

5G Project

Jerry Chen, Daniel Qian, Jason Zhang

Background

- With the advent of 5G mobile networks, we now can potentially have much lower latency communication
- This is beneficial in real-time streaming applications in which users must interact with each other.
- Since 5G is so new, there is the potential for new protocols to arise for better bandwidth utilization

Overall Goals

- Our goal is **to investigate real-time interactivity over a 5G network and design a bandwidth estimation protocol to efficiently utilize bandwidth.**
- We want to try and develop tools to confirm the feasibility of real time communication as well

Problem

First research and experiment with characteristics of cellular networks

Develop a bandwidth estimation protocol that works over cellular links

Use protocol in a proof of concept application

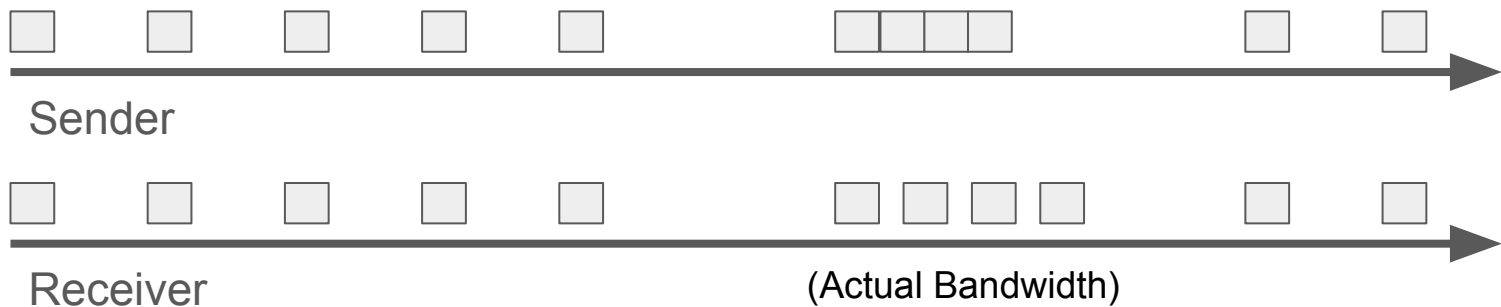
Progress - Network Characteristics

We created various tools to measure latency and bandwidth over networks

- Compared different cellular providers
- Did tests on wired internet as well for sanity check
- We found that carriers at least peered on the East Coast
- On LTE, T-Mobile was around 100ms, AT&T was around 70 ms, Verizon was around 40 ms. On 5G AT&T was about 20 ms

Progress - Bandwidth Estimation

Our initial idea was to send a instantaneous burst of packets and measure interarrival times of the burst. (note wired protocols don't work)

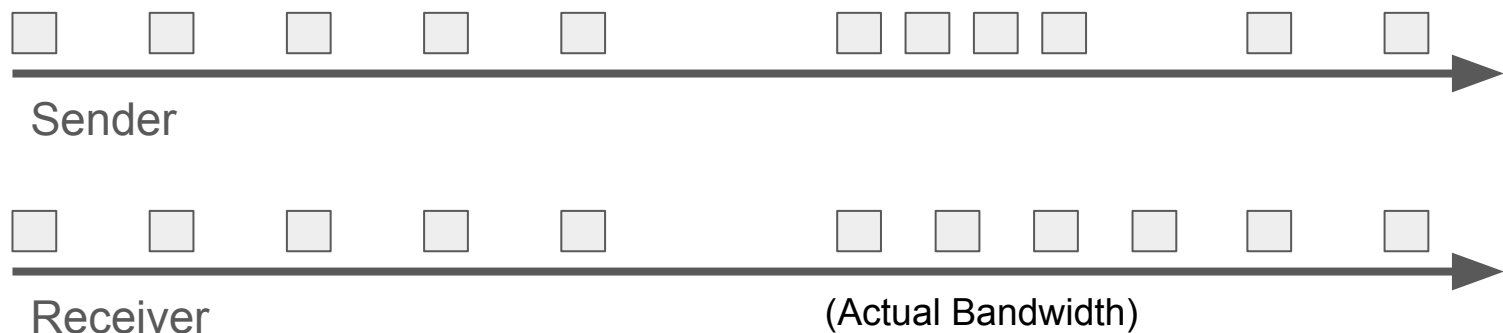


However we ran into an issue

- Receiver received burst very quickly
- Hypothesize that cellular packets can be larger, is grouped and sent as chunk
- Baseband processor is proprietary technology, can't do much

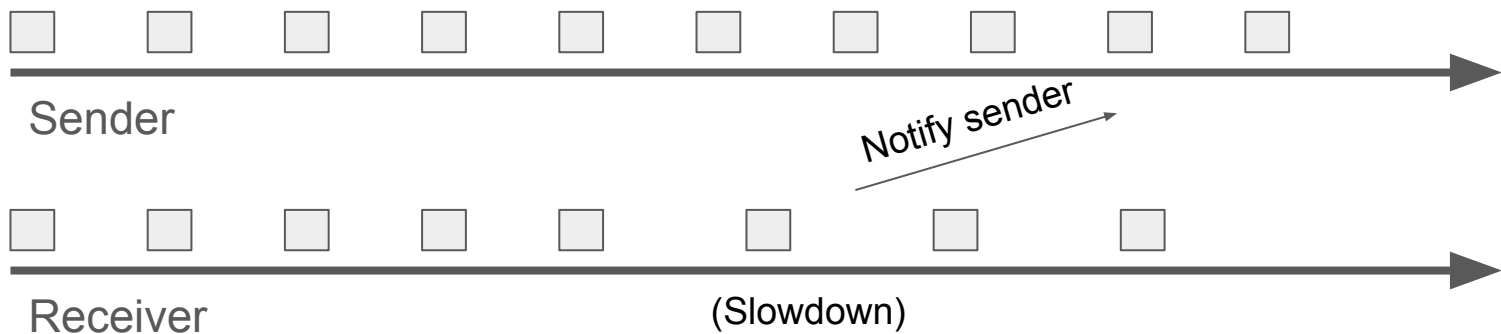
Progress - Bandwidth Estimation

Instead simply periodically send at higher (2x) rate. Can still detect underutilization of capacity.



Progress - Bandwidth Estimation

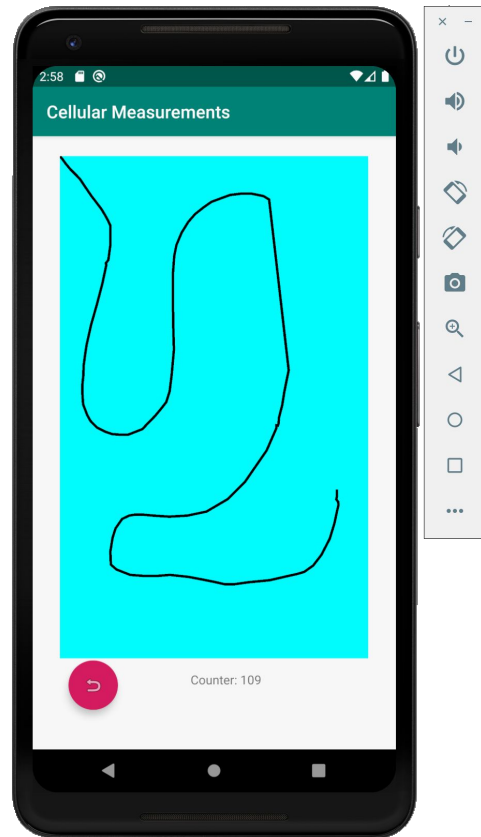
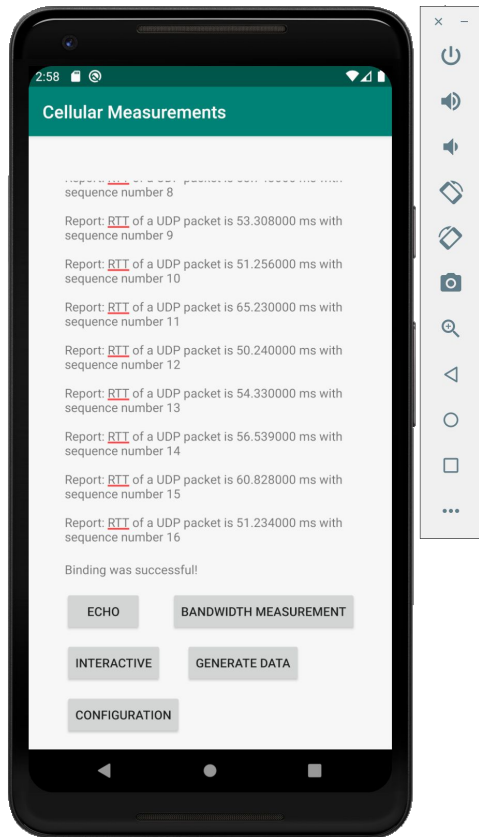
Detecting overuse of capacity is also extremely important



If at any point the bandwidth measured on the receiver side is less than sent, we send a control message and back off.

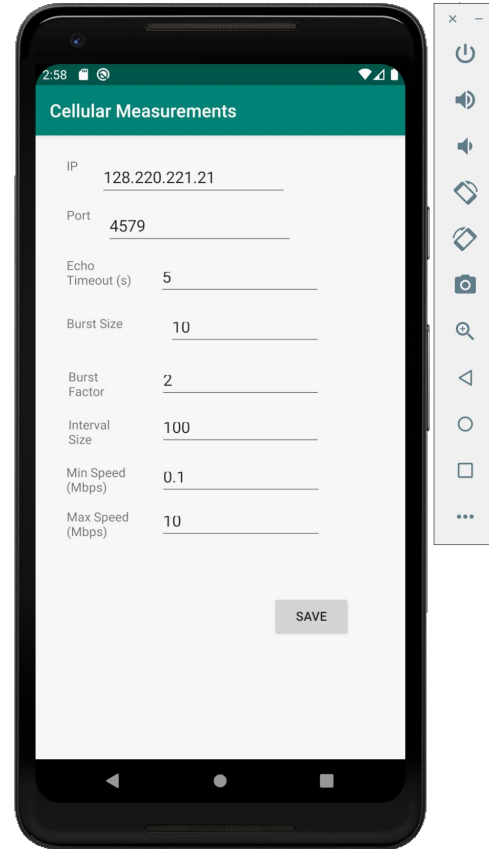
Progress - Application

- Echo: RTT of a UDP packet between the device and the server
- Interaction: visualize the latency



Progress - Application

- Data generator: generates a stream of data at a certain rate
- Bandwidth Measurement: a controller that sends data to the server
- Configuration Page: tuning all parameters



Future Plans

1. Test our bandwidth estimation protocol on mobile (termux)
2. Further integration with app
3. Further investigation into other real-time communication algorithms