Wireless Network and Computer/Communications Lab
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BACHELOR'S THESIS/ MASTER'S THESIS

Development of 5G Network Impairment and Testing Framework

Background

In recent times, 5G communication is utilized more and more. 5G campus networks are set up by institutions and companies to be used for mostly academical and educational, but also for productive applications. The range of possible applications is very broad, as 5G communication is used to substitute other wireless communication techniques that have certain shortcomings, such as Wireless LAN or older cellular standards such as LTE. 5G communication especially enables mobile applications, for example the streaming of high-resolution video material in factories for maintenance purposes. However, mobility might lead to issues such as bad coverage in certain locations. Simply deploying a mobile agent without thorough testing might lead to problematic behaviour that possibly even has safety implications. Therefore, the operation in various possible locations needs to be tested.

Testing applications in a campus network might require serious efforts, as various constellations and parameters influence the performance. In an already running productive network, testing might not even be possible without interrupting other processes. A method to allow for off-site testing outside of the actual network would decrease the cost of testing substantially and would allow for increased versatility.

Thesis Goals

The goal of this thesis is to develop and evaluate a toolbox that can be used for testing 5G applications. For every location in a certain area, performance characteristics such as latency and packet delivery ratio can be measured, calculated or retrieved via simulation. Using this data, the toolbox can emulate channel characteristics for arbitrary positions. Netem[1] is supposed to be used to change the channel characteristics.

Idea: Create a toolbox that:

- can be run on a machine with two LAN ports: One input (connects to UE), one output (connects to LAN)
- takes data from a simulation (position of UE, latency, packet loss ratio, ...)
- calculates and track statistics of the communication performance (standard derivation, jitter, delay, packet delivery ratio, ...)
- when operating: Uses netem to manipulate the performance in the emulated network in relation to the theoretical position of the UE. Example: UE at (x,y) position (0,0) had a latency of 40ms and a packet delivery ratio of .95 in a simulation. When entered (0,0) as the UE's position in the toolbox, the network connection via the toolbox (from UE to LAN) will also have a latency of 40ms and a packet delivery ratio of .95.

Milestones

- Create a simulation with simu5G in which you can collect communication performance metrics based on the position of a UE
- translate this data into a map for the toolbox
- create a toolbox that takes the mapped data for a certain position and emulates the channel characteristics

Required knowledge (or willing to learn)

- Good programming skills (C and C++, Python)
- Experience using OMNeT++ and simu5G

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[1] https://wiki.linuxfoundation.org/networking/netem