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ENGINEERING
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Creating a Robust and Resilient Uplink

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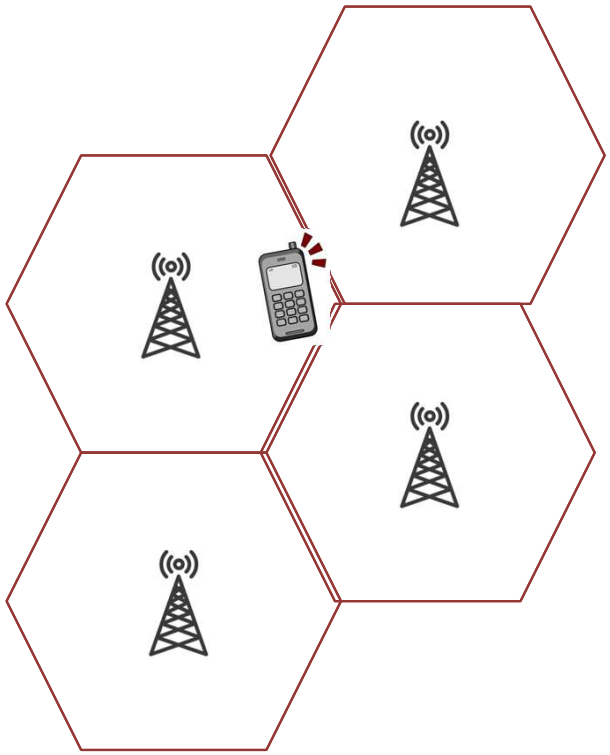
Background

The Internet of Things (IoT) is growing rapidly and with that comes a need for better uplink connectivity.

We utilize “cellular” systems in digital communications today.

Devices only “talk” with one base station at a time.

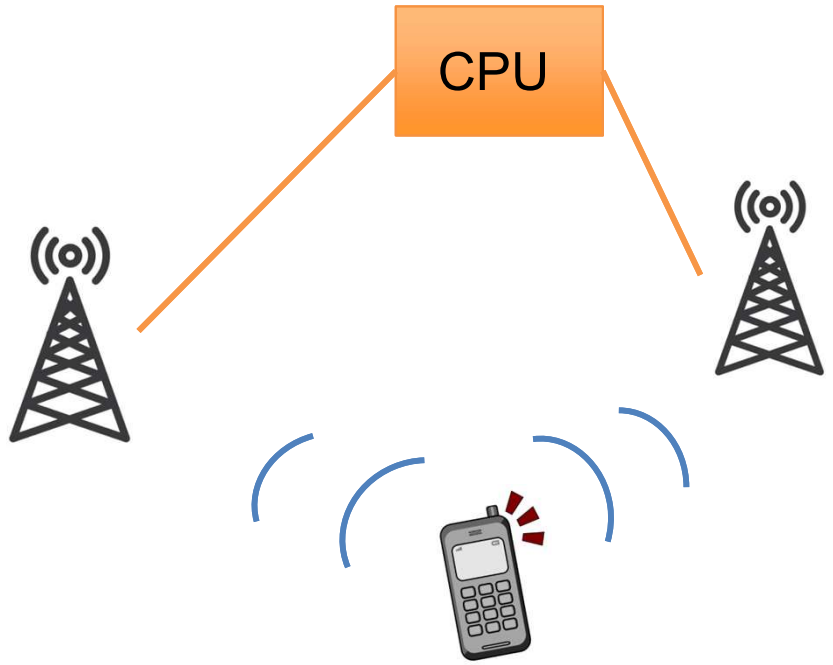
Moving towards a “cell-free” system where devices “talk” with multiple base stations simultaneously.



Project description

I am developing an algorithm that allows a device to communicate with two base stations simultaneously.

This reduces the probability of error and increases coverage.



System Overview

Currently, the transmitter sends a k-sparse binary vector. The channel adds Additive White Gaussian Noise (AWGN) and shadowing effects, and the receivers utilize Approximate Message Passing (AMP).

Transmitter

The transmitter's job is to produce signals.

The signal sent will always be k-sparse. The non-zero values will be:

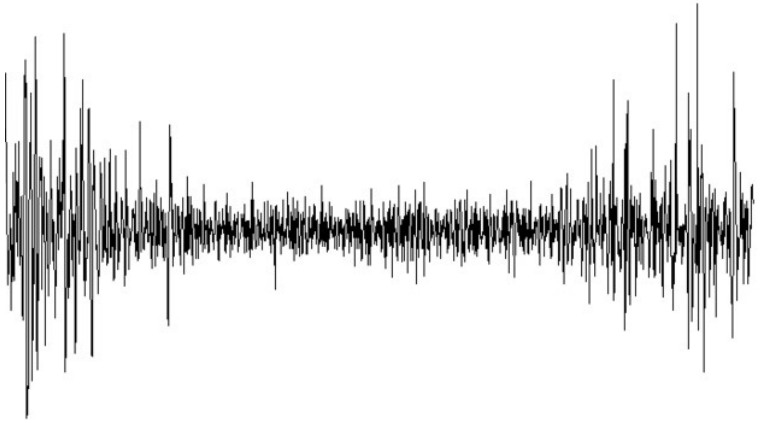
- Completely binary
- Gaussian random variables
- Clustered variables

Channel

The channel adds noise and other distortions to the signal.

The noise will be modeled as:

- AWGN
- Fading/shadowing
- Multi-path channel loss



Receiver

The receiver gets the signal, demodulates it, and compares it with the other base station to ensure it matches.

The algorithm will focus on an efficient demodulation process.

Currently, working to unroll existing algorithms to apply deep learning.

Execution plan

9/20:	10/5	11/15	11/25
Simulate and evaluate multi-bit transmission through noisy channel	Establish a baseline by comparing BER of different models	Algorithm development	Integrate algorithm into one/two receiver model
Monte Carlo performance tests	Read about algorithm unrolling and deep learning	Unroll IST	Test its performance and BER
Read through papers regarding URA and channel modeling		Write background for thesis based on IST unrolling	Begin alterations based on performance evaluation results

Validation

To validate my algorithm:

The system will be simulated with a variety of transmitter/channel combinations and the error of probability compared to that of the single receiver approach.

This will be considered a success if the method has equal or less complexity and the probability of error is less than current approaches.