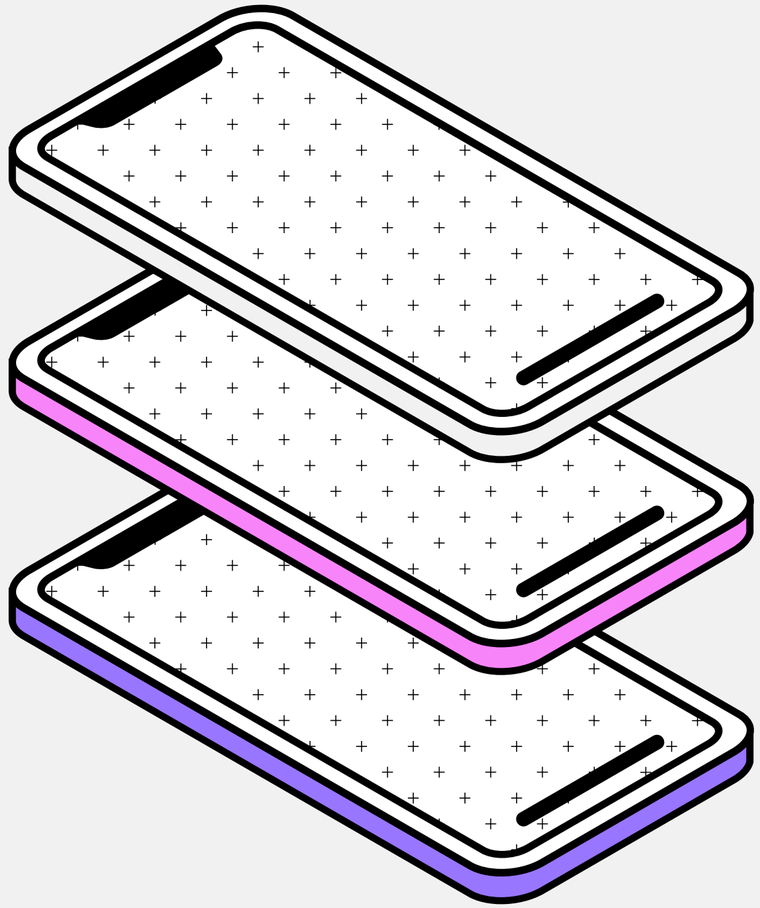
5G Cellular Network Simulator



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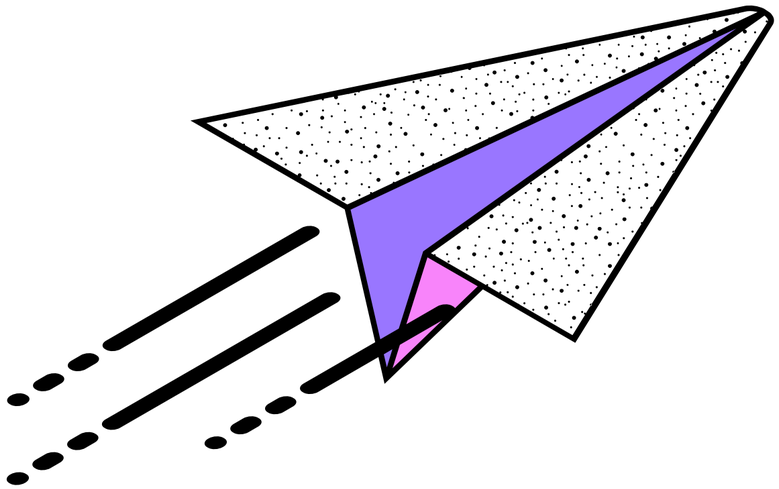
Overview



- Project Goals
- Features Integrated
- Features Left Out
- Implementation Accuracy
- Abstractions, shortcuts, and assumptions
- Demo
- Real world cases and Improvements

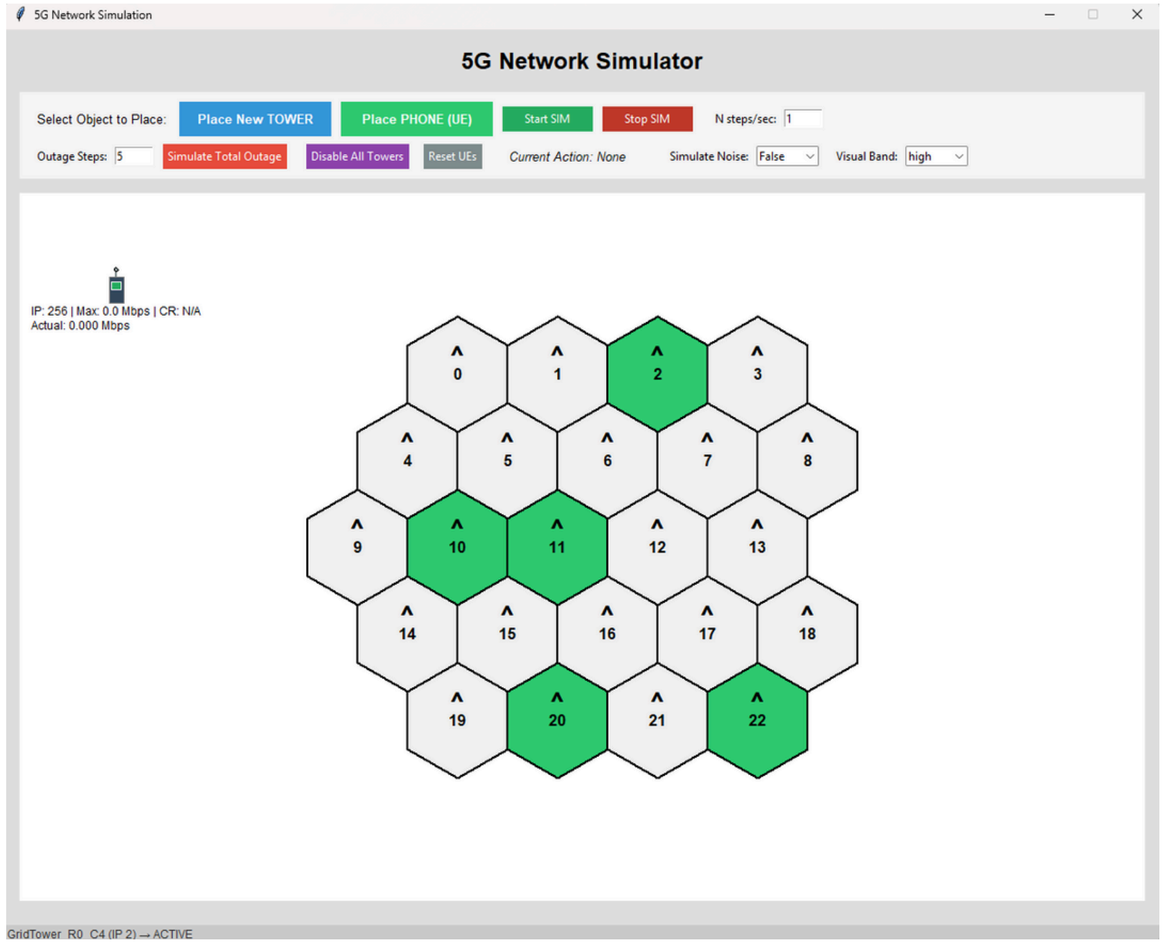
Project Goals

Create a simulator that mimics the behaviors of a 5G network

Our simulator highlights changes in speed based on location of User Equipment from Cell Towers

Features Integrated

- Physical Layer
  - Mimic 5G data speeds and range
  - Define Cell Towers and User Equipment
  - Any Topologies
- Link Layer
  - Simulate link quality
  - Simulate Transmission failure
  - Simulate neighbor discovery algorithm
  - Simulate Automatic Repeat Requests
- Network Layer
  - Topology formation based on physical locations
  - Handover for nodes moving across cells
  - Connectivity restoration
  - Inter-UE data transmissions through IP addresses
- Mobility
  - Cell On/Off
  - Logs



Features Left Out

- Physical Layer
  - 4G and LTE speeds
    - We only have 5G speed simulation but have 3 different bands
- Link Layer
  - Mimic link layer when forming
- Network Layer
  - Realistic IP protocol implementation
- Mobility
  - UE automatic movement - simulating walking a grid or driving

Implementation Accuracy

- Physical Layer
  - Each frequency band defines a set maximum data rate defined by the 5G spec.
  - Modeled noise and SNR using a non-linear function.
- Link Layer
  - Link quality is model using a stochastic non-linear function.
  - Simulations of FEC (LDPC).
  - Neighbor discovery is handled via scanning.
  - Automatic Repeat Requests (ARQ) to improve reliability.
- Network Layer
  - Use a high level IP routing for each device.
  - Multi-cast data delivery.
  - Dynamic topology configuration based on user need.

Abstractions, Shortcuts, and Assumptions

- Simplified Physical layer: uses SNR based models collected from device positioning.
- Bit recovery from is simplified: Uses a stochastic model based on SNR.
- Neighbor discovery is simplified using radial scanning.
- We simplify the IP protocol. The main features used are addressing and TTL.
- Our model assumes the user wants to simulate network traffic in custom scenarios.

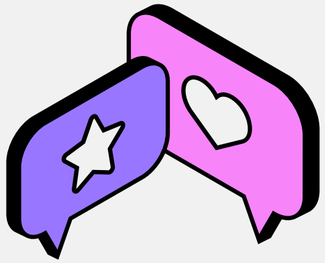
Demo

Real world cases

- Aid in placement of towers to have good coverage in different settings.
- Simulating unstable network environments (random tower outages)
- Simulating congested network scenarios (many devices accessing single cells).
- Testing mass handovers due to network failures.
- Throughput simulations before deployment.

Improvements

- Try different IP routing algorithms that aren’t computationally expensive.
- Implement/emulate the full IP protocol.
- Add more functionality to the GUI such as SNR visualizations and granular control over UE and Tower parameters.
- Implement real data transmission for better network visualizations.
- Write a callable C library to improve data transmission speeds.
- Better looking GUI.



Questions?