LTE Throughput Measurement and Prediction

RESEARCH TOPIC

In order to ensure a reliable connection between AP1-Box and the Safety Server the overall Quality of Service and especially the maximal data throughput of the LTE mobile network were investigated.

DATA ACQUISITION

- A measurement tool called TCPAnalyzer was developed, which continuously measures connection details passively.
- Therefore, the TCPAnalyzer monitors control messages of the TCP protocol for establishing (SYN, SYN-ACK, ACK) and closing a connection (FIN, ACK). Based on these values, round trip times (RTT) and data throughput are calculated.
- Additionally, physical properties of the connection, e.g. RSSI and SINR, are retrieved from the modem.

PREDICTION ARCHITECTURE

ONLINE TCP THROUGHPUT PREDICTION ARCHITECTURE

ACQUISITION

TCPAnalyzer

PREPROCESSING

Filter

NL Preparation

PROCESSING / PREDICTION

SIM Model

Connectivity Map

POSTPROCESSING / EVALUATION

Statistics

API

VISUALIZATION

Webfrontend

Based on the aforementioned measurements different estimators either using geo-based aggregation methods (connectivity maps) or machine learning algorithms (support vector regression, random forests) are created in order to predict the upcoming data throughput.

- The general idea is to use geo-based estimators while historical data is available and to use machine learning algorithms for unknown areas.
- These trained models are inserted into a data processing pipeline based on a microservice architecture which is designed for online prediction and evaluation of the data throughput.
- Each microservice implements a specific loose part in the processing pipeline to increase cohesion of the components.
- All microservices are containerized using Docker to simplify deployment. This composition is running on the AP1-Box.
- Microservices are connected using WebSockets provided by the Tornado framework (Python).

ONLINE VISUALIZATION AND EVALUATION

Web frontend for online visualization of measurements and prediction model accuracy

EVALUATION OF PREDICTION ACCURACY

Mean Errors

actual

evaluated

Accuracy:

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