Prof. (Jun.-Prof.) Dr. Florian Klingler
IoT Engineering
Website: www.tu-ilmenau.de/iot

HAUPTSEMINAR

Backhauling for 5G Mobile Base Stations

Motivation and Background

The demand for wireless mobile networks continues to grow worldwide, as the amount of data transferred wirelessly increases from year to year. However, with increasing demand regarding data rates and nodes participating in the network, more infrastructure is required to meet performance requirements. This is conventionally achieved by installing additional base stations. While this offsets the capacity problems, it causes high capital expenditure (CAPEX). Furthermore, the capacity demand of the network varies throughout the day, leading to overprovisioning during most of the day [2].

A possible solution to approach this issue is the usage of mobile base stations, which could be mounted on vehicles such as cars or busses. The advantage of combining communication infrastructure with vehicles is that usually the vehicles will be where many network participants are present, providing network densification dynamically. However, this approach introduces various new challenges, such as backhauling: Data sent to a mobile base station has to be transmitted to the core network. There is rich literature describing backhauling and its challenges, e.g. [3], [1], [4].

Seminar Project Goals

The main goal of this seminar is to create a literature overview of the different concepts, challenges and opportunities of backhauling in 5G networks. Furthermore, a hands-on practical task has to be completed. There are two options offered for the practical task:

First, a simulation study can be conducted. This includes conducting simulations in OMNeT++, Simu5G and INET to analyze and study backhauling techniques from the literature.

The second option is to create a prototype of a mobile base station in order to conduct real-world measurements in our 5G Campus Network. For this, an actual 5G base station has to be wirelessly connected to the core network using WiFi. An interesting project to familiarize oneself with in this regard is the OpenMPTCP Router[1].

Required knowledge (or willing to learn)

- For Simulation Study:
  - C++ programming experience
  - Usage of a statistics evaluation language (e.g., R, Python)
- For 5G Hardware Experiments:
  - Programming experience in a suitable programming language (e.g., Bash/ Python)
  - Linux/ openWRT experience
- A basic understanding of wireless communication principles and technologies
- Scientific literature review, and writing

References

[1] M. M. Ahamed and S. Faruque. 5g backhaul: requirements, challenges, and emerging technologies. *Broadband Communications Networks: Recent Advances and Lessons from Practice*, 43:2018, 2018.

[2] F. Dressler, F. Klingler, and G. A. Rizzo. Dynamic Mobile Base Stations in 5G Networks – The Moving Network Paradigm. In M. Ajmone Marsan, N. Blefari Melazzi, S. Buzzi, and S. Palazzo, editors, *The 5G Italy Book 2019: a Multiperspective View of 5G*, pages 477–492. Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), 2019.

[3] X. Ge, H. Cheng, M. Guizani, and T. Han. 5g wireless backhaul networks: challenges and research advances. *IEEE network*, 28(6):6–11, 2014.

[4] B. Tezergil and E. Onur. Wireless backhaul in 5g and beyond: Issues, challenges and opportunities. *IEEE Communications Surveys & Tutorials*, 2022.

---

[1]https://www.openmptcprouter.com/