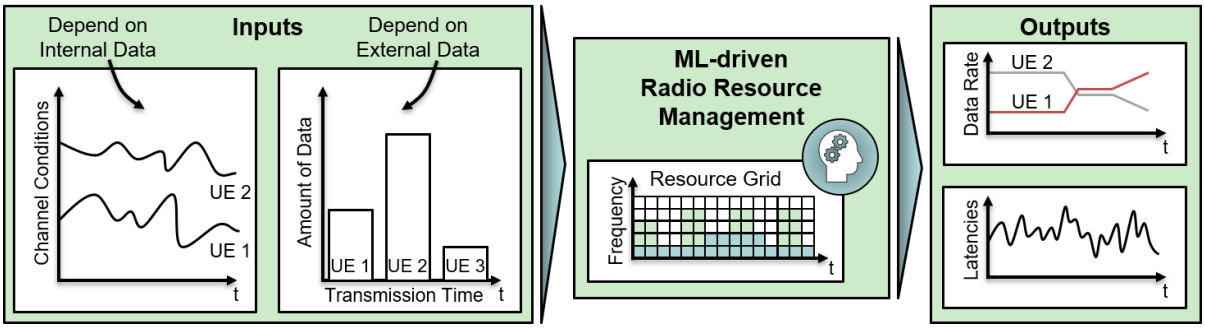
technische universität dortmund

Fakultät für Elektro- und Informationstechnik
Lehrstuhl für Kommunikationsnetze
Prof. Dr.-Ing. C. Wietfeld

Bachelor Thesis

Performance Evaluation of Data-Driven Resource Management Considering Channel Conditions

The feed-in behavior of renewable energy sources such as solar and wind energy is characterized by high volatility and strong weather-related fluctuations. In order to still meet the high demands on reliability and grid stability in future intelligent energy grids, so-called "smart grids", a large number of monitoring and control units are required down to the customer level. These in turn require high-performance communication networks that can transmit the resulting data in a timely manner via shared, possibly public 5G infrastructures. This can be addressed with the help of network slicing [1]. However, to provide reliable, efficient resources to each inhabitant of a network slice, sophisticated radio resource management is needed [2].



Channel quality and traffic prediction are increasingly important for enabling precise allocation of resources on the Radio Access Network and therefore mitigating delays in the transmission for so-called URLLC traffic. Within the scope of this work, channel quality analysis is to be performed to provide input for scheduling algorithms. For this, channel data needs to be aggregated and analyzed utilizing data-driven concepts. These concepts are then to be validated and evaluated, building on previous works [3], to provide channel quality consideration within a virtualized 5G radio environment. Learning approaches aim to provide resources according to environments [4] necessitating data-driven approaches. While most works concentrate on predicting traffic peaks [5] on larger time scales as, for example, in vehicular scenarios, this work aims to provide anticipated channel quality on millisecond timescales.

dennis.overbeck@tu-dortmund.de | www.cni.tu-dortmund.de

Proposed working points:

- Familiarization with 5G standard and development of knowledge scheduling and machine learning
- Data aggregation and extraction for data-driven Network Slicing use cases
- Design and setup of (virtual) experimental setup
- Implementation and training of suitable prediction models
- Validation, evaluation and optimization of the developed solution

Requirements:

- Required: General understanding of communication networks and protocols
- Desirable: Programming skills in C/C++
- Desirable: Knowledge in data visualization (e.g. with Python)
- Optional: Git and Linux knowledge
- Optional: Experience in handling ML-Tools

References:

[1] X. Foukas, G. Patounas, A. Elmokashfi and M. K. Marina, "Network Slicing in 5G: Survey and Challenges," in IEEE Communications Magazine, vol. 55, no. 5, pp. 94-100, May 2017.

[2] M. Elsayed and M. Erol-Kantarci, "AI-Enabled Future Wireless Networks: Challenges, Opportunities, and Open Issues," in IEEE Vehicular Technology Magazine, vol. 14, no. 3, pp. 70-77, Sept. 2019

[3] D. Overbeck, N. A. Wagner, F. Kurtz, C. Wietfeld, "Proactive Resource Management for Predictive 5G Uplink Slicing“, In IEEE Global Communications Conference (GLOBECOM): Cognitive Radio and AI-Enabled Network Symposium, Rio de Janeiro, Brazil, December 2022. (accepted for presentation)

[4] M. Zambianco, A. Lieto, I. Malanchini and G. Verticale, "A Learning Approach for Production-Aware 5G Slicing in Private Industrial Networks," ICC 2022 - IEEE International Conference on Communications, 2022, pp. 1542-1548, doi: 10.1109/ICC45855.2022.9838527.

[5] M. Yan, G. Feng, J. Zhou, Y. Sun and Y. -C. Liang, "Intelligent Resource Scheduling for 5G Radio Access Network Slicing," in IEEE Transactions on Vehicular Technology, vol. 68, no. 8, pp. 7691-7703, Aug. 2019