2019 Public Safety Broadband Stakeholder Meeting

DHS Portfolio

Next Generation First Responder Deployables and Internet of Things Technology

Panel Members

#PSCR2019

Sam Ray, Alison Kahn, Hien Nguyen, Maxwell Maurice

This work is sponsored by:

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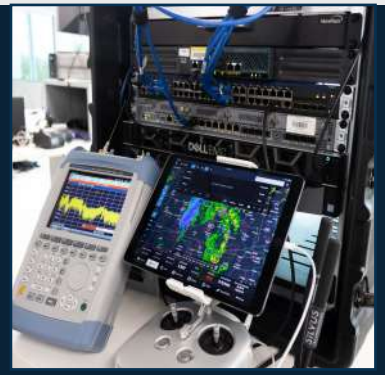
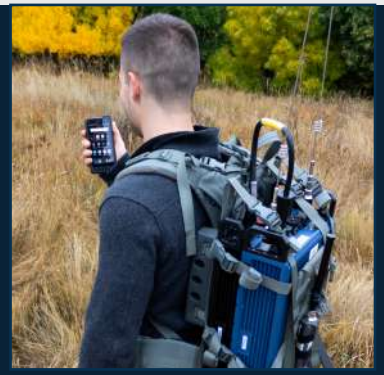
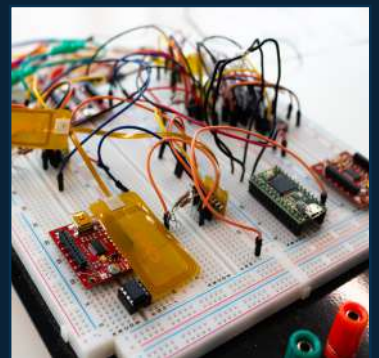
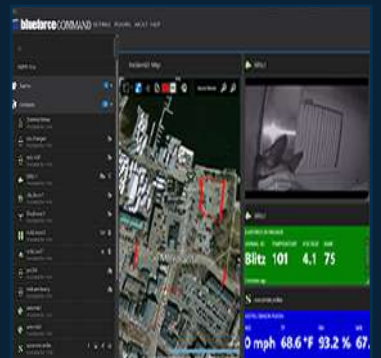
*Please note, unless mentioned in reference to a NIST Publication, all information and data presented is preliminary/in-progress and subject to change

Project Background: Deployables and IoT









Deployable Systems

Configuration and integration of deployable LTE networks with applications and services to create a complete system for first responders.

Highly Mobile Deployable Networks

Interconnection of multiple deployable systems with limited or no backhaul connection (portable, manpacks, airborne).

Personal Area Networks for Public Safety

Issues surrounding Internet of things (IoT) technology for public safety. Determining how to maintain sensor data availability in mission critical scenarios.

Agenda

Introduction

Sam Ray, DHS Portfolio Lead

Personal Area Networks

Alison Kahn, Project Lead

- Timeline, Architecture
- IoT Roundtable
- Issues, Future Research

Highly Mobile Deployed Networks

Maxwell Maurice, Project Lead - HMDN

- Why We Need Deployables
- Research Highlights
- Real Scenario, Dataset

Highly Mobile Deployed Networks

Hien Nguyen, Project Lead – Deployable Systems

- Drones for Public Safety Comms
- PSCR Research – Simulations
- Lab/Field Testing

Q & A

Demonstration: Michigan Ballroom

PSCR

PUBLIC SAFETY INTERNET OF THINGS

Alison Kahn

Project Timeline

DHS Personal Area Networking Project

2017

Public Safety Internet of Things

Assessing the state of IoT for Public Safety

2017

Sensor Integration

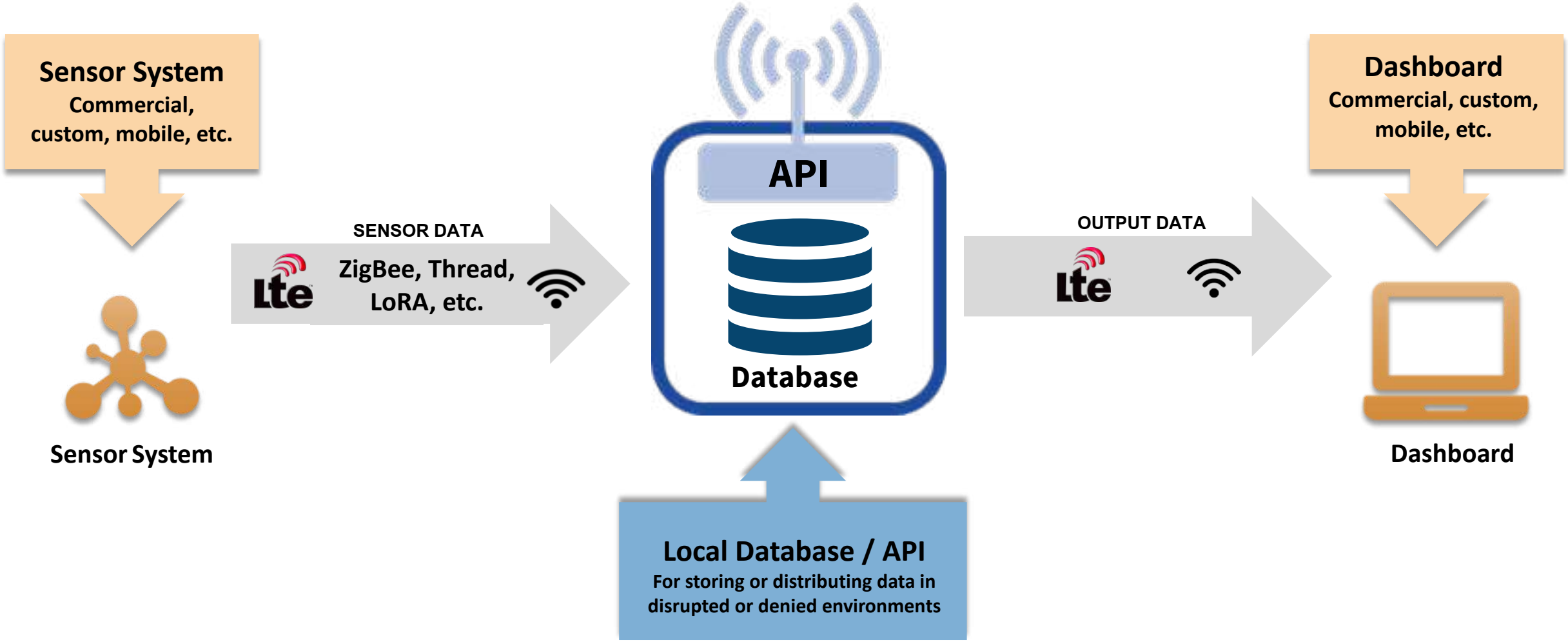
Examining standards related to sensor integration

2018

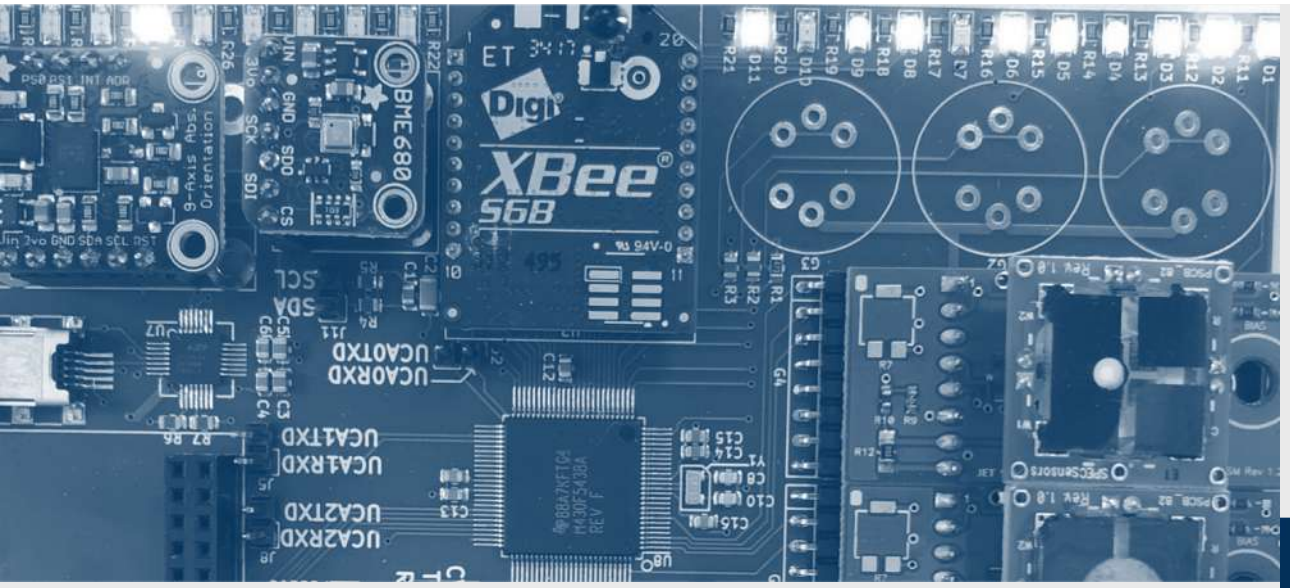
Architecture Development

Creating an architecture to address gaps

PSCR Architecture Overview



PSCR-Developed Components



Biosuit Sensor Hub

Multi-sensor platform for a first responder

Used to demonstrate sensor input to API

API

Ingests and stores data from sensors

Makes data available to dashboards

Public Safety IoT Roundtable

April 3 & 4, 2019 – Boulder, CO

Goal: Discuss the current state of IoT for Public Safety, and determine issues that must be solved for it to succeed in the field.

Roundtable Activities

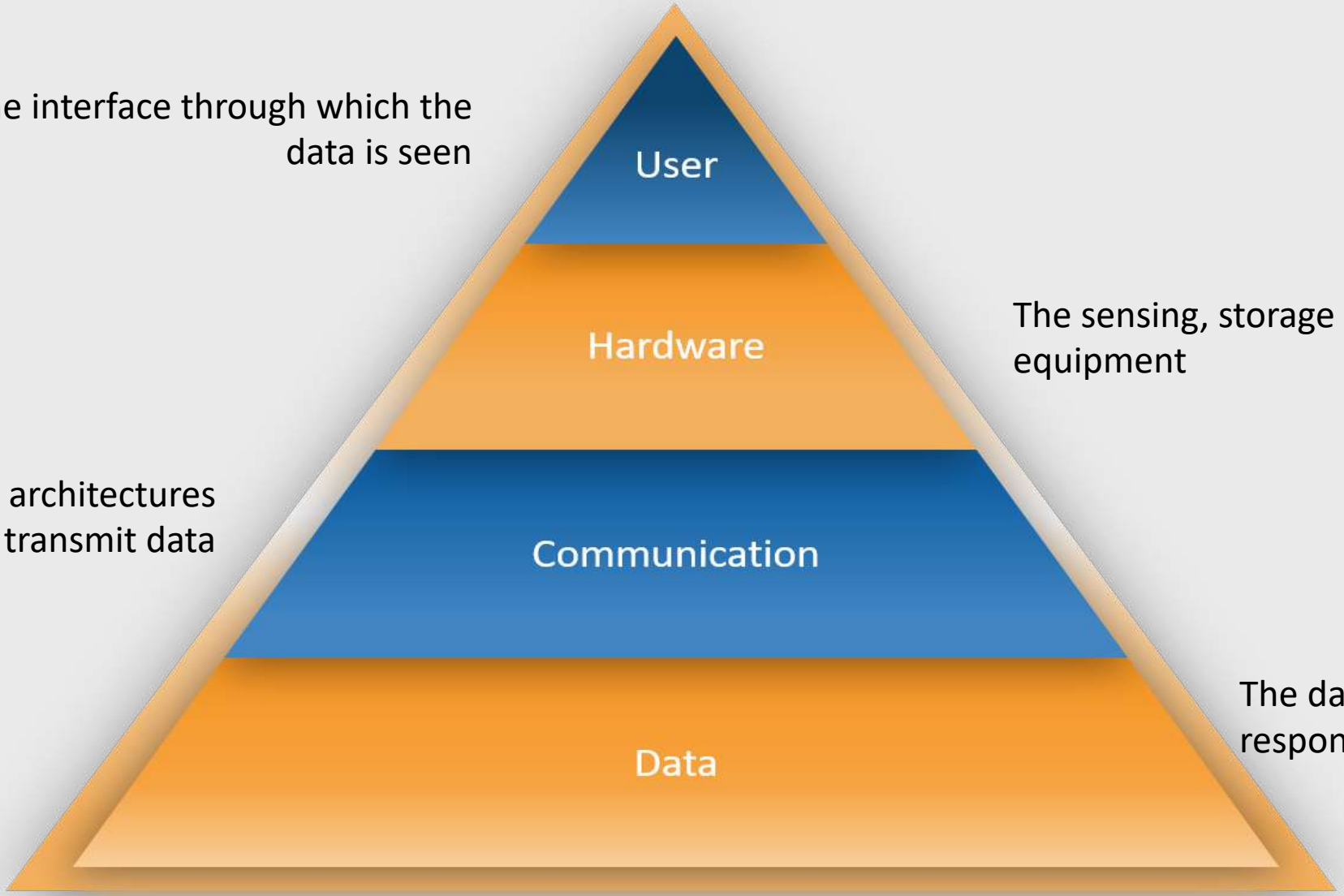
How the group examined IoT for public safety

1. Identification of Enabling Technologies
2. Gap Categorization and Prioritization
3. End to End Solution Brainstorming

Four Elements of a Personal Area Network

Where are the Gaps for Public Safety?

The interface through which the data is seen



The sensing, storage and display equipment

The protocols and architectures used to transmit data

The data necessary for first responders

PSCR Future Research Areas

Future PSCR Research Areas

Communication

How do we ensure that communication lines are available?

How do we bring the data as close as possible?

Data

What data elements are used by public safety?

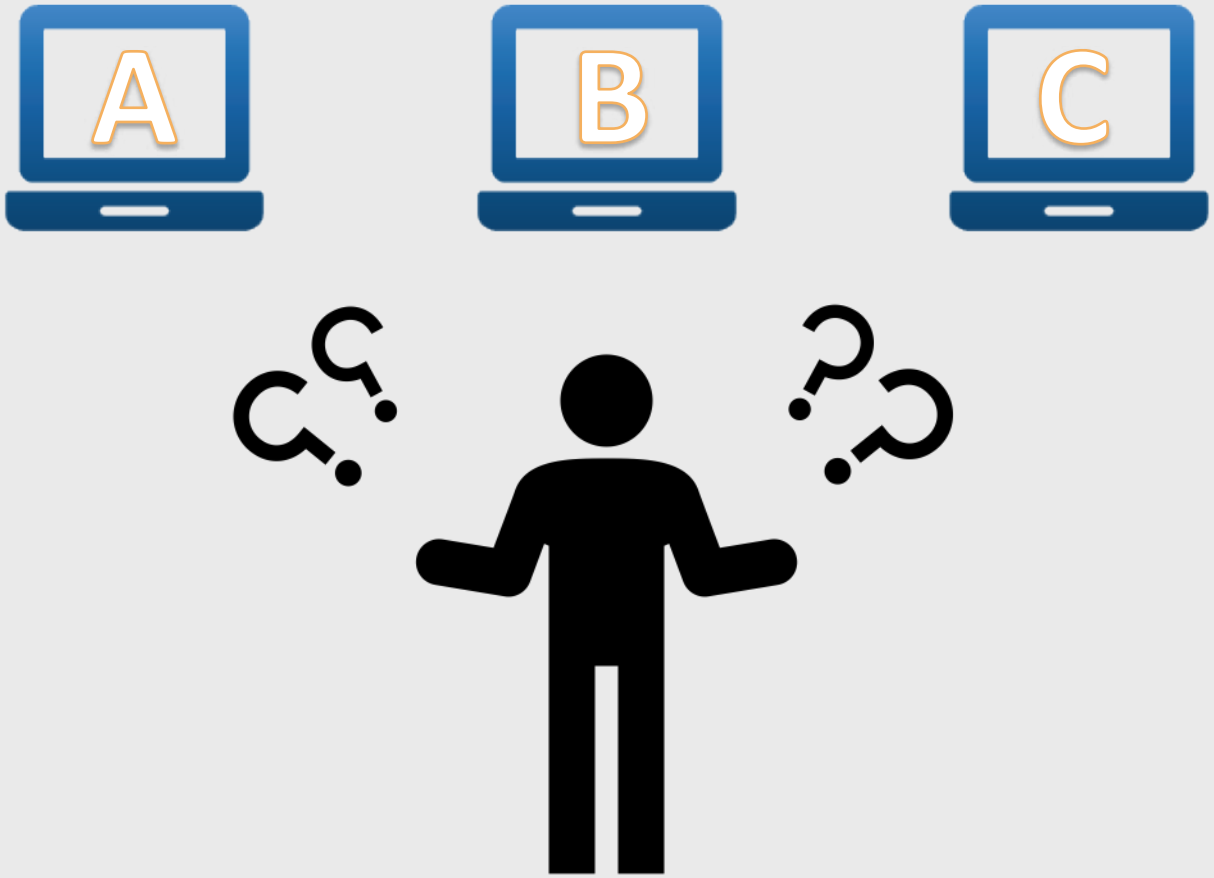
How can they be defined?

Data Exchange Obstacles

A “Real World” Example

Data Exchange Obstacles

A “Real World” Example



Inter-Vendor Data Exchange – Current Model (Using JSON)

{"id":523525,"p":4388,"d":"06802","u":598,"r":"F-B12","s":"A-P","x":0,"c":"","t":1558538807,"rack":0,"l":35.96074,"g":-79.05737,"z":171,"h":354,"m":40,"a":5}

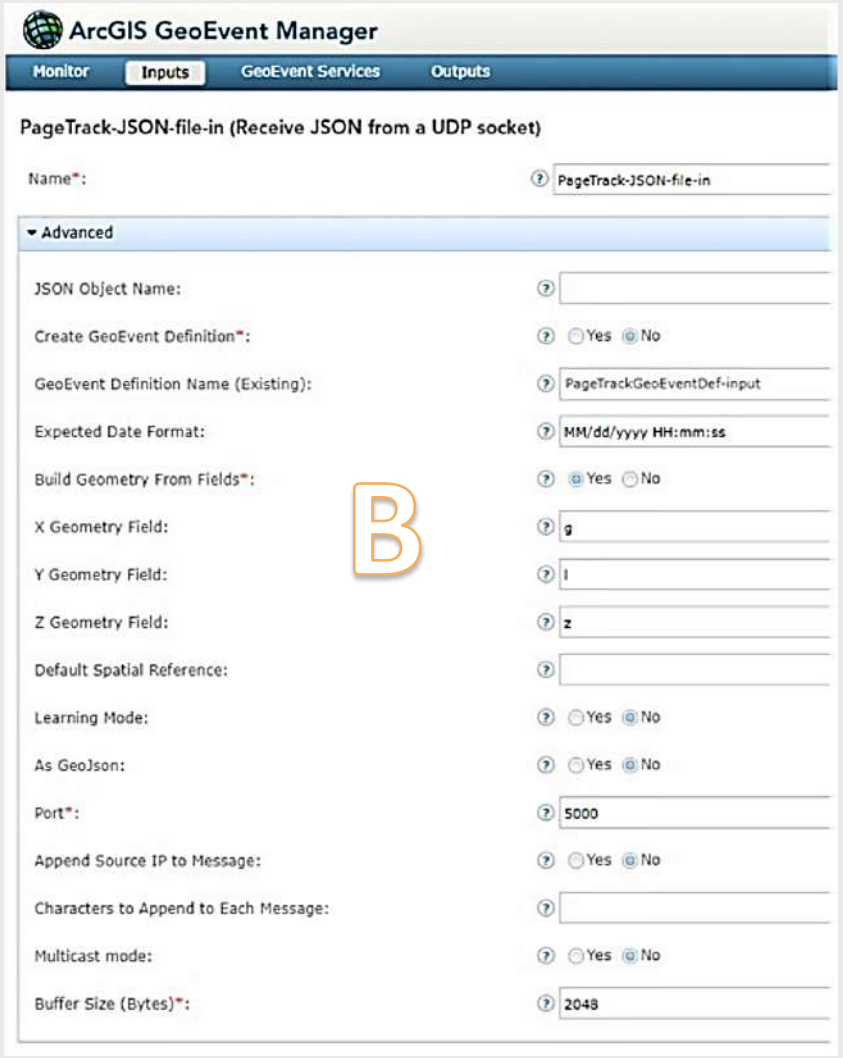
In object form:

```
{
        "id":523525,
        "p":4388,          // PSAP ID
        "d":"06802",       // Department FDID
        "u":598, // Responder ID
        "r":"F-B12",       // Unit type ('F'ire, 'B12" r  number)
        "s":"A-P",         // Status: 'A'vailbe 'P'er   ll
        "x":0,             // CFS identifier Number (0=none)
        "c":"",            // CFS Identifier String
        "t":1558538807, // UNIX timestamp for this IOT data
        "rack":0,          // Receive Acknowledge
        "l":35.96074,      // Latitude (floating point format)
        "g":-79.05737,     // Longitude
        "z":171, // Altitude (MSL)
        "h":354, // Heading
        "m":40,            // Speed in MPH
        "a":5              // GPS accuracy, Meters
}
```

A

Using JSON Objects

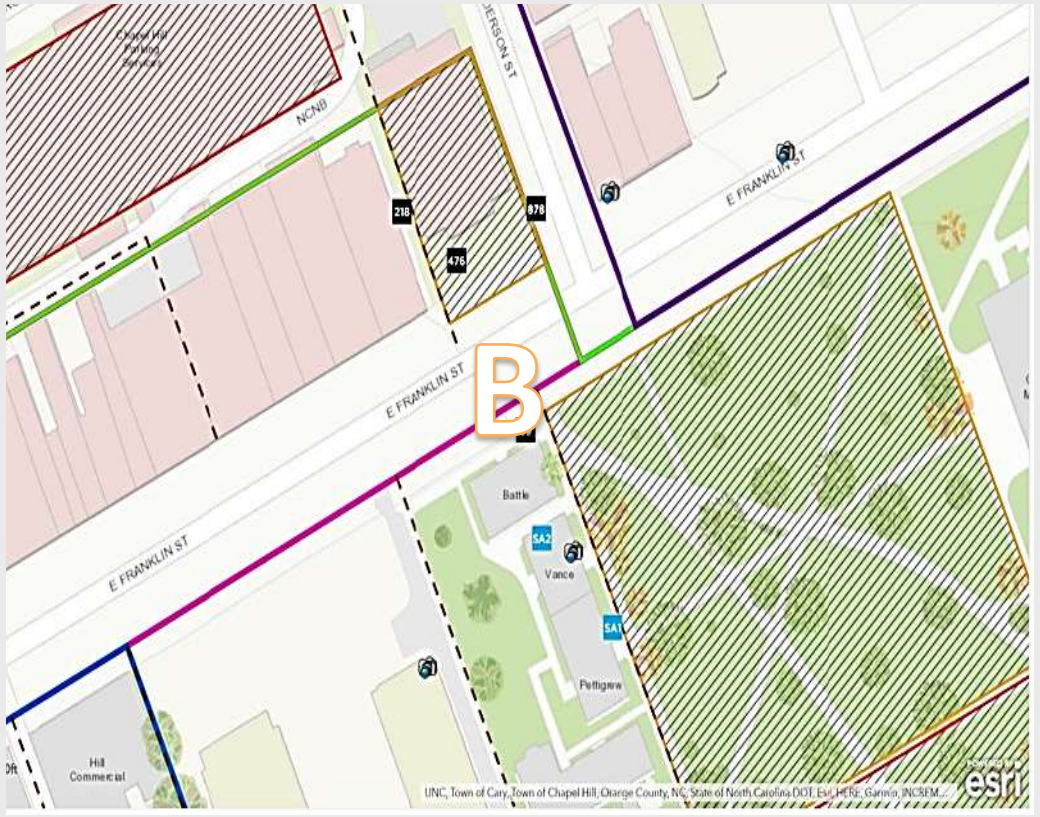
Data from A can be displayed on B



B

Inter-Vendor Data Exchange – Current Model (Using JSON)

First responders' locations in Chapel Hill, NC
being tracked on PageTrack in Efland, NC

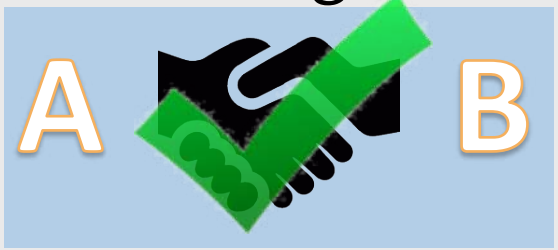


ESRI taking JSON objects from PageTrack
and displaying them in real time in Chapel Hill center

Goal: Disparate Systems To Communicate Without Losing Their Uniqueness By Using A Common Date Exchange Format

Issues with Current Data Exchange Model

Company A and Company B have an agreement:



What about:

And then we add in:

D E F G . . .

Defining Data Objects

Step Number One

01

Determine data needed for success

Step Number Two

02

Conduct Interviews with First Responders

Step Number Three

03

Establish what data is missing

Step Number Four

04

Compile information

Interested in Participating?
Sign up in our app!

Defining Data Objects

Conduct Interviews with First Responders

01

Step Number One

Step Num

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02

Establish if data is

ng

er Three

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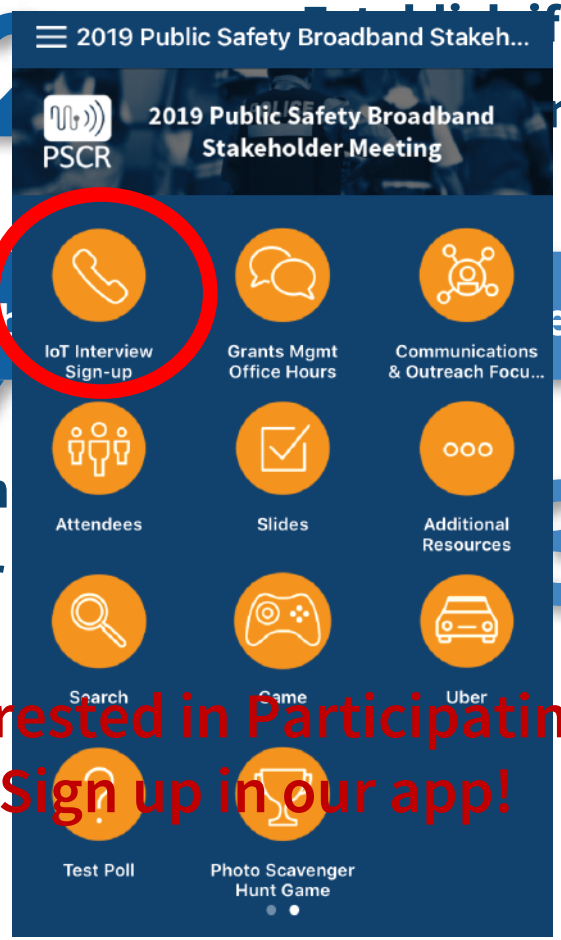


Step Number Four

04

Compile information into document

Interested in Participating?
Sign up in our app!

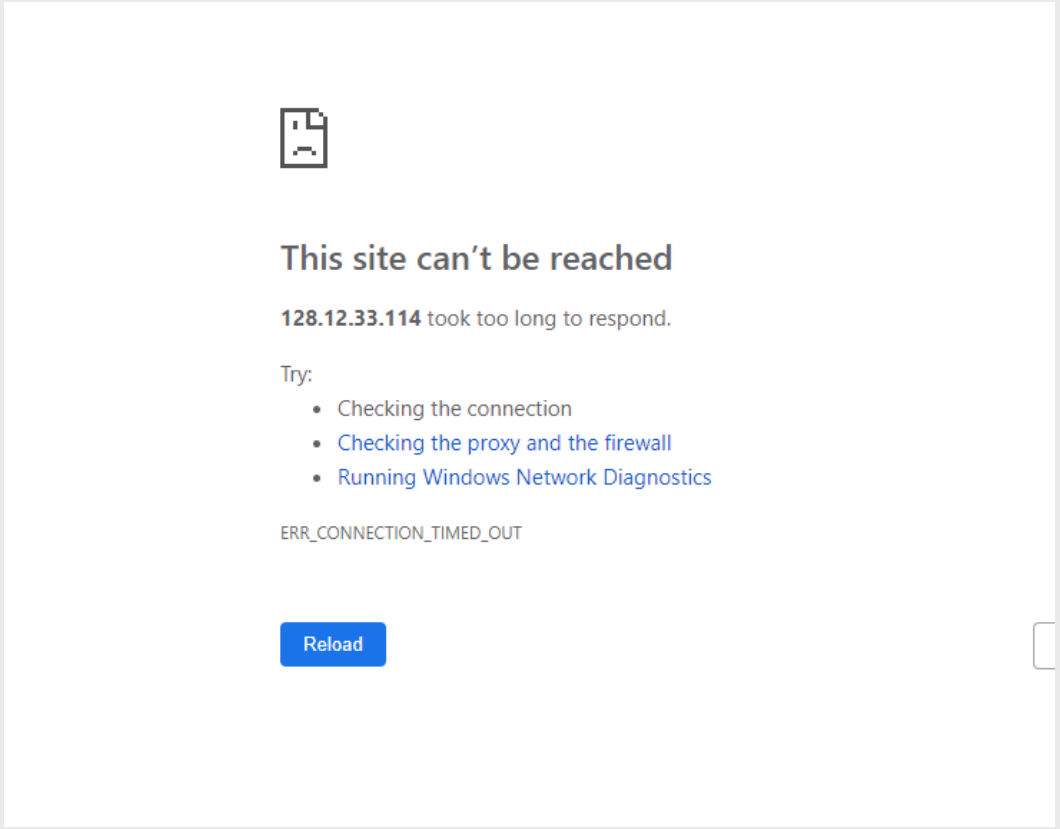
PSCR

Maxwell Maurice and Hien Nguyen

How to maintain these services

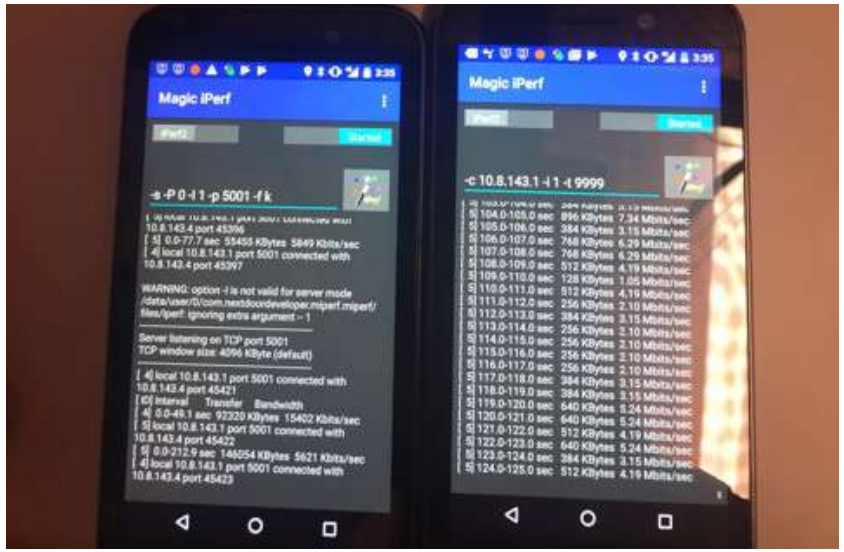
10 minutes ago

At the incident



Project Highlights

1. Defining how to combine deployable systems
2. Looked at some hardware requirements and specs
3. Spectrum study
4. Named Data Networking
5. Real deployment measurements



Real Deployment Scenario

The Objective :

Show the coverage and service potential of a realistic public safety scenario

The Scenario:

A fire team deployed to a brush fire

Pam Boyd. “Update on wildfire burning north of Gypsum” Vail Daily, July 23, 2018
URL: https://www.summitdaily.com/news/wildfire-burning-north-of-gypsum/

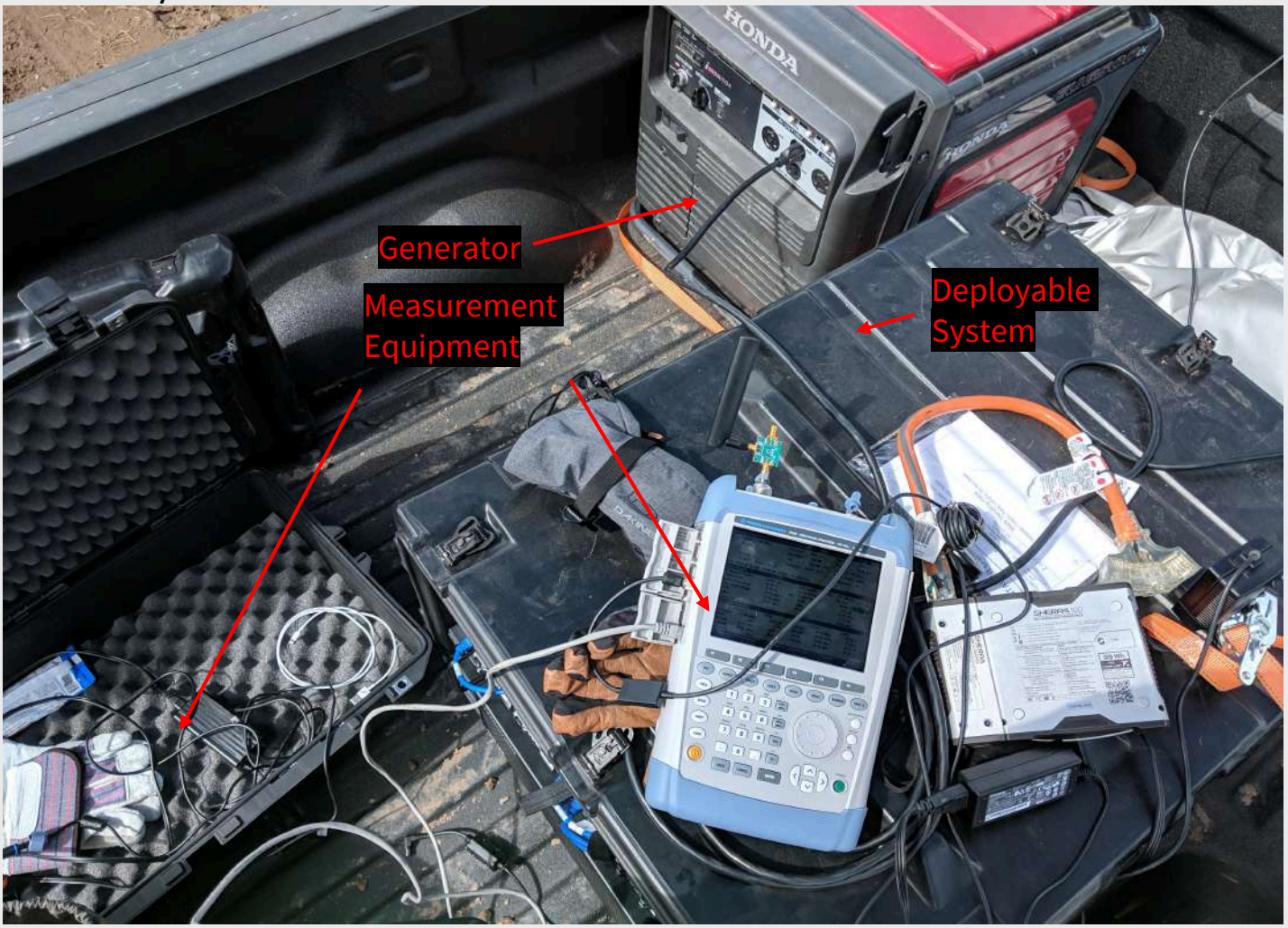
Location

Below are photos of the site where the deployable system was placed for operation.


View from the truck

Test Equipment

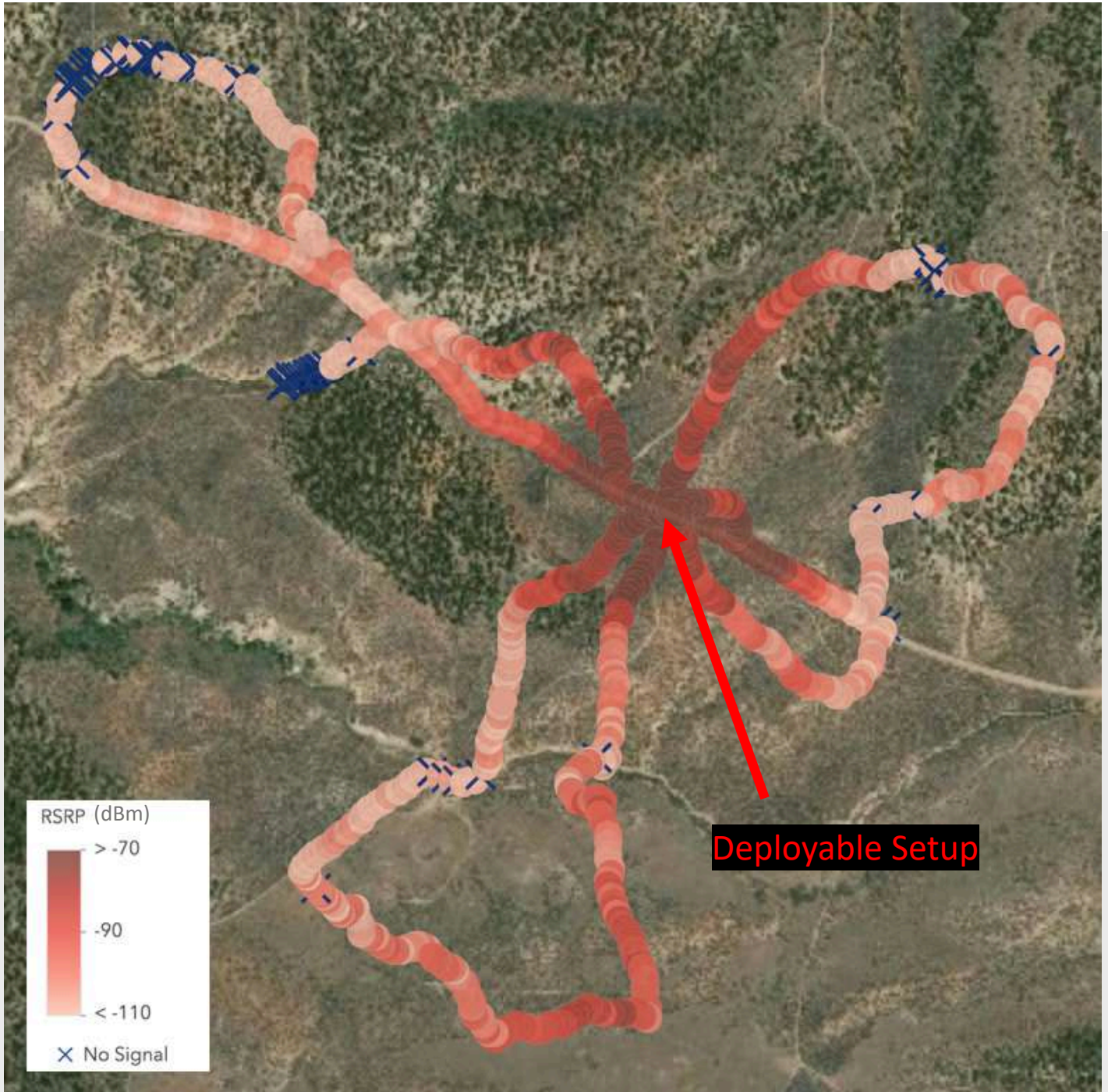
Full LTE System



Dataset

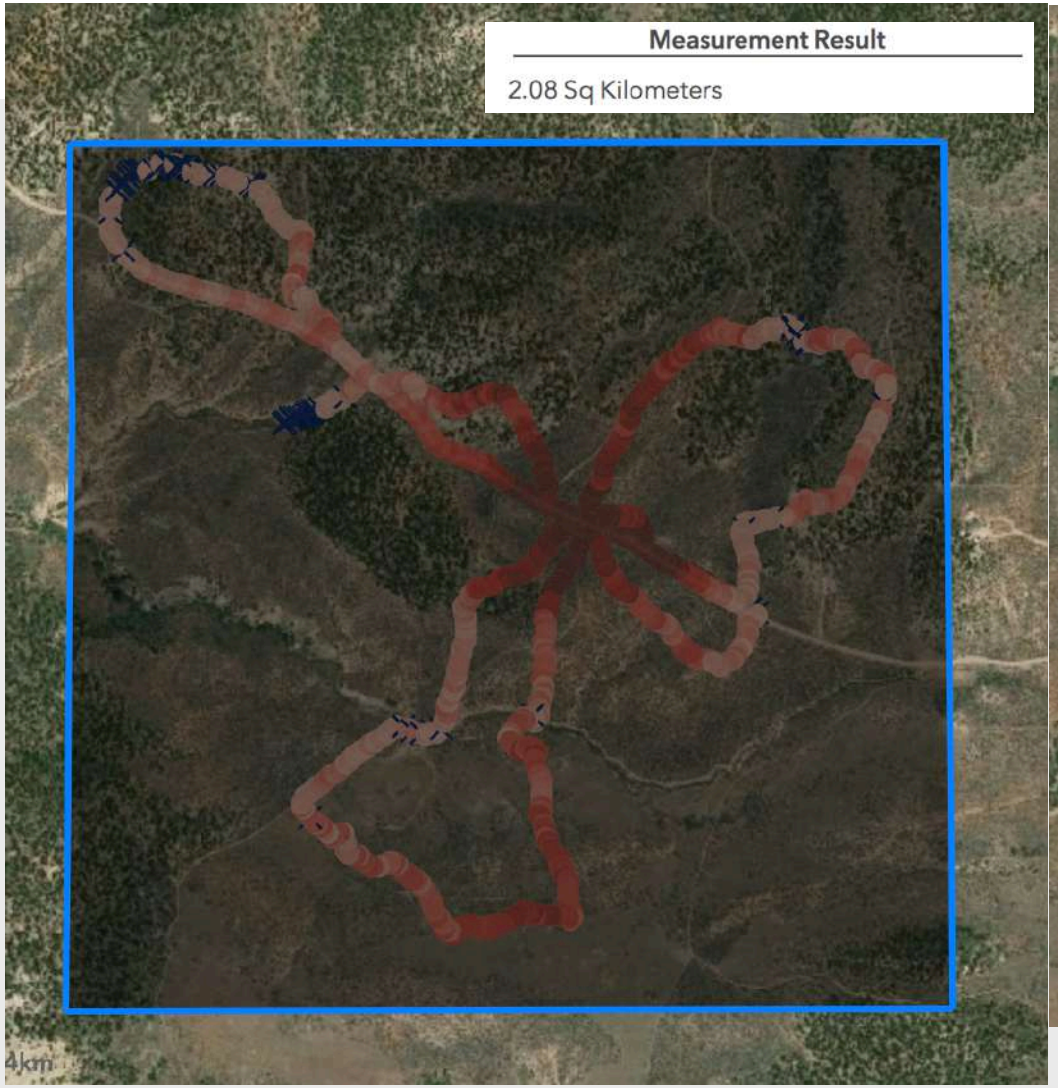
Reference signal received power (RSRP), is the power of the reference signals.

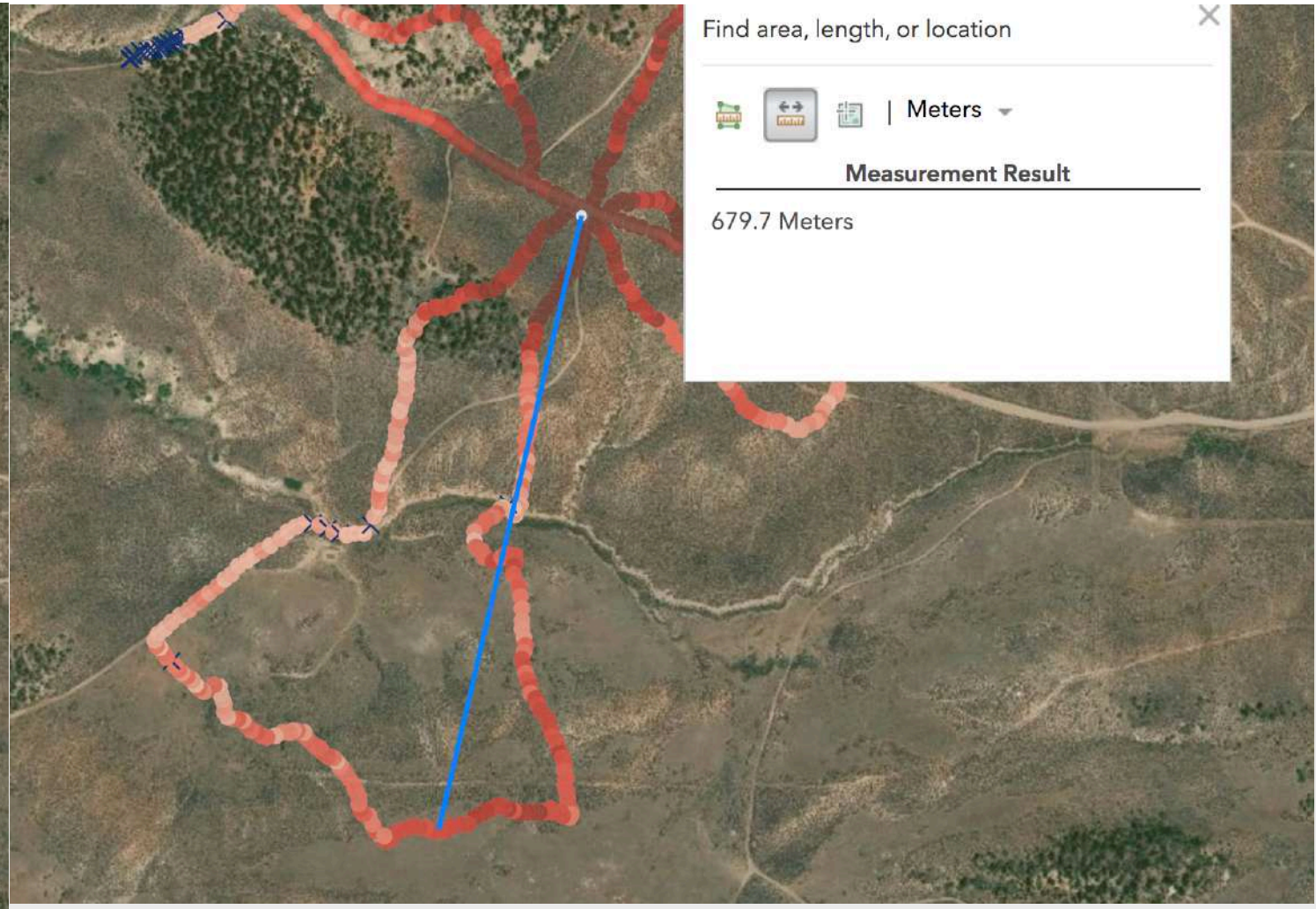
3GPP defined metric for LTE coverage prediction.



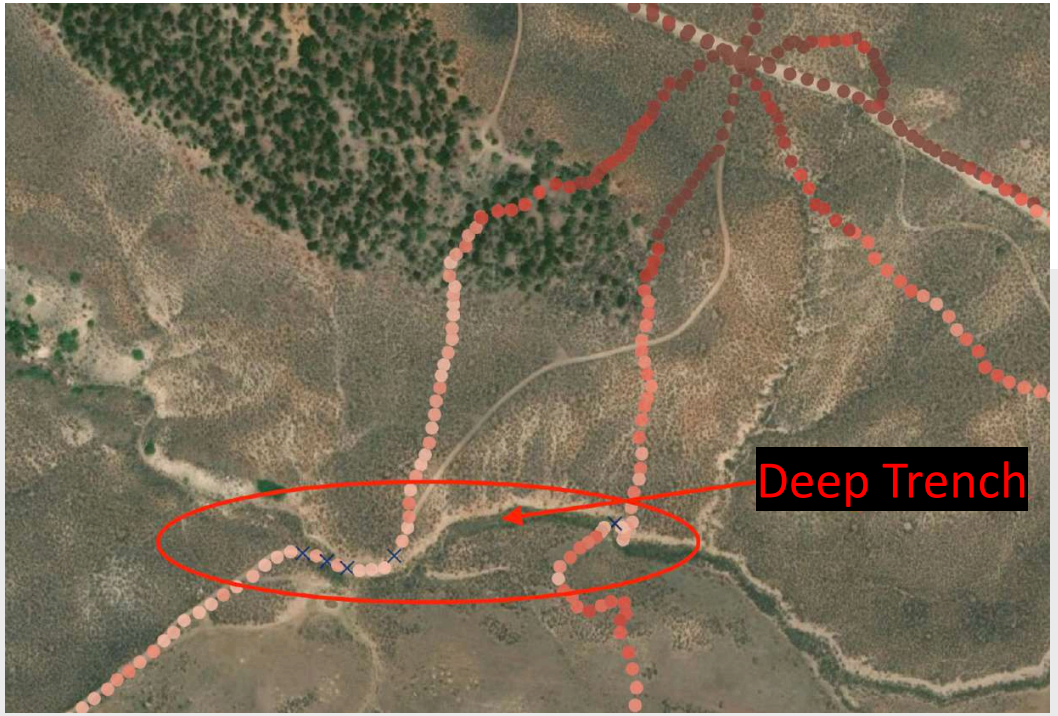
Dataset

In total, the area measured was about 2 km^2 (less than a square mile).





Dataset



Dataset

Out of Coverage

Dataset

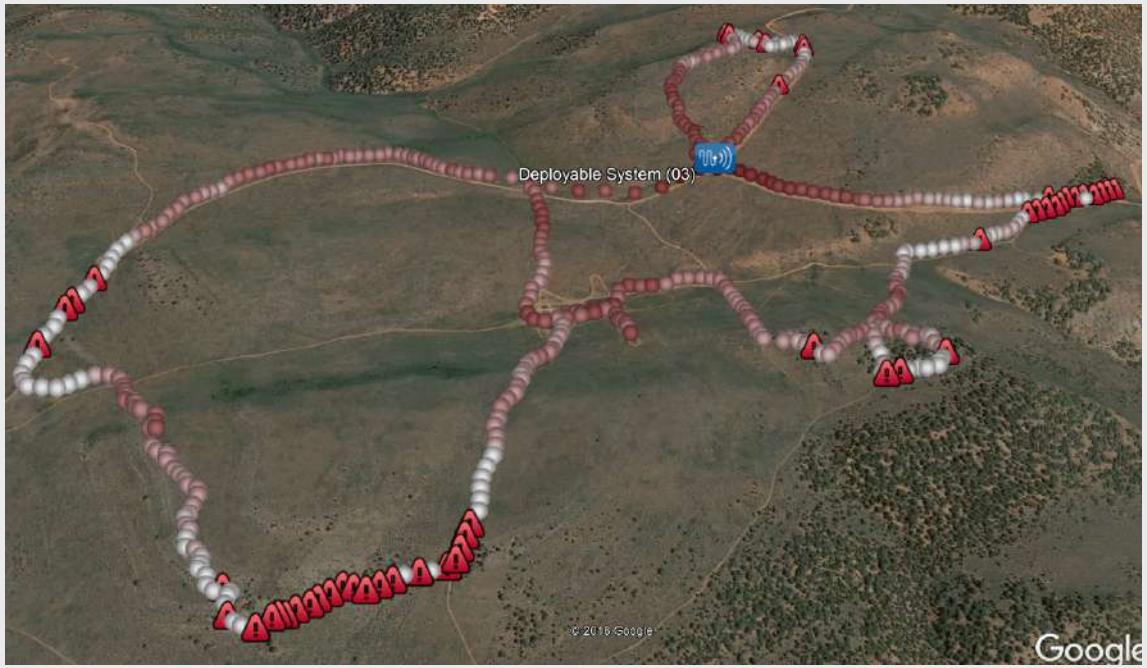

Hill
© 2018 Google
Image Landsat / Copernicus
Google Earth
1999
Imagery Date: 6/23/2017 39°41'42.15" N 106°56'37.84" W elev 7510 ft eye alt 7607 ft

Dataset

0.5 m separation (1.7 ft or 1.28 wavelengths)

Dataset

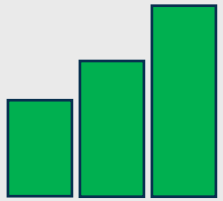
7 ft (no mast)

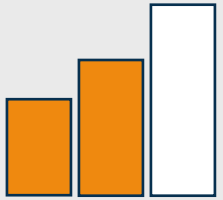


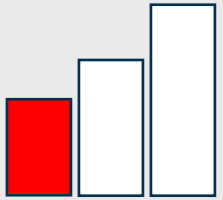
14 ft (mast)

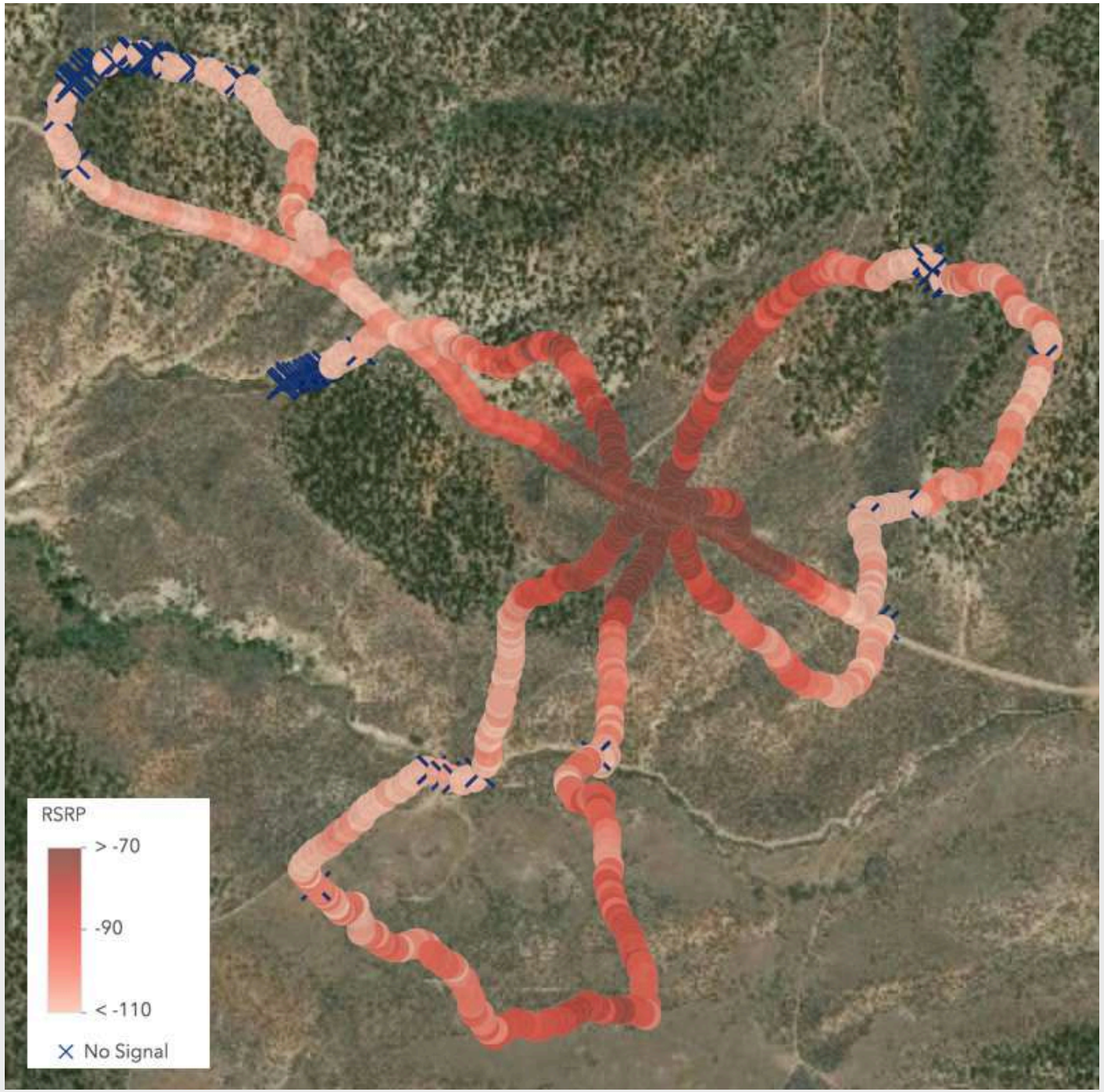
Translation

What is RSRP? What do the colors mean? Why is it Negative?

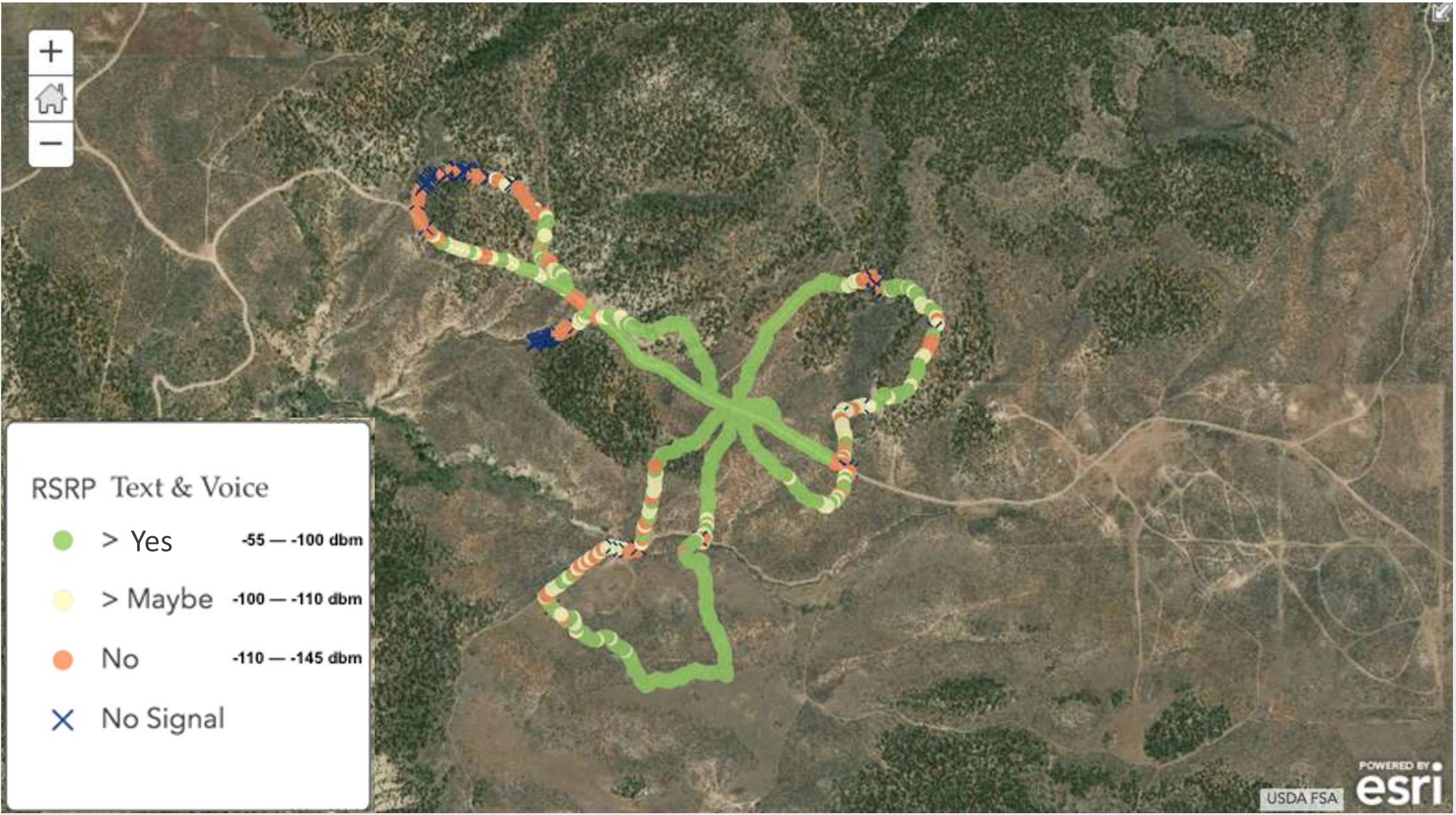








Translation



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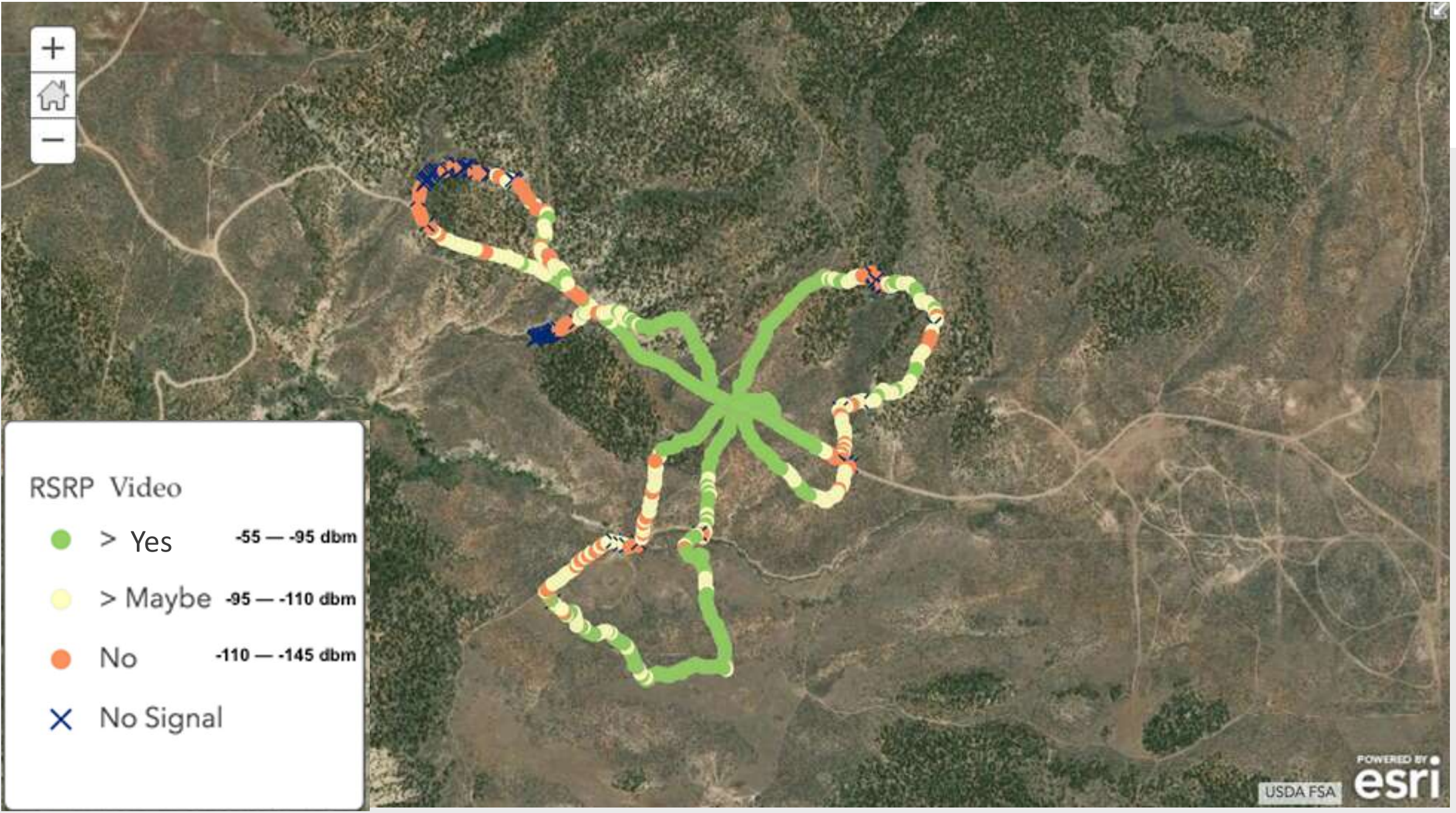
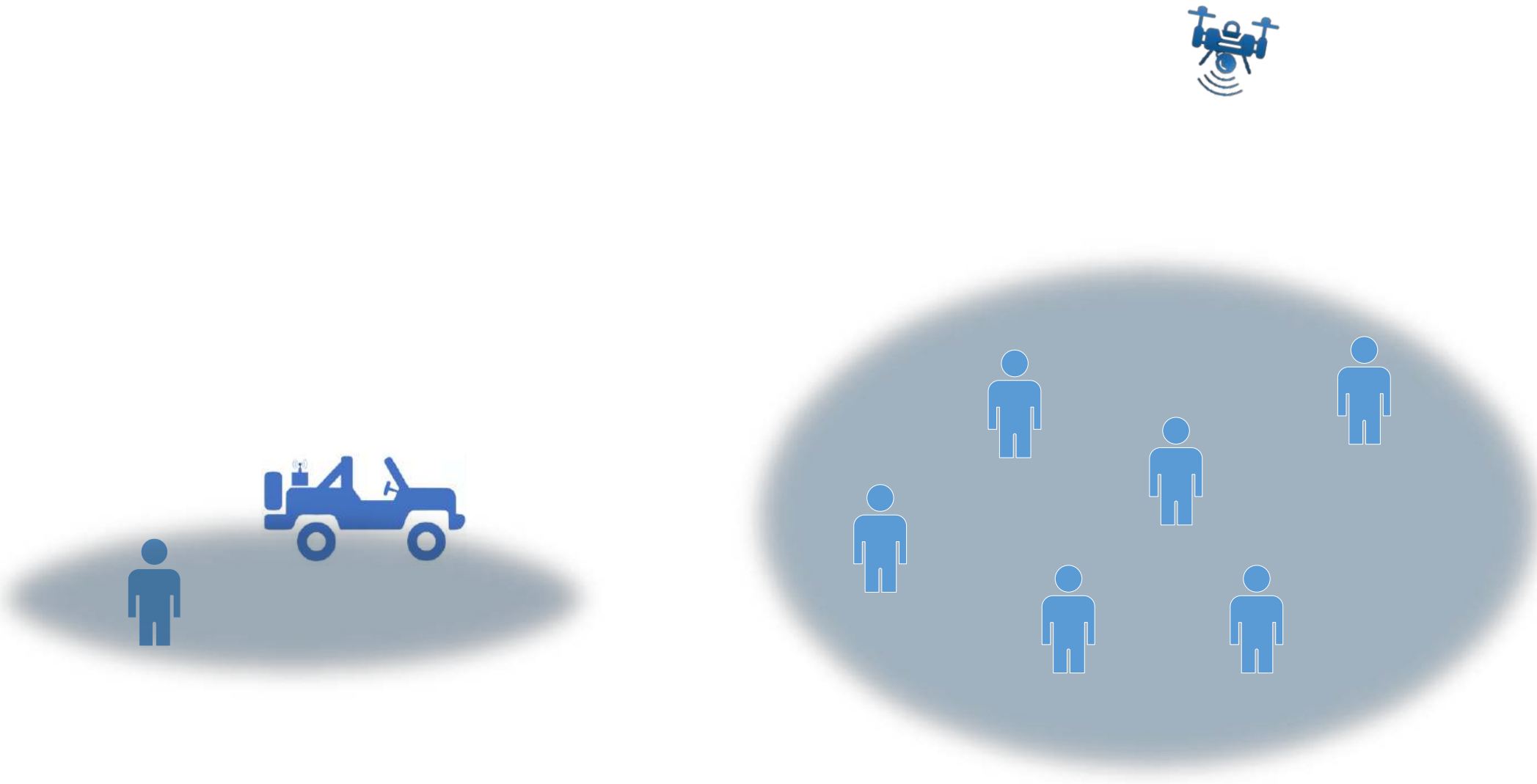


Future: Tech to Protect

The objective of this contest is to enable participants to create prototype network diagnostic tools to help emergency responders understand what coverage a broadband deployable system can provide.

Line of Sight is King



Drones for Public Safety Communications

Communication challenge for first responders

- Areas with no/degraded coverage
- Non-accessible terrain

Drones for Public Safety Communications

Public Safety Drone Survey

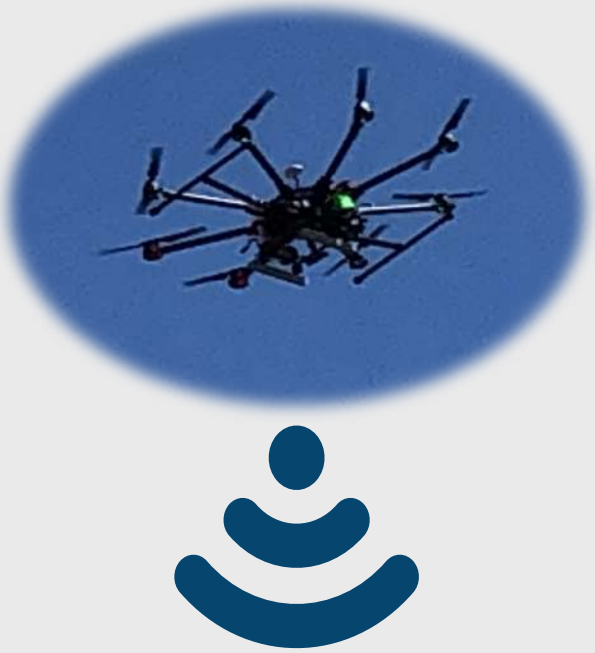
(May 2019)

>94% **Would have benefited from wireless communication**

>63% **Agencies had some type of drone operation in the last 5 years**

(Note: statistics based on more than 170 survey respondents)

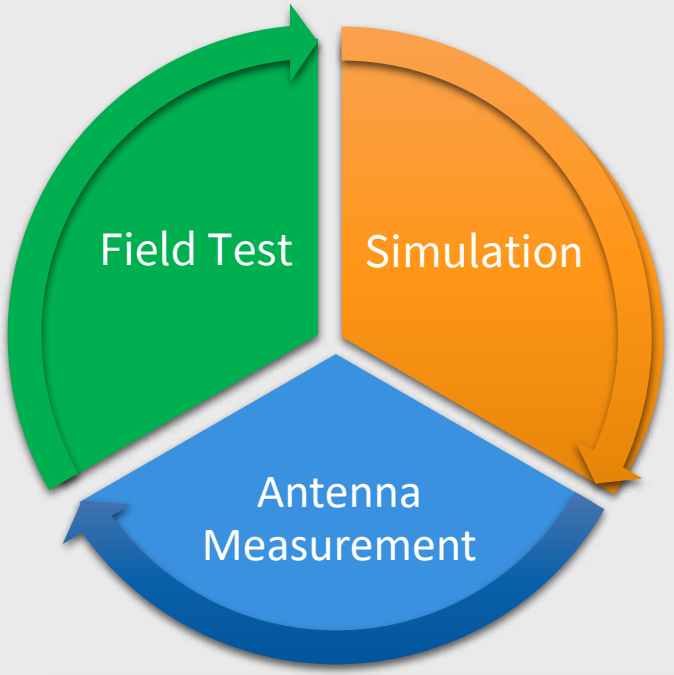
Drones for Public Safety Communications

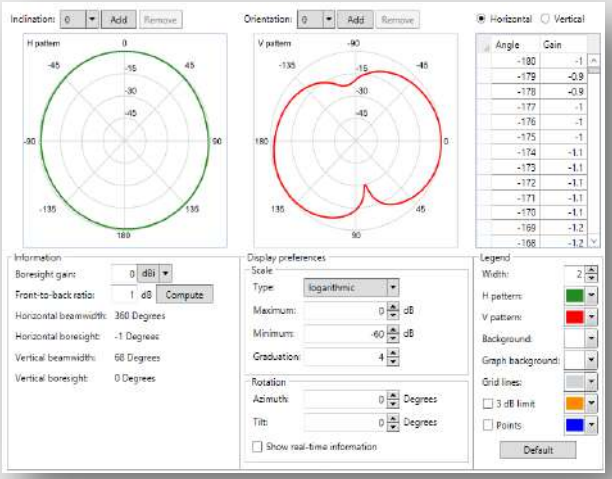


- **Need for communication**
  - ✓ **Anytime**
  - ✓ **Anywhere**
- **For specific missions, drones carrying communication systems show great potential in fulfilling this need**

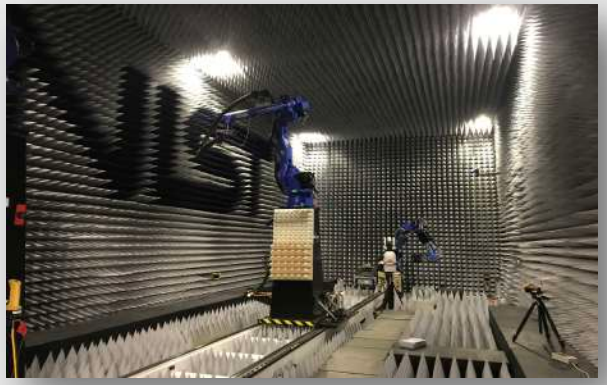
Drones and Communication Research at PSCR

Field Test
(Boulder, CO)





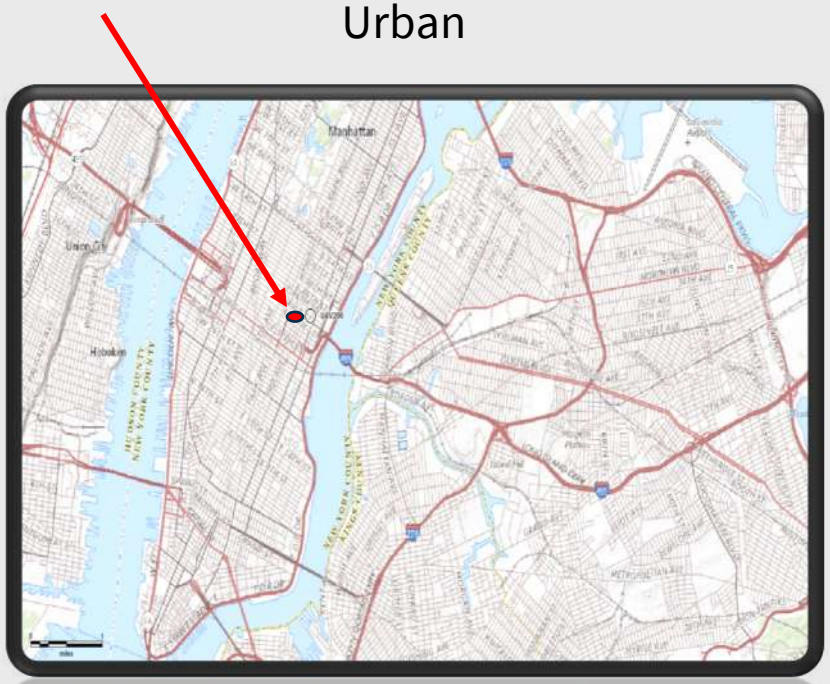
Sample of antenna pattern used in simulation



Anechoic Chamber at
NIST (Boulder, CO)

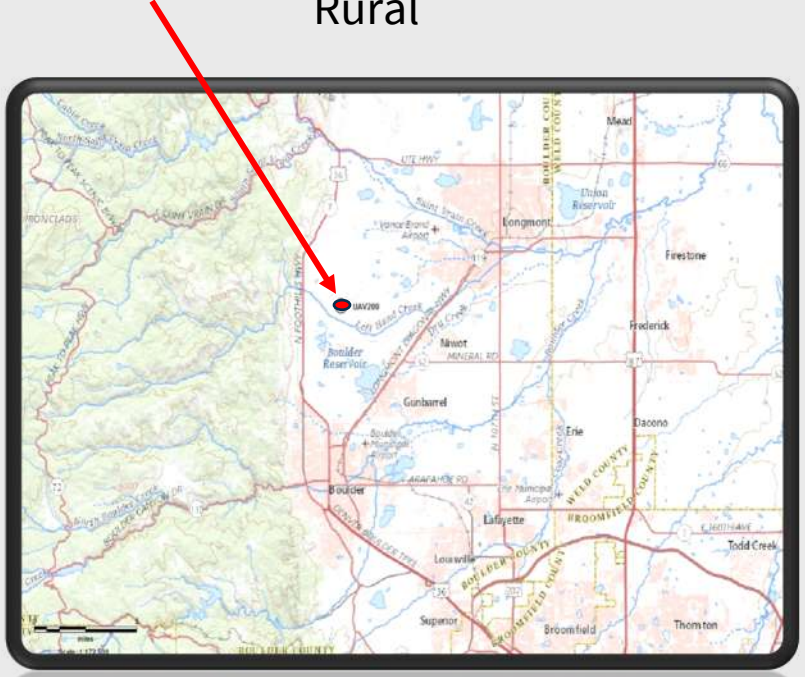
Drones and Communication Research – Simulation Scenarios

Urban



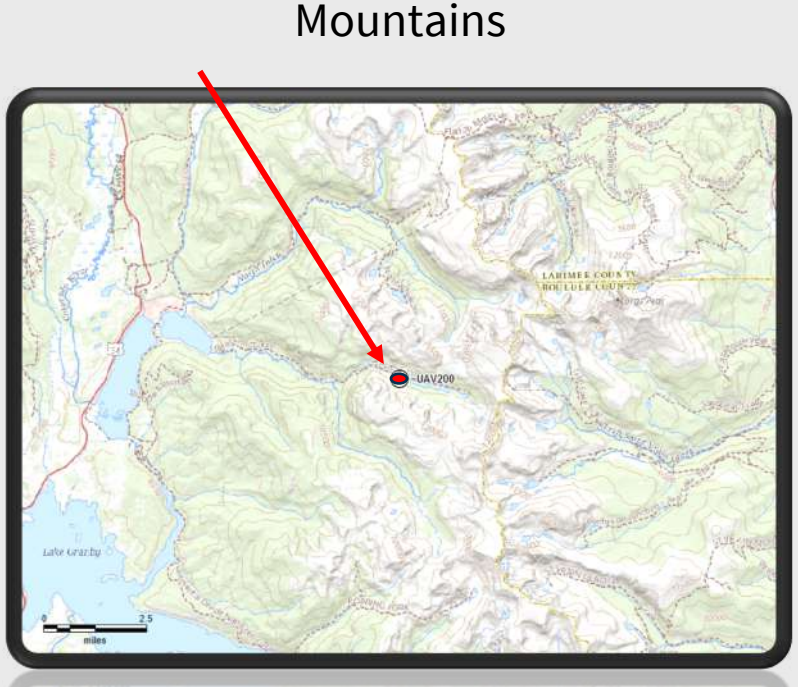
Manhattan, NY
40.750983N, -73.972874W

Rural



Boulder, CO
40.120394N, -105.2481960W

Mountains

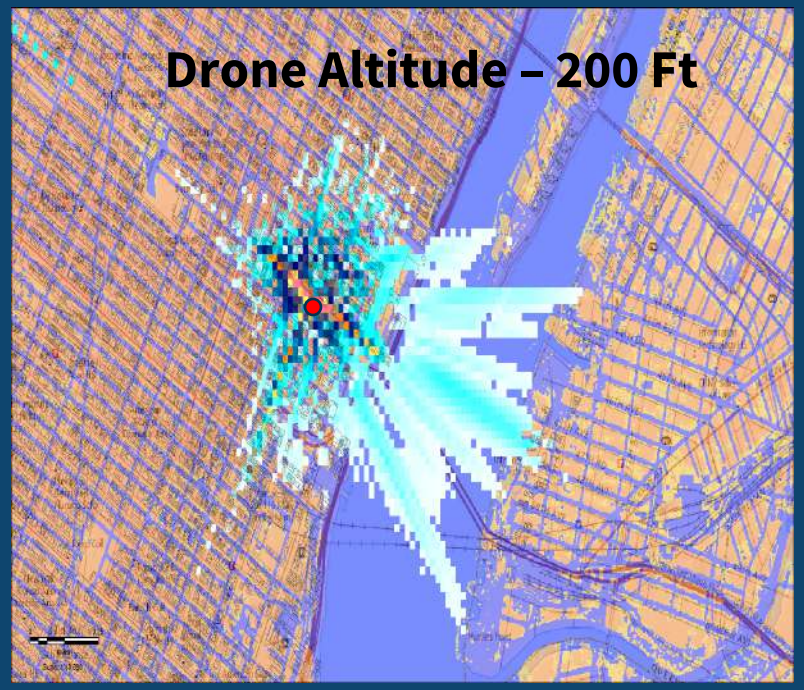


Boulder, CO
40.22760N, -105.716700W

Drone Location

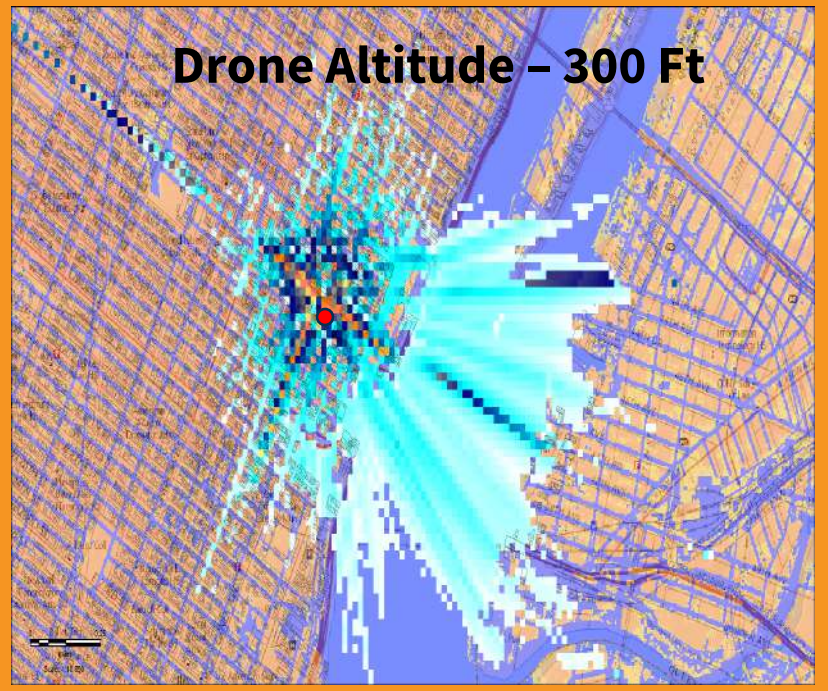
UAS and Antenna Measurement Research - Simulation

Urban Scenario



RSRP (dBm)

-70 to -60
-80 to -70
-90 to -80
-100 to -90
-110 to -100
-120 to -110
-130 to -120



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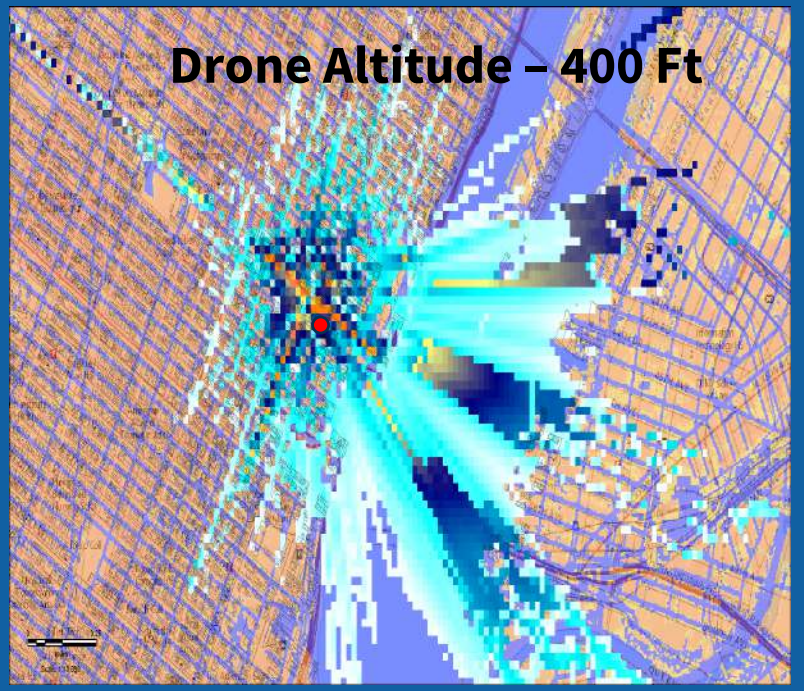

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-70 to -60
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-110 to -100
-120 to -110
-130 to -120

UAS and Antenna Measurement Research - Simulation

Rural Scenario

Drone Altitude – 200 Ft

RSRP (dBm)

-70 to -60
-80 to -70
-90 to -80
-100 to -90
-110 to -100
-120 to -110
-130 to -120

Drone Altitude – 300 Ft

RSRP (dBm)

-70 to -60
-80 to -70
-90 to -80
-100 to -90
-110 to -100
-120 to -110
-130 to -120

Drone Altitude – 400 Ft

RSRP (dBm)

-70 to -60
-80 to -70
-90 to -80
-100 to -90
-110 to -100
-120 to -110
-130 to -120

UAS and Antenna Measurement Research - Simulation

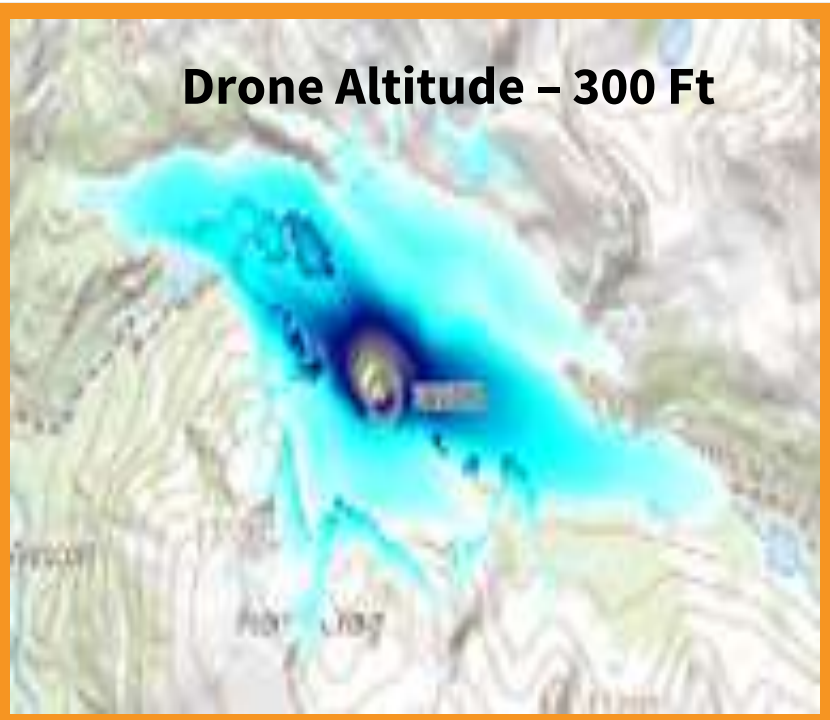
Mountains Scenario

Drone Altitude – 200 Ft

RSRP (dBm)

-70 to -60
-80 to -70
-90 to -80
-100 to -90
-110 to -100
-120 to -110
-130 to -120

Drone Altitude – 300 Ft



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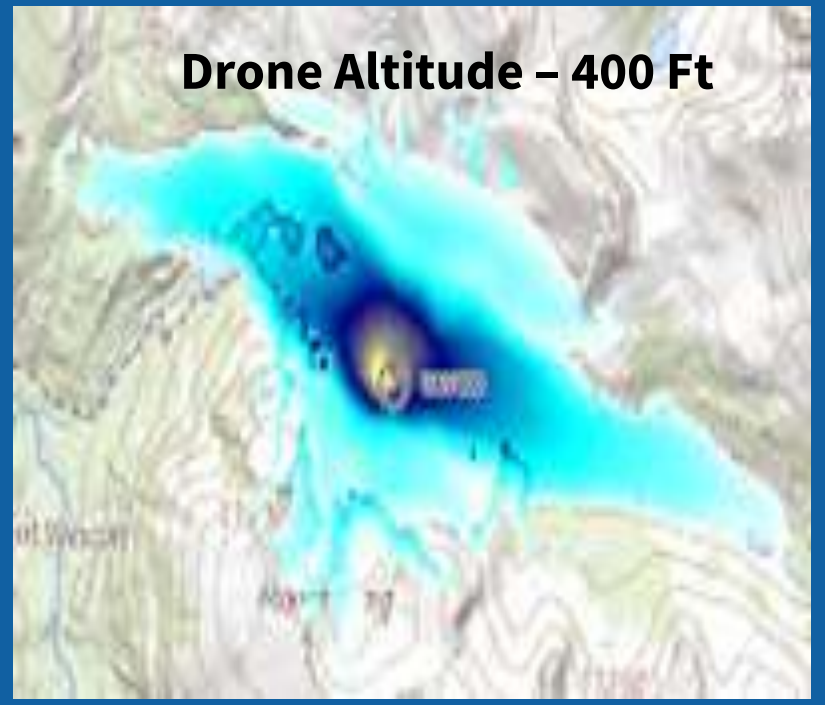

RSRP (dBm)

-70 to -60
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-130 to -120

Drones and Communication Research
Anechoic Chamber Antenna Measurement Testing

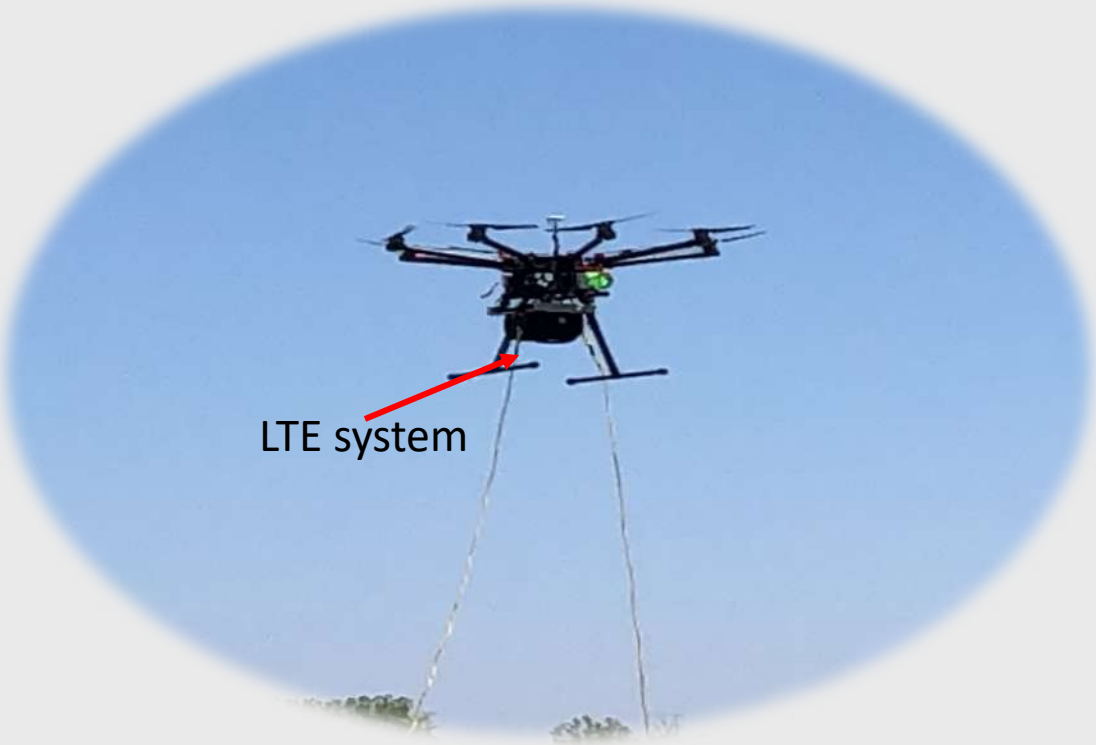
NIST Anechoic Test Chamber – Boulder, CO

Robotic arm with 6 degrees of freedom

*Planned for 2019

Drones and Communication Research – Field Testing

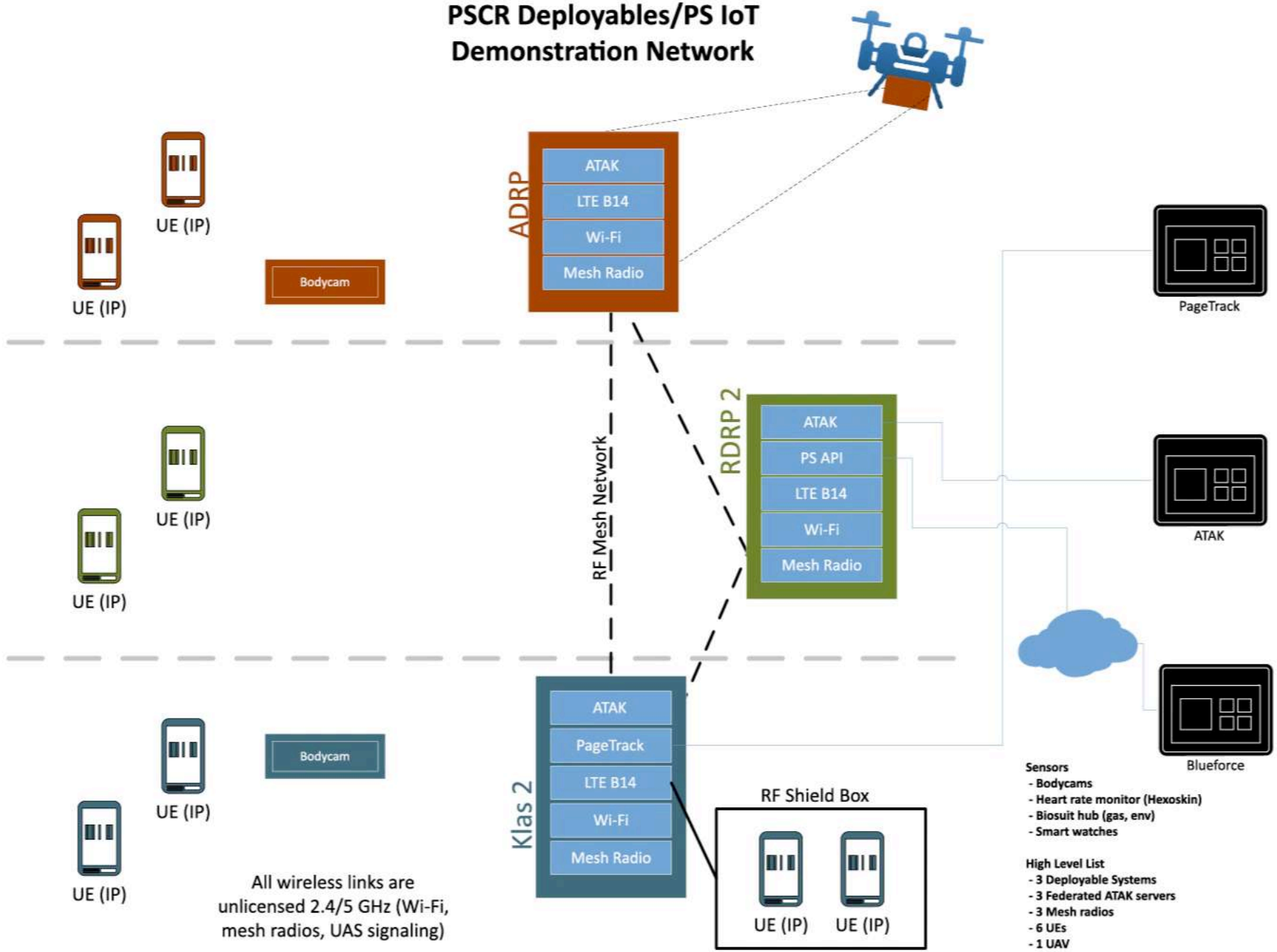
Safety Flight – May 2019



Drones and Communication Research – YOU CAN HELP US


NIST
PSCR
Questions?
Please join us at our demo table!
Michigan Ballroom

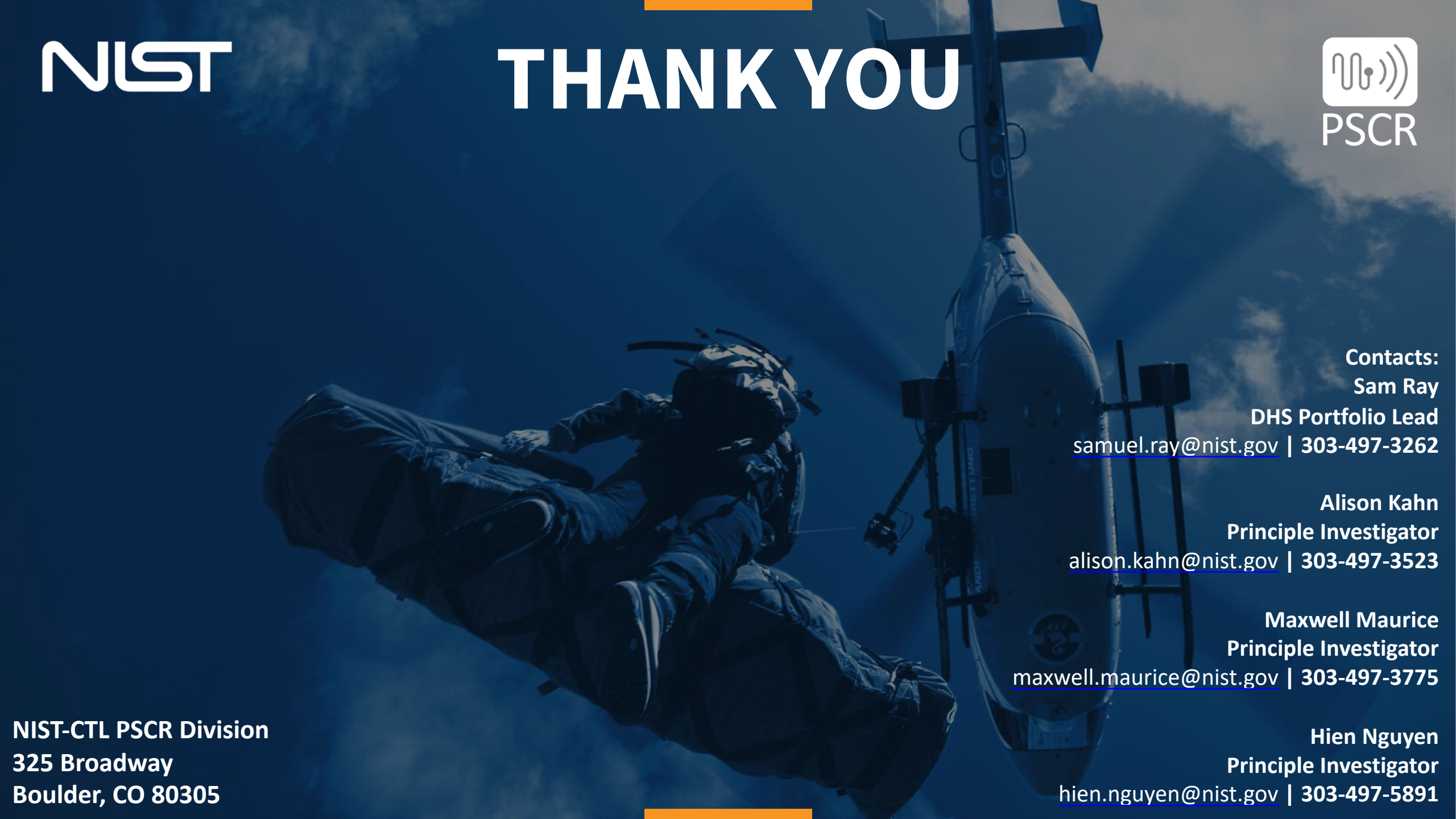
PSCR Deployables/PS IoT Demonstration Network



Sensors
- Bodycams
- Heart rate monitor (Hexoskin)
- Biosuit hub (gas, env)
- Smart watches

High Level List
- 3 Deployable Systems
- 3 Federated ATAK servers
- 3 Mesh radios
- 6 UEs
- 1 UAV

THANK YOU



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#PSCR2019

Get your hands on the tech!

Demos Open

BACK TOMORROW

8:00 AM