4G and Beyond - Exploiting Heterogeneity in Mobile Networks

Current and future mobile networks will constitute of multiple coexisting Radio Access Technologies (RATs), cells of different size (macro-, metro-, pico-, femtocells) forming a Heterogeneous Network (HetNet), and Base Stations (BSs) of various architectures. This thesis addresses different aspects of mobile networks and focuses on the main challenges resulting from their heterogeneity.

To effectively manage this diversity, a novel hierarchical approach considering all types of resources, spectral, optical and computational is proposed. The generic framework covers all kinds of network heterogeneity and can be beneficial at any stage of network deployment or operation. Furthermore, a dedicated study of RAT selection and resource allocation is performed and a new optimisation model is introduced and evaluated. The results show a significant reduction of number of handovers at the cost of a slight throughput degradation, which leads to a more stable connectivity in multi-RAT environments.

A new HetNet architecture with control and user plane separation is thoroughly evaluated. The study focuses on the soft-pilot requirements and assignment problem, which is solved using a proposed optimisation model and a number of heuristic approaches. The analysis for a number of deployment scenarios demonstrates the feasibility of this architecture. Furthermore, the obtained results show the potential benefits of the new architecture in terms of mobility management and energy efficiency.

Network sharing has become a common strategy among network operators and it is important to evaluate the benefits of such cooperation. A teletrac theory analysis for various network dimensioning approaches is provided and based on the results clear recommendations are given.

All the presented concepts are standard agnostic, meaning that they can be applied to any RAT, including technologies that have the potential to become part of the next generation mobile networking. This makes the proposed solutions universal and in line with the current trends to design future mobile networks.