Slice-Aware Radio Resource Management in 5G Networks

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Prof. Dr.-Ing. Dr. h.c. G. Fettweis
Vodafone Chair
01062 Dresden, Germany
Tel.: +49 351 463 41000
Fax: +49 351 463 41099
www.vodafone-chair.com

Vodafone Chair contact:
MSc. Behnam Khodapanah

Project Partners:

NOKIA

TECHNISCHE UNIVERSITÄT DRESDEN

Motivation:

It is anticipated that the fifth generation of mobile networks (5G) should simultaneously serve multiple heterogeneous service classes. The diversity of the requirements of such service classes, make their coexistence in a single network challenging. eMBB, mMTC and URLLC are major use-cases that have various requirements on throughput, delay, reliability, etc. On the other hand, the benefits of sharing a single network infrastructure by several slices will bring about massive savings. The concept of network slicing, where several end-to-end (E2E) logical networks, i.e. slices, share the resources of a single physical network, has drawn the attention of both industry and academia. Although slicing the Core Network (CN) has been studied extensively, it is unclear how the Radio Access Network (RAN) and Radio Resource Management (RRM) should be sliced. In this project, we investigate the potential design choices for RAN slicing and propose new functionalities that can facilitate the enforcement of network slicing's objectives.

Objective:

The objectives of network slicing in context of RRM is enforcement of Service Level Agreements (SLAs) while dynamically sharing the radio resources. Besides, there should exist a mechanism that enables the slice-protection, i.e., the slices should be immune to congestion, failure, etc. of another slice.

Approach:

We propose a network entity, called "Mapping Layer", that monitors the target Key Performance Indicators (KPIs) and compare them with the targets defined in the SLAs. Moreover, this entity monitors the traffic demand that slices introduce to the network and identify the slices that overload. By outputting the proper control parameters to the RRM mechanisms, such as Admission Control (AC) and Packet Scheduler (PS), the slices that introduce nominal load will have their SLAs fulfilled. On the other hand, this entity will isolates the slice that overloads, so that the negative effects are reflected only in the overloading slice's performance. To determine what are the optimal control parameters, an optimization framework is proposed that minimizes the slices' deviation from SLA targets and punishes the overloading slices.

Vodafone Chair Contribution:

- Identify the main RRM functionalities that enable network slicing.
- Determine the inter-slice and intra-slice interactions.
- Devise the optimization framework for SLA enforcement of Mapping Layer.
- Develop system-level simulations for identifying the crucial components.