Investigations of 5G and 6G public mobile communication networks for sustainability

Master's thesis

Background of the thesis

Modern wireless communication systems consume large amounts of energy and materials, which have an increasing impact on the global energy and material balances. Several networks are under operation in each country, both organized by private as well as public networks, which supply both communication and data services. With the upcoming 5G and 5G Advanced standards new features are becoming available in the network under establishment. Safety-relevant systems as well as emergency services of public networks are mandatory. Their availability of the networks triggers large contributions to their energy consumption. Sustainability measures need to be established also for public networks with very-high standards with respect to availability and security. Further, upcoming 6G networks trigger even harsher functions, e.g. much higher transmission losses in the higher mm-wave bands.

Thus the main objective of this thesis is to investigate possibilities of consumption mitigation and to isolate the effect of modern 5G and possible 6G techniques on the sustainability measures. This includes creating data sets in ongoing research projects. Control is a major source for potential improvement measurements, while the parallel availability of the network for safety and security services is critical to the users.

Intended tasks

1. Understanding the main consumers in a given network topology based on the services available.
2. Understanding and quantification of change measures imposed by 5G and 6G.
3. Understanding the boundaries of and the impact of changes by performing a survey in an ongoing BMBF project.
4. Understanding of hardware- and software-related change possible for consideration.
5. Evaluate material and energy consumptions of network deployment especially for 6G.
6. Establish key sustainability indicators for the networks.
7. Detailed selection of measures of improvement for sustainability.
8. Design and simulate two scenarios using the design environment and compare to a baseline 5G model.
9. Detailed performance comparison of the proposed measures with their impact.
10. Writing the thesis.

A baseline model for 5G is available at the start of the thesis.

Contact and supervision

INATECH: Prof. Dr. Rüdiger Quay, ruediger.quay@inatech.uni-freiburg.de (1st supervisor)

Duration

According to exam regulations, (6 months)

Application documents

Please send your relevant application documents in a PDF-file (cover letter, resume and transcript of records (Bachelor grades) in an e-mail to:
ruediger.quay@inatech.uni-freiburg.de .