UC San Diego
JACOBS SCHOOL OF ENGINEERING
Computer Science and Engineering

Wireless Sensor Network Localization: April Monthly Check-in

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WES Spring 2022

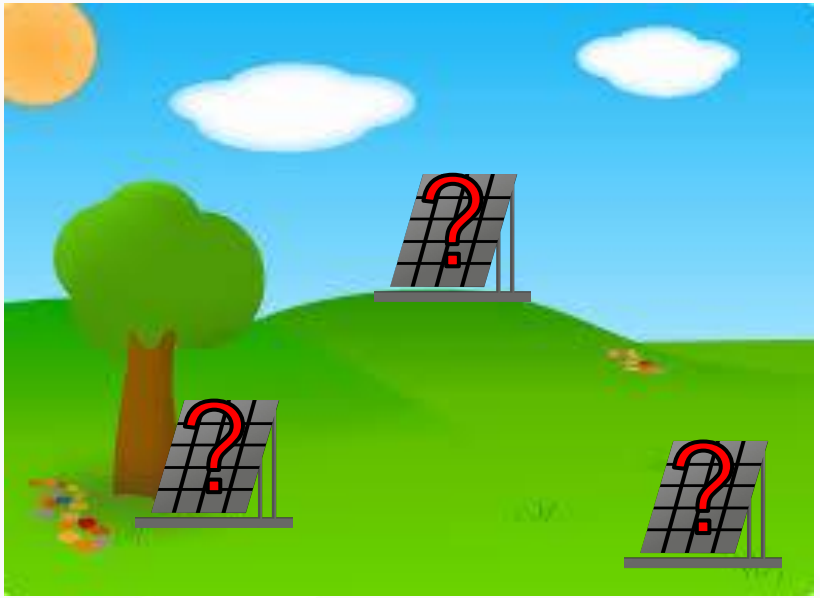
Project Refresher

High level idea:

1. We want to measure something in an area
    - i.e., sunlight across an open field
2. Place sensors across area
3. Record and report values
4. Localize values in environment
5. Process and visualize data

Goal of this project:

- Deploy Pluto-based sensors that form a wireless ad-hoc network in order to graphically report audio levels



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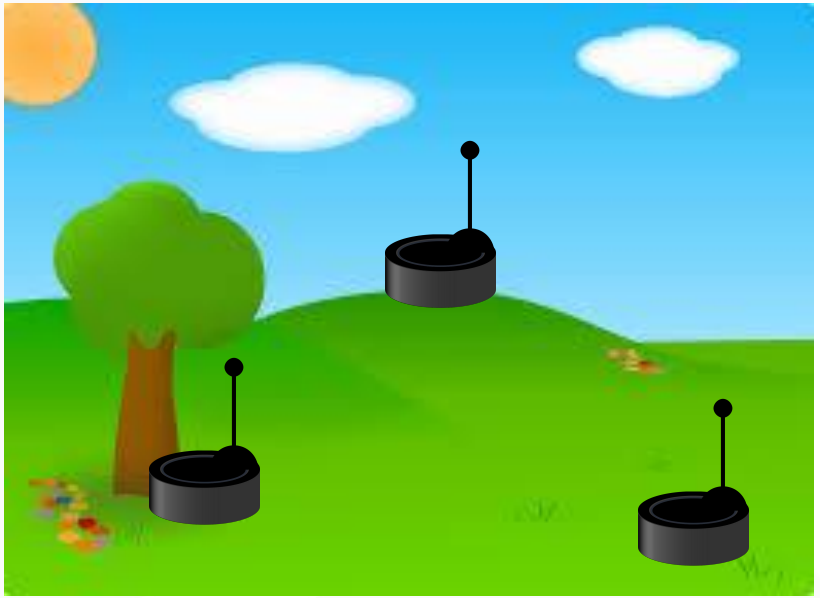

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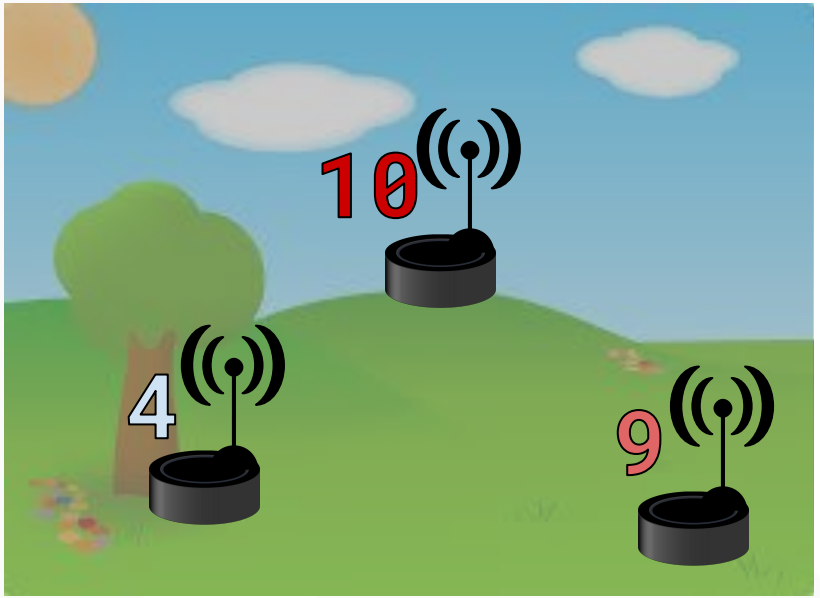

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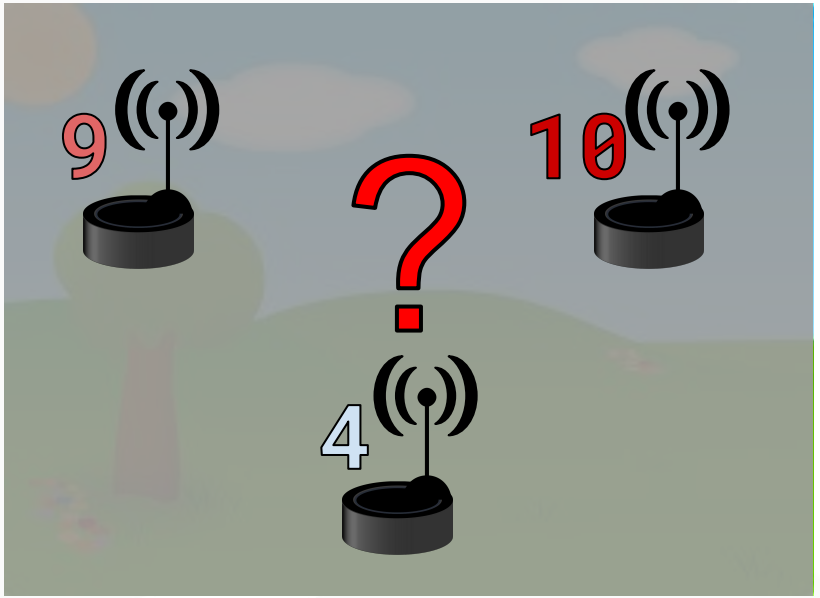

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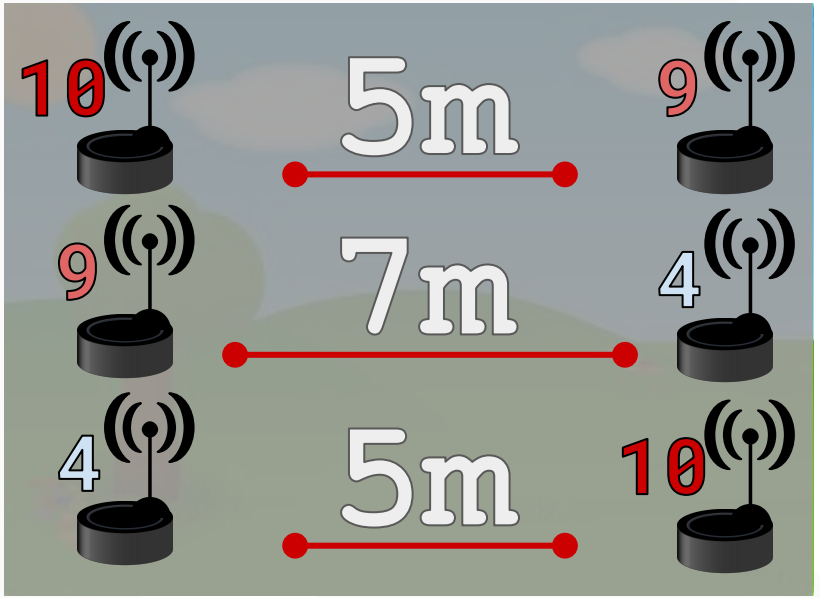

Measure link distances…

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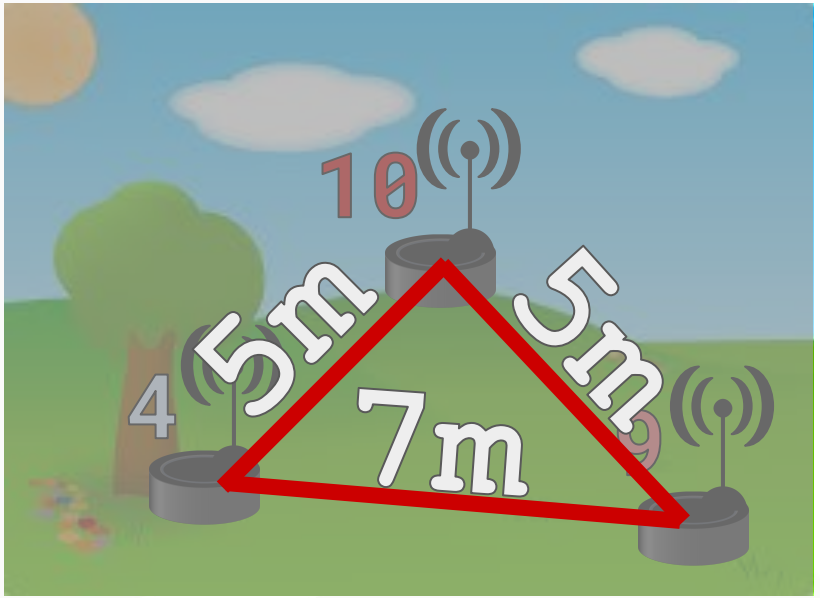

…to calculate topologies.

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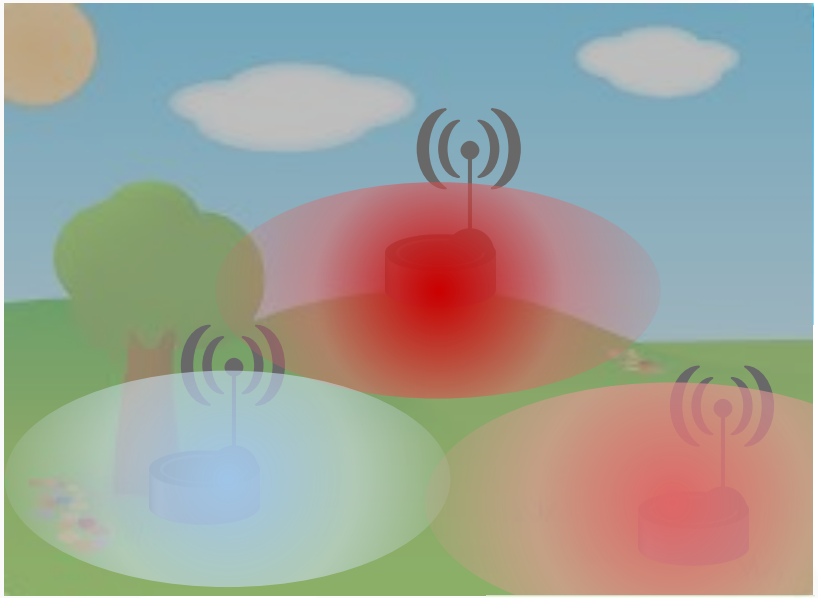

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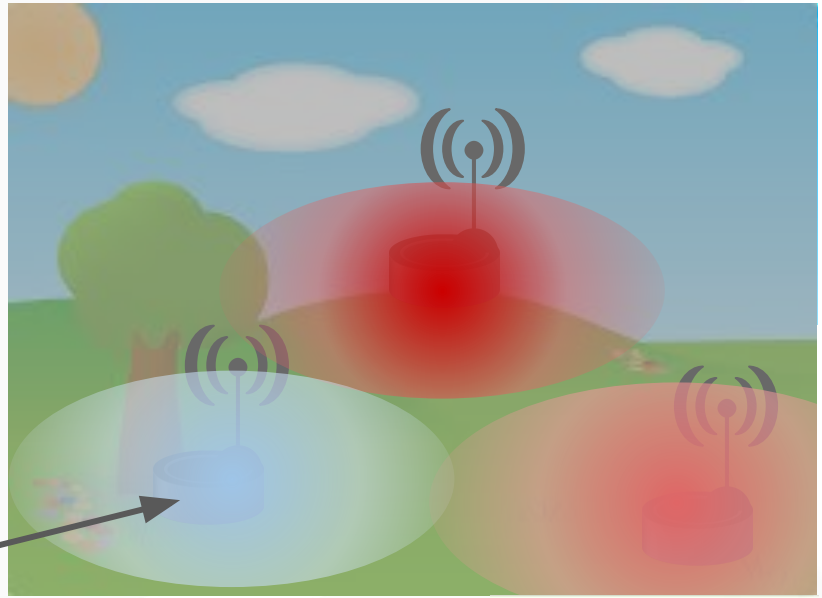
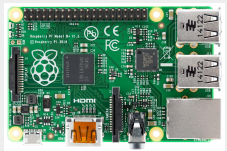
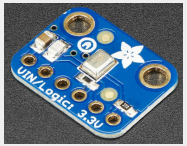


Node

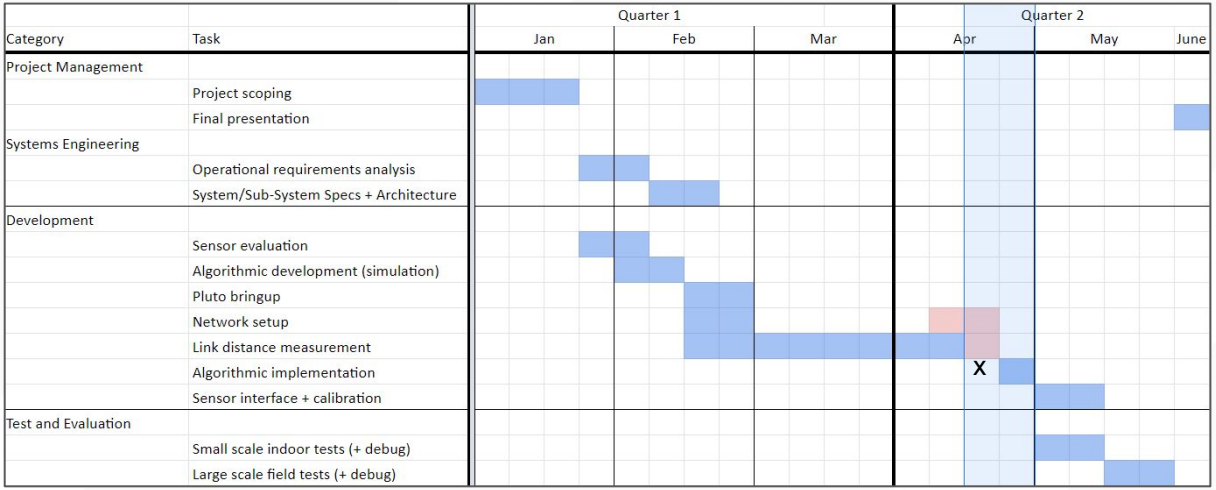




Schedule

Overall summary: slight slippage, still (pre-planned) slack remaining

- Previous sprint goals:
  - Scale up to 3 nodes: success, but some debugging remains
  - Finish ToF measurements: works, but needs calibration
- Coming sprint:
  - Complete open tasks above
  - Migrate cMDS from MATLAB sims to Python on Plutos
  - GUI?



Scaling Up

Recommendation last time was to start scaling up

- Exposed CFO synchronization problems in library
  - Led to somewhat finicky 2-way comms, almost completely fragmented 3-way comms
    - Pluto's 25ppm*915 MHz = ±22.9 kHz, carrier spacing is only 19 kHz
    - Original author mostly employed guess-and-check hand-tuning
  - Steps to fix
    - Increased training sequence length for better fine freq correction
    - Allocated more subcarriers to pilots (low throughput needed anyway)
- BATMAN broadcast messages overwhelming network
  - More nodes = more broadcasts = more contention
  - Scaled back individual reporting rate, but may need to scale based on network size
- Set up simple Python web server to aggregate link data

BATMAN-ADV Technical Overview

- **B**etter **A**pproach to **M**obile **A**d-hoc **N**etworking
- OSI Layer 2 protocol
  - Uses Ethernet frames and bridges
  - Acts as a virtual switch
    - Hides mesh behavior from all upper layers
- Heavily routed
  - End goal: track fastest routes to non-mesh (endpoint) users to maintain switch appearance
  - Broadcast messages serve 3 purposes:
    - Track single hop neighbors
    - Track best route to broadcast originator
    - Populate “translation tables” indicating where non-mesh users are attached
- Bonus features:
  - Bridge loop avoidance
  - Packet fragmentationni

Questions?