Title:

Energy Efficiency with Quality of Service Constraints in Heterogenous Networks

Abstract:

The Fifth Generation (5G) cellular network is a new technology  that is driven by the demand of high data usage, large number of wireless devices and better Quality of Service (QoS). An important challenge  for 5G is the energy consumption which is causing the wireless communication networks to be one of the main contributors of the global worming. Thus, energy efficiency becomes  an important aspect in designing the wireless communication networks.

In this thesis, we study different approaches for Energy Efficient (EE) operation of Small Base Stations (SBSs) in Heterogenous wireless Networks (HetNets). First, we focus on enhancing  energy efficiency in heterogenous networks, where Macro BSs (MBSs) and SBSs  co-exist, by presenting a sleeping strategy. In the sleeping strategy SBSs serving few or no users are turned off and their users and resources are offloaded to neighboring SBSs. However, adapting the sleeping strategy will affect the lifetime of the electronics of the SBSs, due to the frequent change of power level between turning ON and OFF the SBS. Therefore, in order to maximize  energy savings, we formulate an optimization problem that provides an optimal user association and SBSs sleeping strategy for the entire network, while minimizing the total numbers of the switching of SBSs ON and OFF.

Furthermore, an other approach consider is the deactivated SBSs are equipped with two power sources, a harvested energy (HE) source and a grid power source, where first the SBS will use its available HE to serve the associated users. Then, the SBS will request any shortage of its energy from other active or deactivated SBSs which have surplus of HE. Finally, if there is still shortage in energy, the SBS will use the power drawn from the grid.  However, since the formulated problem is a Mixed Integer NonLinear Problem (MINLP), Generalized Bender Decomposition (GBD) is proposed to decompose the  problem into two subproblems. Moreover, a new heuristic approach is proposed to provide a computational efficient algorithm to solve and optimize the user association and energy harvesting of the system model.

A new UEs’ prediction method is introduced to provide a future information for the model and to apply an accurate designing parameters.  This method is based on a combined approach of Non-linear Autoregressive with External input(NARX) and probabilistic Latent semantic Analysis (pLSA) to provide accurate prediction for multiple steps.

Therefore, we consider integrating the powerful Machine Learning (ML) techniques to provide solution of the system model with less computation demands. Thus, we introduced an efficient less complex approach that is based on synthetically generating data from the optimization problem and employing it to train and configure an Artificial Neural Network.
An extensive simulation results are presented to show the effectiveness of our approaches in comparison to the optimal results.