Data Collection from Outdoor IoT 802.15.4 Sensor Networks using Unmanned Aerial Systems

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Motivation

Unmanned Aircraft Systems (UAS) are a promising technology for data collection from outdoor sensor networks. However, unlike other wireless standards, 802.15.4 is well studied on the ground, but has not received rigorous evaluation in three dimensional communication.

Goals

1. Conduct performance analysis of 802.15.4 2.4GHz in a mobile 3D environment.
2. Identify elements critical to successful data collection from an 802.15.4 2.4GHz network using a moving UAS.

Materials & Methods

Equipment:

- DJI Matrice 100
- Digi XBee 3

Antenna Experimentation:

- Altitude
- Orientation
- Elevation
- Obstruction

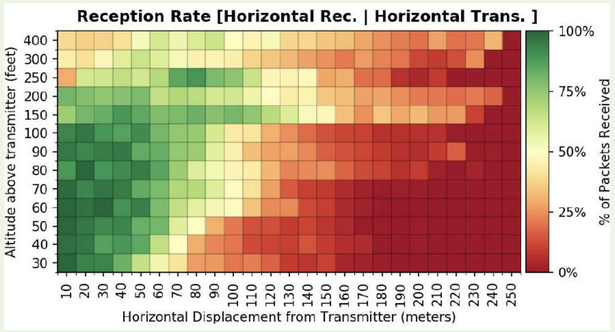
Experiments:

- 9 Hours Flight Time
- 121, 503 Packets
- 13 Elevations
- 3 Locations

Results

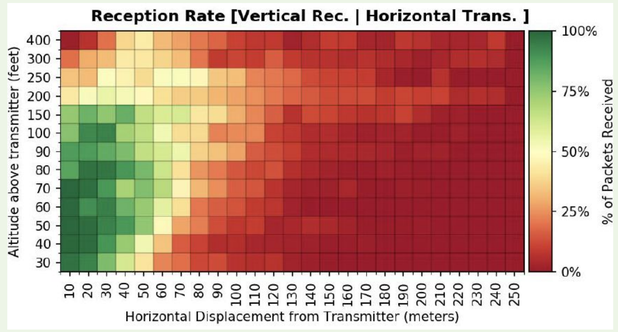
Performance Metrics

Our measurements show that **aggregate RSSI is a poor indicator** of overall network quality, whereas **packet reception rate (PRR) better reflects network performance**.



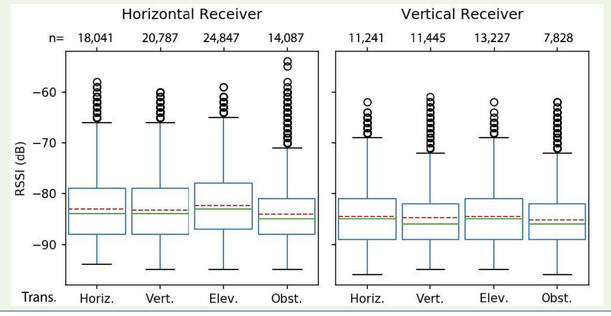
Transceiver Orientation

We find **that *receiver* orientation noticeably impacts loss**, while *transmitter* orientation has a negligible effect.



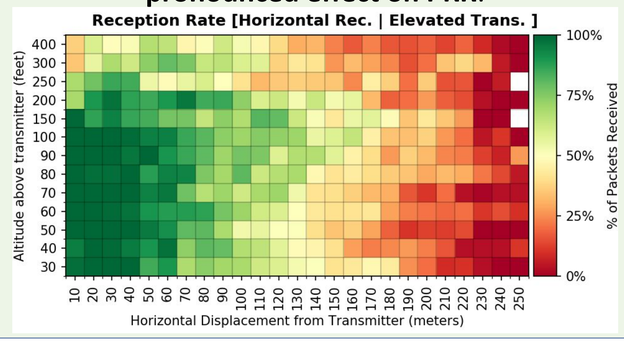
Transceiver Obstruction

While we find that obstruction **minimally affects** *reported* **RSSI**, it has a **significant impact on PRR.**



Transceiver Elevation

Again we find elevation **minimally affects RSSI**, but has a **pronounced effect on PRR**.



Applications

Mapping IoT Deployments

We envision UASs as a way to automatically map and track changes to an outdoor IoT deployment.

Detecting Malfunctioning IoT Nodes

By comparing passive network scans before and after a disaster, a UAS-based system could automatically detect buried or inoperable sensors.