**Ph.D. in Information Technology**
**Thesis Defense**

**June 1st, 2022**
**at 15:00**
**Room Seminari**

**Ligia Maria MOREIRA ZORELLO** – XXXIV Cycle

## Optimization Techniques for Virtual Baseband Function Placement for 5G Radio Access in Metro-Area Networks

Supervisor: Prof. **Guido Maier**

**Abstract:**

Mobile operators face the challenge of deploying a flexible network to handle different emerging applications. A new Radio Access Network (RAN) for 5G was proposed to provide more dynamic, low-cost, and energy-efficient network management, resource allocation, and service provisioning compared to 4G. One of its main features is the deployment of functional splits, which divide the RAN baseband functions into different radio-network units. Nevertheless, this architecture brings new challenges to network operators. The optimal placement of these units is non-trivial: it depends on the application requirements, on the expected traffic volume, and on the costs derived by the placement. This PhD dissertation optimizes the resource allocation in mobile networks to minimize cost and guarantee compliance with the quality of service required by users. We propose several optimization techniques to enable static and dynamic resource allocation. We developed mathematical programming and heuristic algorithms to solve the baseband virtual network function problem in metro-area networks. We minimize the overall system power consumption, including network and node components subject to all split-related constraints. In addition, it is important to plan the baseband placement in advance. Machine learning algorithms are typically deployed to accurately forecast traffic and, hence, improve the applicability of optimization frameworks in real-time scenarios. However, unpredictable events may create perturbations in these patterns. Therefore, the traditional techniques used to predict the traffic and then optimize the placement fail to provide solutions that ensures feasibility in real-time. Instead, we propose machine-learning and black-box-based techniques tailored to the resource allocation. These techniques apply intelligent mechanisms to overestimate the demands to ensure the feasibility of the placement in real time.

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