

# 5G Core and RAN Network Slicing for QoE-Aware Resource Allocation

## Motivation

In prior work [1], we investigated the feasibility of using 5G Quality of Service mechanisms together with network slicing to provide and optimize Quality of Experience (QoE) guarantees. A simplified one-link client-server topology was used for simulations, focusing on a simplified version of the Core Network (CN). The Radio Access Network (RAN) and control plane were left out of the scope. Simulations were performed in OMNeT++/INET framework, where a custom-built module for Hierarchical Token Bucket [2] was used for network slice emulation.

To demonstrate the functionality of a fully sliced 5G system, the Simu5G framework [3] could be used. However, it does not natively support network slicing. Therefore, a recent master's thesis integrated a simple version of network slicing in the RAN into Simu5G. The implementation is based on resource block distribution for packet scheduling, similar to the concept introduced in [4].

Your goal would be to combine the RAN Network Slicing integration with the approach presented in [1], to realize slicing in both CN and RAN, emulating the "true" (although simulated) end-to-end network slicing. Furthermore, it is interesting to verify if the results of the scenarios evaluated in [1] are still valid with the end-to-end slicing approach. Thereby, the thesis should also analyze the effects of end-to-end slicing on QoE guarantees and system utilization. Furthermore, the impact of dynamic resource allocation, as introduced, e.g., in [5] could be investigated.

## Your Tasks

- Verify the correctness of available Resource-Block-based RAN Slicing integration
- Investigate options for 5G RAN slicing and its combination with CN slicing
- Implement a solution for end-to-end network slicing
- Validate the solution, e.g., with findings from our previous work [1]
- Possibly extend the solution with dynamic resource allocation, e.g., as in [5]

## Requirements

- General knowledge of computer networking; 5G knowledge is a plus
- Good understanding of C and C++
- OMNeT++ knowledge is a plus

## References

- [1] Bosk, Marcin, Marija Gajić, Susanna Schwarzmann, Stanislav Lange, Riccardo Trivisonno, Clarissa Marquezan, and Thomas Zinner. "Using 5G QoS mechanisms to achieve QoE-aware resource allocation." In 2021 17th International Conference on Network and Service Management (CNSM), pp. 283-291. IEEE, 2021.
- [2] Bosk, Marcin, Marija Gajić, Susanna Schwarzmann, Stanislav Lange, and Thomas Zinner. "Htbqueue: A hierarchical token bucket implementation for the omnet++/inet framework." arXiv preprint arXiv:2109.12879 (2021).
- [3] Nardini, Giovanni, Dario Sabella, Giovanni Stea, Purvi Thakkar, and Antonio Virdis. "Simu5g—an omnet++ library for end-to-end performance evaluation of 5g networks." IEEE Access 8 (2020): 181176-181191.
- [4] Sallent, Oriol, Jordi Perez-Romero, Ramon Ferrus, and Ramon Agustí. "On radio access network slicing from a radio resource management perspective." IEEE Wireless Communications 24, no. 5 (2017): 166-174.
- [5] Ramberg, Andreas Karl Emil. "Dynamic Resource Allocation and QoE-aware Packet Scheduling using HTB in OMNeT++." Master's thesis, NTNU, 2024.



## Contact

Marcin Bosk, Marija Gajić  
Email: bosk@in.tum.de