedia and low-power applications. Such development has made the demand for effective deployment of communication networks. Lately, research works in protocol development have enhanced the performance significantly. However, efficient transmission in wireless environment is still a challenging task. Theoretical techniques are applied for wireless networks prototyping, to solve this problem. One of the key challenges of such techniques in wireless environment is also achieve the same efficiency gain in practice.

This work takes the advantage of multi-user multiple-input multiple-output (MU-MIMO) technology which is being conceived as a potential candidate for next-generation wireless communication systems to meet such demand. Assuming that, we designed an adaptive transmission system that adapts transmit power and modulation to maximize the system capacity by exploiting the beamforming in time-varying imperfect channels. This system devises the closed-form expression in MU-MIMO to define the switching thresholds for various modulations. Then, based on the derived expression, it optimally allocates the transmit power, by taking the doppler frequency into account, and designs the linear pre-coding scheme for each mobile terminal (MT).

Being aware of the theoretical and simulative shortcomings, which lack the realism in results, in technology evaluation phase, in this thesis, we try to bridge the gap between simulation experiments and real-world testing. We use the network emulation technique to develop the wireless emulation framework to emulate next-generation protocols and algorithms of wireless networks. Finally, we show the feasibility of emulation framework by evaluating the adaptive system in realistic environment. Hence, several experimental results both in simulation and emulation, show the adaptive transmission system improves the overall system throughput which is close to analytical throughput, and demonstrate its validity and potential uses.

This work contributes in both ways, theoretically and practically, to the researches of next-generation wireless networks. As for theoretical implications, this work presets an adaptive transmission system for improving communication performance of each UT and overall system throughput. As for practical implications, we develop a framework to evaluate the protocols and algorithms of next-generation wireless networks in realistic environment. This framework also exhibits a different way to carry out large-scale experiments with next-generation wireless networks which can not be easily accomplished with real wireless testbeds.

Keywords: Adaptive transmission system, time-varying channel, MU-MIMO, realistic environment, NS-3, QOMET