

Bachelor Thesis

Design and Deployment of a Minimal 5G Standalone Testbed

Motivation

Our work group is working on the deployment of a 5G testbed for research on the next generation(s) of mobile communication as well as Vehicle-to-Infrastructure (V2I) and Internet of Things (IoT) applications as part of Wireless Wide Area Networks (WWANs). Commercial solutions for deploying 5G networks are expensive in terms of hardware and licensing cost and are often too closed for proper academic work. It would be helpful to have an open source solution that works with inexpensive hardware to get started with the underlying protocols as well as hardware and software components. Plenty of open source software stacks exist for building standalone 5G mobile networks, with varying degrees of progress and features.

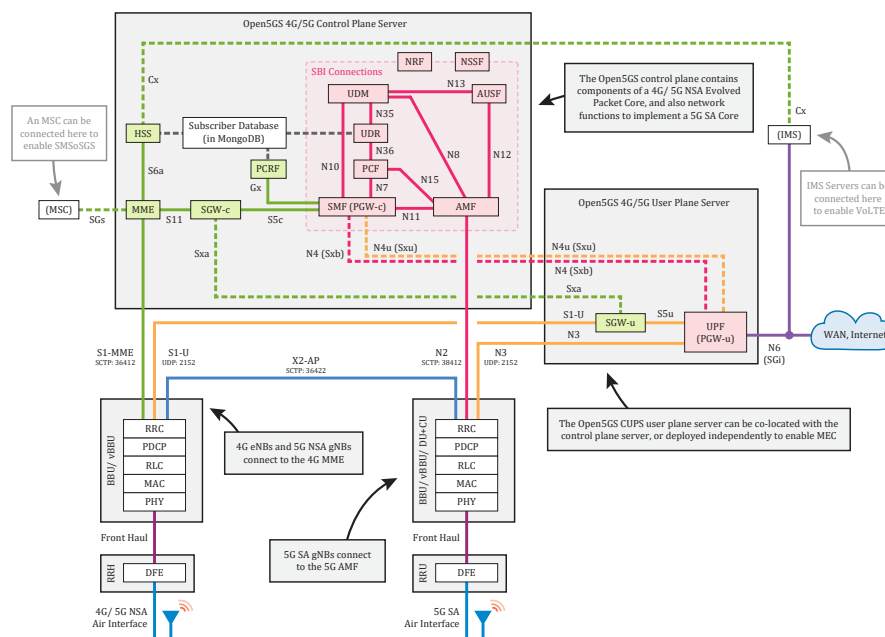


Figure 1. Components of a Network Setup with Open5GS¹.

One of the more complete ones is the Open5GS project which implements the Core Network (CN) for 4G LTE and 5G mobile networks (management software) [1], which can be used in conjunction with e.g. srsRAN, an implementation of the Radio Access Network (RAN), the software interfacing with real or emulating virtual hardware [2].

Project type Bachelor Thesis
Duration Software Project
Language(s) English, German
Field Computer Science



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Goal

The goal of this thesis is to design, implement and evaluate a testbed for a single 5G Standalone (SA) network, including all of its necessary hardware (antennas, amplifiers et cetera) or its emulation, and software. In order to characterize the network's capabilities, throughputs and latencies shall be evaluated.

Tasks

- get (and give) an overview about the system's hardware and software components
- set up software (e.g. Open5GS & srsRAN) and hardware (possibly emulation) for a single 5G SA mobile network
 - at least one gNodeB (base station in 5G) and one exemplary User Equipment (UE) (end-user devices e.g. smartphone, microcontroller with 5G radio, your choice)
 - develop a simple, guided setup process
- evaluate the network's performance
 - measure throughput and latencies
 - use case is your choice (e.g. V2I, IoT et cetera)
 - compare with existing setups like in [3]
- give guidance regarding expansion to multi-UE setups

References

- [1] *Open5GS*, Jul. 2025. [Online]. Available: <https://open5gs.org/>.
- [2] *srsRAN*, Jul. 2025. [Online]. Available: <https://www.srslte.com/>.
- [3] L. Mamushiane, A. A. Lysko, T. Makhosa, *et al.*, "Towards stress testing open5gs core (upf node) on a 5g standalone testbed," in *2023 IEEE AFRICON*, 2023, pp. 1–6. DOI: 10.1109/AFRICON55910.2023.10293284.

¹Source: <https://open5gs.org/open5gs/docs/guide/01-quickstart/>

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