TITLE / ABSTRACT

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Smart Interference Management and Optimization for 5G HetNets

Abstract:

The foreseen increase in mobile traffic over the next coming years will lead to evermore stringent design requirements in mobile networks. The research community at large is now orientating fundamental research towards 5th Generation (5G) mobile networks in a bid to provide new networking platforms that can deliver 10-100x peak data rate, 1000x network capacity, 10x energy efficiency, and 10-30x lower latency paving the way towards gigabit wireless. These ambitious requirements of 5G mobile networks can be realized by combining gains from emerging technologies like, massive multiple input multiple output (MIMO), hyper densification of small cells, millimeter wave (mmWave) spectrum in access network, visible light communication (VLC), local caching and green communication. In this thesis we focus on dense heterogeneous networks (HetNets) being a promising solution to the ever increasing wireless capacity demand and efficient spectrum utilization. However, severe interference scenarios exist in HetNets which hinder the overall network performance. It is necessary to find optimal resource allocation strategies which can maximize capacity by mitigating interference to reap the benefits of HetNets. We formulate the problem of capacity maximization subject to interference and minimum data rate requirement constraints, in D2D assisted HetNets supported by relays. The optimization problem belongs to a class of mixed integer nonlinear programming (MINLP) problems, which are generally NP-hard. Though small cells in HetNets have a relatively lower power consumption, dense deployments may result in high aggregate energy consumption. This motivated us to modify our problem formulation with respect to energy efficiency. We formulated energy efficiency maximization in HetNets as a fractional programming problem, where objective is to maximize network throughput for unit network power consumption subject to minimum data rate requirement. We use Charnes-Cooper transformation to convert proposed fractional programming problem into concave optimization problem. We propose the outer approximation algorithm (OAA) to solve the converted concave optimization problem. Proposed algorithm is evaluated by extensive simulation work. The performance of ε-optimal solution obtained by OAA method is shown for different system parameters such as number of users, required data rate and capacity of network.

We have also investigated the role of LTE-Unlicensed (LTE-U) in HetNets. LTE-U is an emerging technology which aggregates licensed and unlicensed bands, which means larger bandwidth and hence higher data rates for end users. To reap the benefits of LTE-U technology, ceratin challenges need to be addressed. The biggest challenge is continuous interference from LTE-U to Wifi, resulting in starved Wifi users. We formulated an optimization problem to maximize network throughput subject to quality of service (QoS) and interference constraints in LTE-U HetNets where joint resource allocation on license and unlicensed bands is considered. We propose the mesh adaptive direct search (MADS) as a solution to MINLP problem.