Bachelor Thesis

Power Consumption Optimization of Novel 5G New Radio User Devices

Motivation and Problem Statement

Energy efficiency and environmental impact are increasingly important in a world of exponentially increasing data transmitted via mobile networks [1]. This is especially true for the new mobile communication technology, 5G New Radio.

One method of reducing the power consumption on the UE side is to postpone transmissions until a satisfactory channel condition is present. In the case of 4G networks, the impact of communication at bad radio channel conditions on the battery life of smartphones has been analyzed by [2]. A power consumption model based on the radio channel (CoPoMo) has been developed. One result is the sharp increase in the power consumption with the uplink transmission power after a certain point, which significantly impacts mobile devices' battery life. By combining this knowledge with probabilistic data transmissions wherever possible, the battery life of 4G user equipment could be significantly prolonged [3].

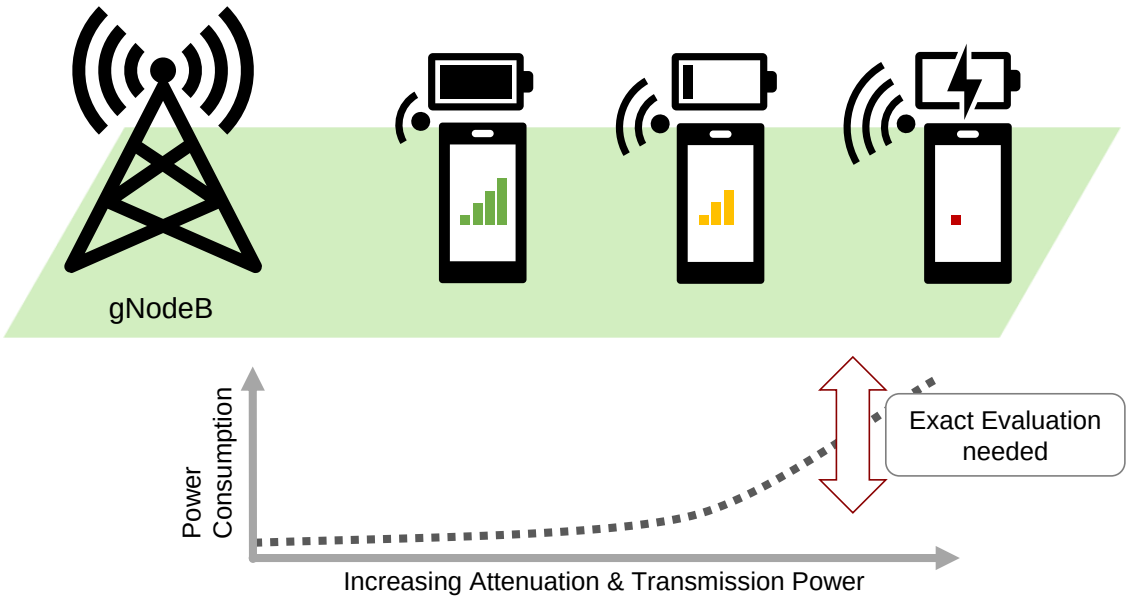

Figure 1: Power Consumption of mobile devices depending on the distance to the serving mobile cell

However, it is unclear if these findings can be easily transferred to 5G. This thesis thus aims to analyze the context of channel quality, transmission power, data rate, and other parameters to the resulting power consumption of end devices. The results will be evaluated in a second step to assess what can be done to reduce battery consumption. After that, the highlighted relations can be analyzed to estimate how much energy can be saved in everyday scenarios by acting accordingly.

A professional 4G, 5G Non-Standalone and 5G standalone base station emulator and a power analyzer can be used in a laboratory environment to accomplish these tasks. The student can build upon an existing automation script for the base station emulator and power analyzer, which needs to be extended.

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Potential Work Steps of the Bachelor Thesis:

- Surveying related work on reducing energy consumption for 5G and current 4G networks to generate scenarios and appropriate measurement setups for 5G power consumption measurements.
- Familiarization with and configuration of the base station emulator and the power analyzer
- Measuring UE power consumption with the help of a professional 5G base station emulator and a dedicated power meter.
- Transfer the results to methods and algorithms to save energy on the UE side and estimate the possible energy consumption reduction.

Requirements

- Interest in mobile communication and 5G technology
- Participation in CNI lectures (Grade: excellent/good) is highly desirable
- Excellent English skills are highly desirable; Willingness to write the thesis in English is a plus
- Advanced Python and basic LaTeX/TikZ skills

References

[1] Ericsson, “Ericsson Mobility Report June 2022,” Stockholm, Sweden, Jun. 2022. [Online]. Available: https://www.ericsson.com/49d3a0/assets/local/reports-papers/mobility-report/documents/2022/ericsson-mobility-report-june-2022.pdf

[2] B. Dusza, C. Ide, L. Cheng, and C. Wietfeld, “CoPoMo: a context-aware power consumption model for LTE user equipment,” Trans. Emerging Tel. Tech., vol. 24, no. 6, pp. 615–632, Oct. 2013, doi: 10.1002/ett.2702.

[3] B. Sliwa, R. Falkenberg, T. Liebig, N. Piatkowski, and C. Wietfeld, “Boosting Vehicle-to-Cloud Communication by Machine Learning-Enabled Context Prediction,” IEEE Transactions on Intelligent Transportation Systems, vol. 21, no. 8, pp. 3497–3512, 2020, doi: 10.1109/TITS.2019.2930109.