Motivation: Mobile applications come with distinct quality of service requirements. For example, a 4k video needs a guaranteed data rate for smooth display. User equipments (UE) need a quick, accurate, and data-saving way to characterize the network. This benchmarking can be performed actively through the injection of additional network traffic or passively through eavesdropping. Such a characterization of the network is particularly interesting for the upcoming 5G standard.

Research question: This work aims to find a quick and data-saving methodology to benchmark reactive mobile communication networks on UEs. Reactive states that the network changes its properties on injected traffic. The following subquestions arise:

Q1: Which method is most suitable to characterize reactive mobile communication networks on a UE?
Q2: Are the results produced by the developed solution accurate?
Q3: Where and how can this solution work in 5G networks?

State of the Art

Available bandwidth (ABW) is ideal to benchmark the network path [1].

Techniques for wired networks or WiFi are inaccurate in reactive mobile networks because the traffic arrives in bursts.

Traditional bandwidth measurement apps take around 10 sec. and need up to 100 MB.

Techniques to estimate the ABW may take less than a second and use a few kB of data.

The most suitable technique to estimate the ABW is CRUSP [2].

CRUSP

In Constant Rate Ultra Short Probing (CRUSP), a sender transmits a series of UDP datagrams at a constant rate to a receiver, where they are timestamped.

(a) UDP datagrams arrive in bursts. Each datagram is recorded by a timestamp.

(b) Cumulate all data volumes and identify the last datagram of each burst.

(c) For each burst sum up its data volume (DV) and map it to its last datagram.

(d) Calculate the ABW $r[n]$ for each burst:

$$r[n] = \frac{DV}{time}$$

Software Development

CRUSP for Mobile:

- Android application for CRUSP
- Scaleable backend with micro services
- Frontend for measurement analysis

CRUSP for UEs:

- Android application for CRUSP
- Scaleable backend with micro services
- Frontend for measurement analysis

Evaluation:

- CRUSP measurements in LTE with 930 kB in around 0.2 sec are accurate. They yield an average error of 2.44% to iPerf3.

5G Use Cases

- Instant Video Quality Assistant
- Crowdsourcing for Mobile Coverage Map
- Vehicle-to-Vehicle Passing Assistant

Results

Test setup for repeatable measurements:

Future work:

- Find appropriate CRUSP configurations for UMTS and 5G to achieve high accuracy.
- Evaluation of CRUSP for Mobile in 5G.
- Develop passive monitoring with CRUSP.

References:
