CBRS Sharing Ecosystem Assessment (SEA)

Briefing to WInnForum

6/26/2024 – DRAFT – PRE-DECISIONAL

NASCTN
National Advanced Spectrum and Communications Test Network

Agenda

- NASCTN Program & CBRS SEA Project Overview
- Modeling Informed Sensor Site Selection
- Field Update
- Data Sharing Plan
- Task 1 Test Plan for Review
- Next Steps and Schedule
- Q & A

Bottom Line Up Front (BLUF)

- High level examples of modeling and simulation
- Progress towards deployment
- Data sharing plan of pre-publication data
- Test Plan and comments

National Advanced Spectrum and Communications Test Network (NASCTN)

NIST hosts NASCTN Program Office and a core team to ensure rapid response, access to key skills, consistency, and knowledge management.

NASCTN is a multi-agency, chartered organization that includes DoD, NASA, NIST, NOAA, NSF, and NTIA.

The purpose of NASCTN is to improve opportunities for successful spectrum sharing through accurate, reliable, and unbiased measurements and analyses.

NASCTN does not make policy recommendations.

Through its members, NASCTN provides:

- **Robust test processes** and **validated measurement data** necessary to develop, evaluate and deploy spectrum sharing technologies
- Best practices for spectrum sharing **metrology, testing, measurement, and data analysis** to improve quality of information provided to the spectrum community
- **Access** to testing capabilities, spectrum test data, analyses, and reports
- **Protects** all controlled information (proprietary, sensitive, classified)

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National Advanced Spectrum and Communications Test Network

TEST REQUEST: DoD CBRS Sharing Ecosystem Assessment (SEA) Program

Test Request: CBRS Sharing Ecosystem Assessment (SEA)
Collect data required for DISA PEO Spectrum to ascertain the effectiveness of the sharing ecosystem between CBRS systems as managed by Spectrum Access Systems (SASs), and DoD systems as monitored by Environmental Sensing Capabilities (ESCs). Provide insight into the sharing ecosystem's effectiveness, and track changes in the spectrum environment over time.

Background: DoD 3.5 GHz Transition Plans focus on ecosystem validations, environmental assessments, and continued engagement on refining the CBRS infrastructure. One component was identified for submission to NASCTN, *to evaluate the effectiveness of the CBRS sharing ecosystem to co-exist with DoD radar systems, via independent trusted agent*

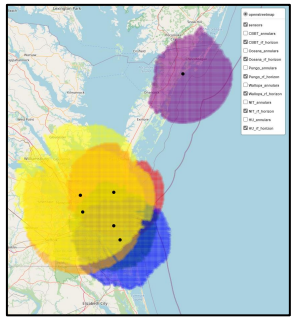
4 Key Objectives

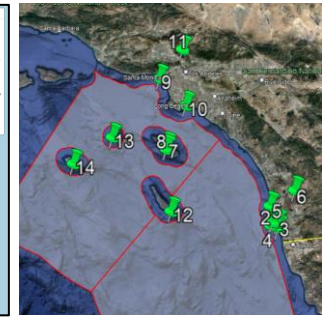
1. Provide data to determine efficacy of permanent sharing between CBRS systems as managed by SAS systems and ESC systems
    - Attempt to obtain corroborating data from the CBRS community stakeholders
2. Collect power levels in the CBRS band through continuous automated observations
3. Collect emissions in the CBRS band in the vicinity of San Diego, CA and Norfolk, VA
4. Collect emissions in the CBRS band within at least one Always-On Dynamic Protection Area (DPA)

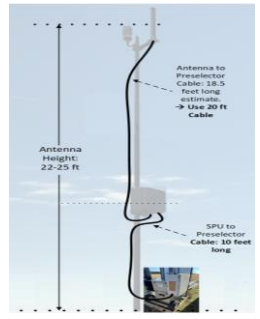
NASCTN SEA Test Framework – Project Approach

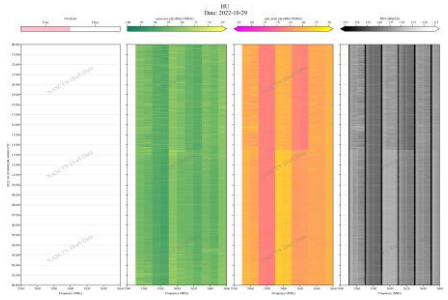
To achieve the 4 objectives, 3 major technical tasks were identified:

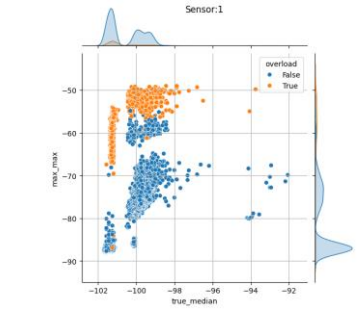
- **Task 1 – Passive Observation in the CBRS Band in Vicinity of Coastal Dynamic Protection Areas (DPAs)**
  - Characterize aggregate emissions within the CBRS band 3550-3700 MHz in the vicinity of at least two Coastal DPAs, with and without DPA activations
  - Assess ecosystem performance to timely respond, and measure increase in background emission due to wireless system deployments over time
- **Task 2 – Passive Observation in the CBRS Band in Always-On DPAs**
  - Characterize aggregate emissions within the CBRS band 3550-3700 MHz in at least one Always-On DPA or ground-based DPA (GB-DPA)
  - Assess ecosystem performance to limit CBRS emissions in the Always-On DPA
- **Task 3 – Long Term Data Analysis and Support**
  - Collection and analysis of Passive Observations throughout sensor deployment
  - Support transfer of data to a DoD data repository











Modeling Informed Sensor Site Selection

NASCTN SEA Modeling

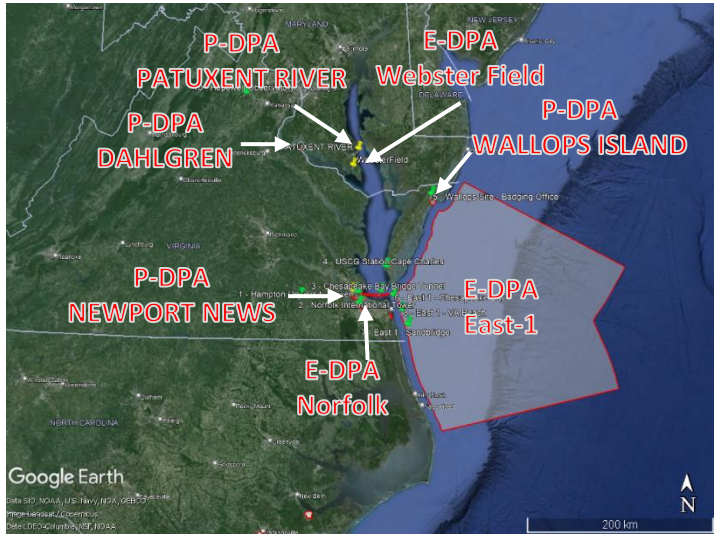
	E-DPA, P-DPA, GB-DPA
	Candidate SEA sensor location

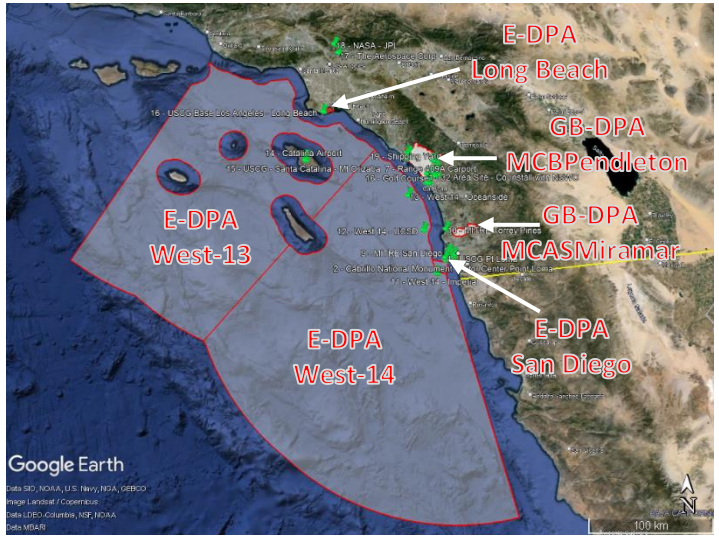
Objectives

- Utilize modeling as a tool to help informing site selections for NASCTN SEA sensors to measure emissions in the CBRS band
- Estimate aggregate emissions from CBSDs to protection points and candidate SEA sensor locations
  - DPA inactive (emissions from neighbor list CBSD grants)
  - DPA active (emissions from keep list CBSD grants)

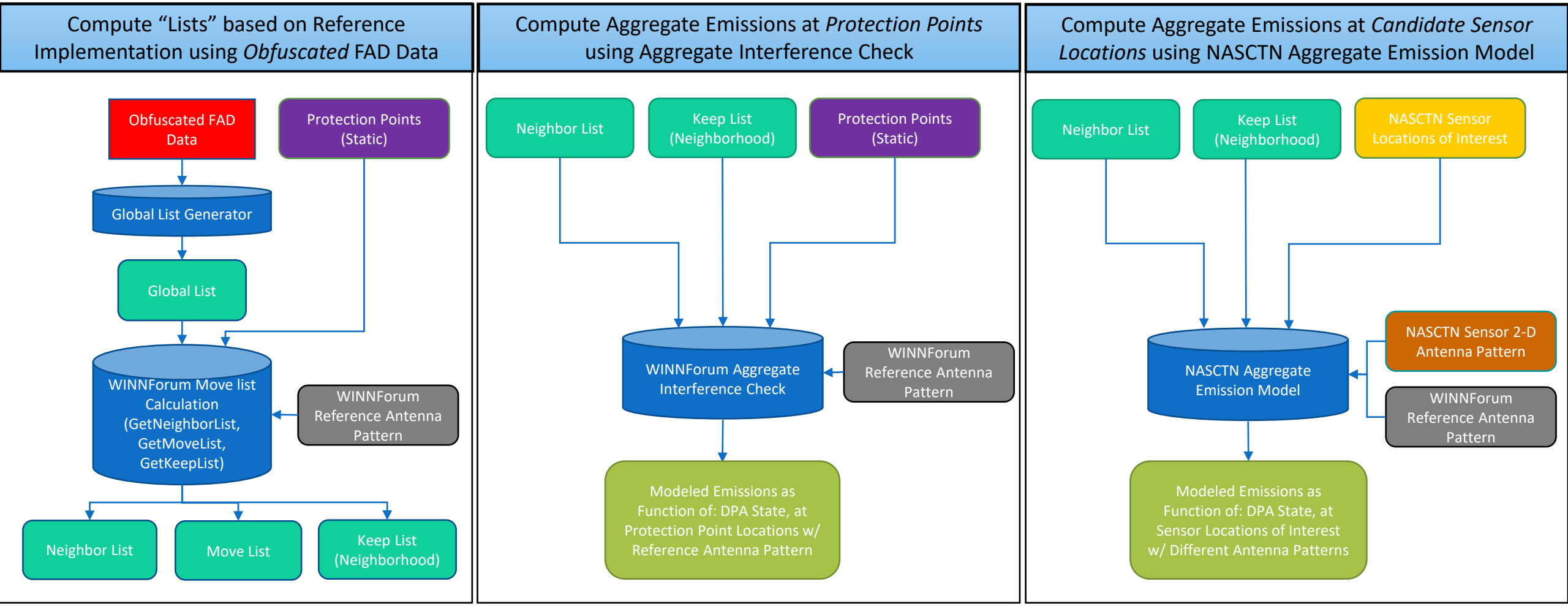
Approach

- Leverage obfuscated full activity dump (FAD) data provided by industry and NTIA ITS
- Adapt Wireless Innovation Forum (WInnForum) reference DPA move list algorithm
- Consider recent proposed relaxation of DPA changes
  - 8 dB EIRP reduction (duty cycle and network loading factor)
  - P.2108 median clutter loss applied to CBSDs with ≤ 6 m AGL
  - ITM median path loss without Monte Carlo simulation
  - Smaller DPA neighborhoods

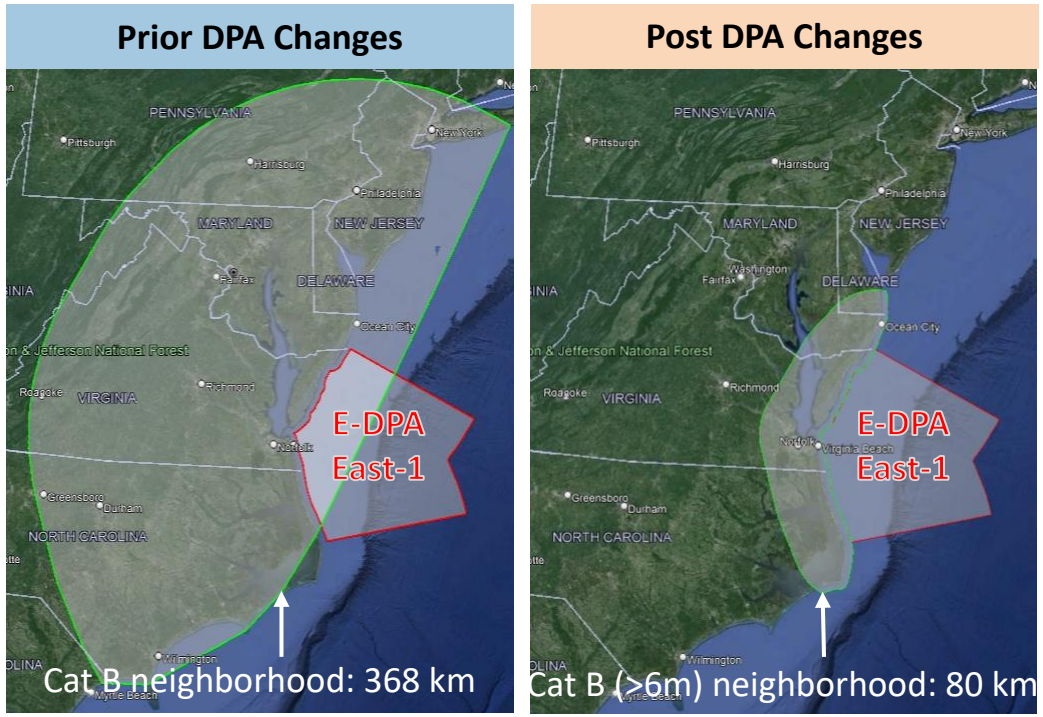


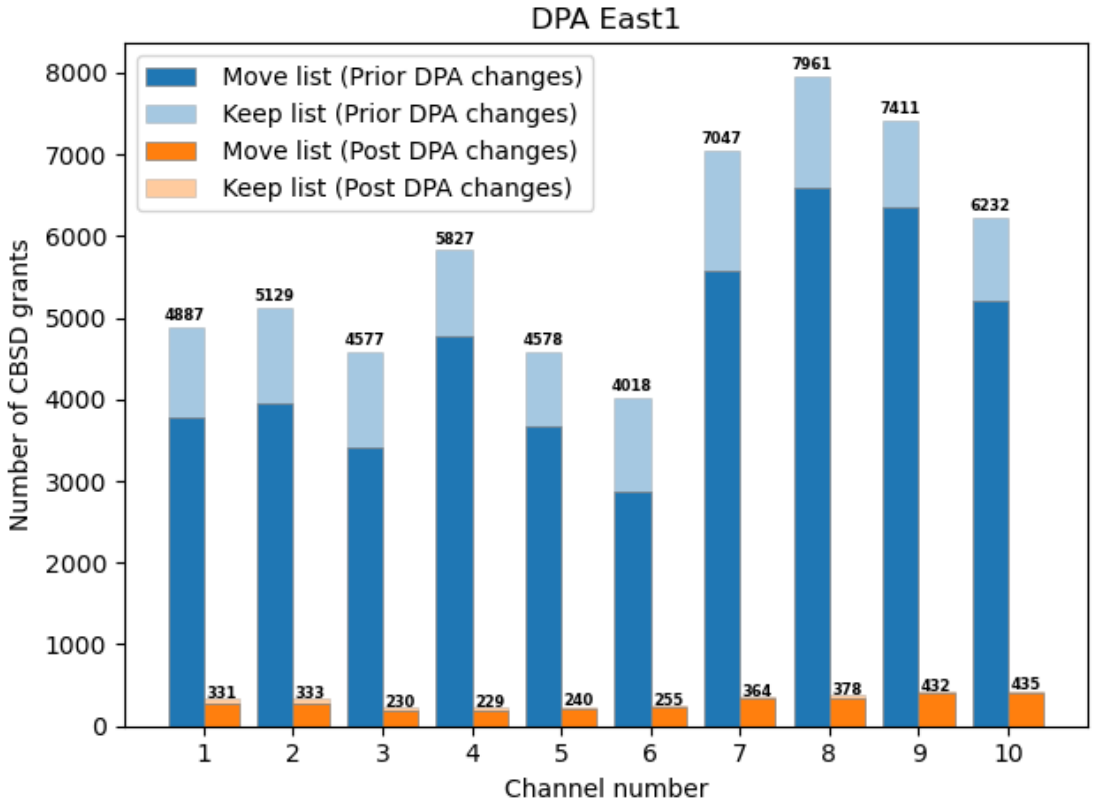


Modeling Block Diagram



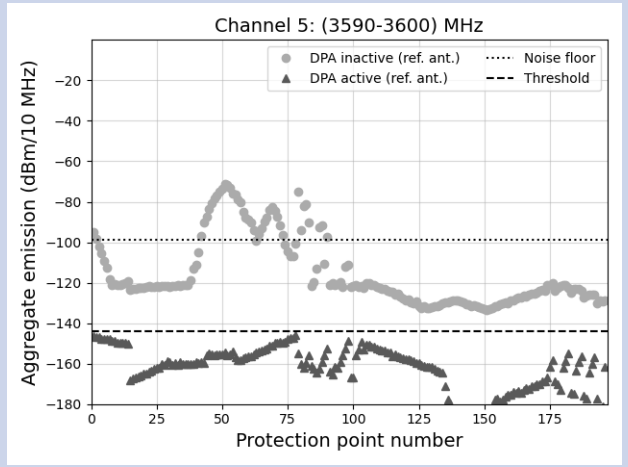
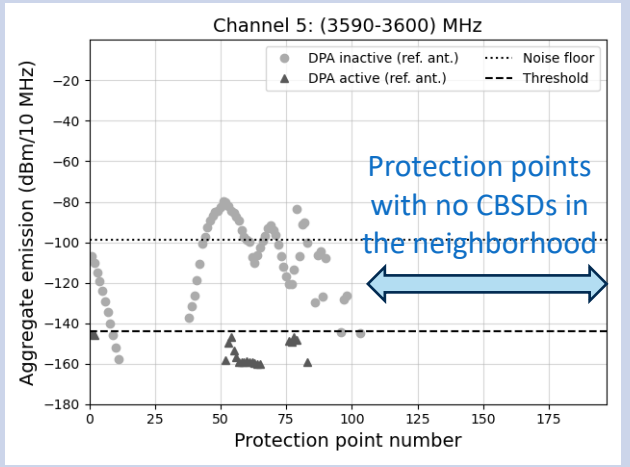
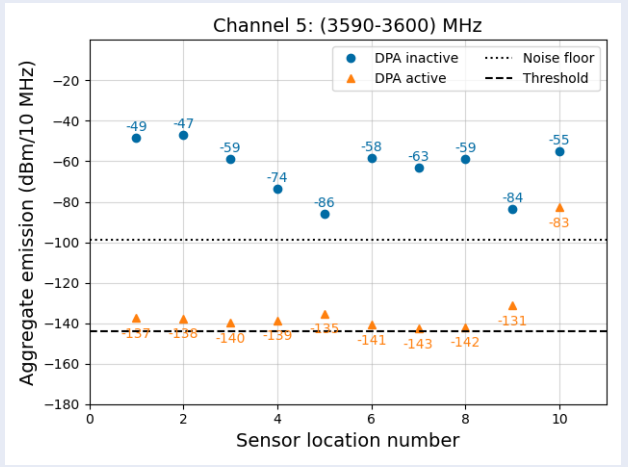
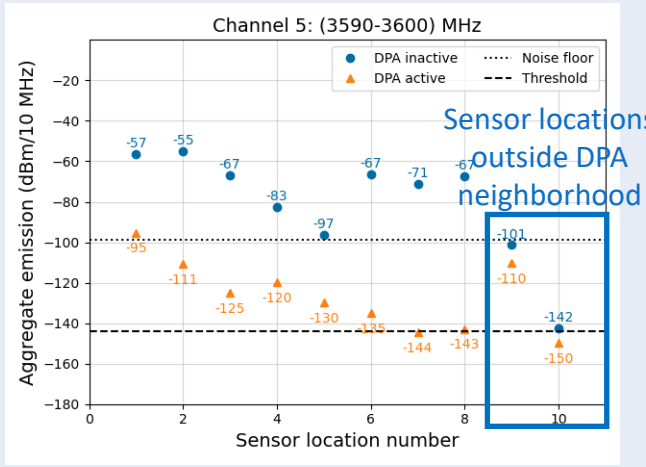
Example – East-1 Move List & Keep List



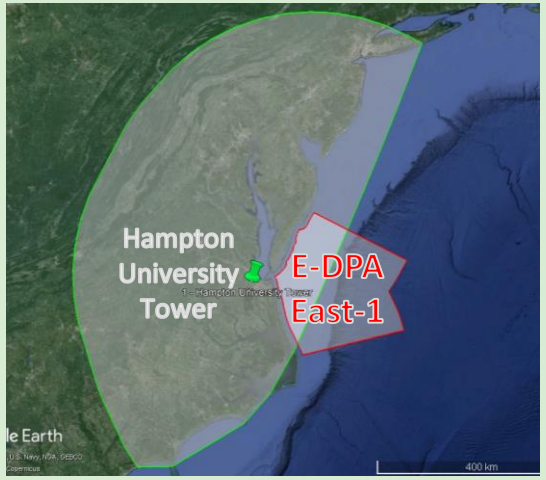
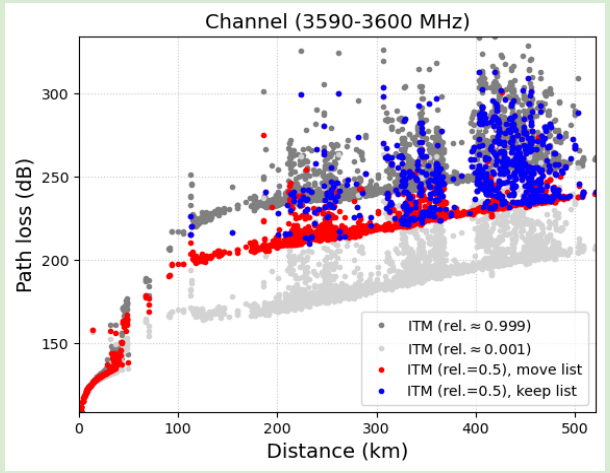
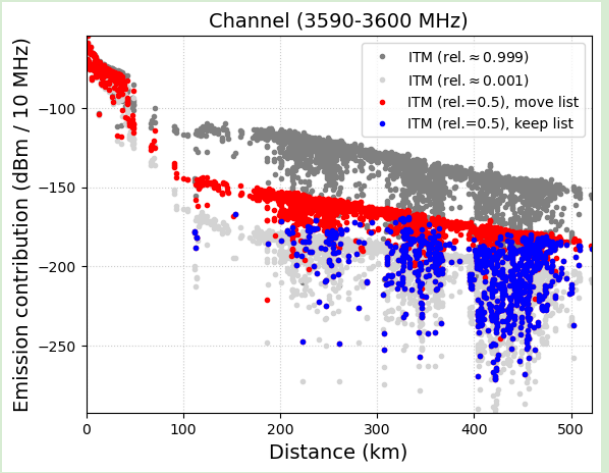
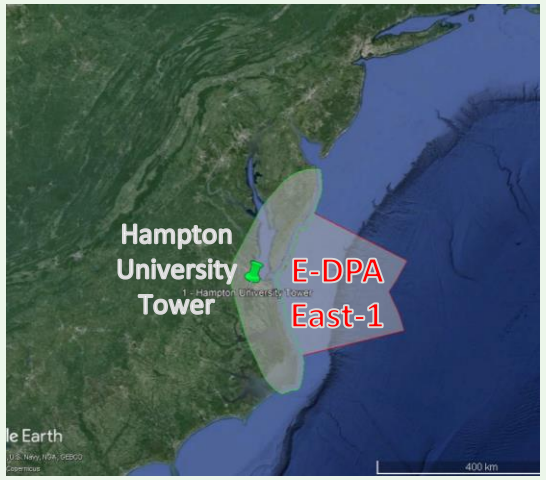
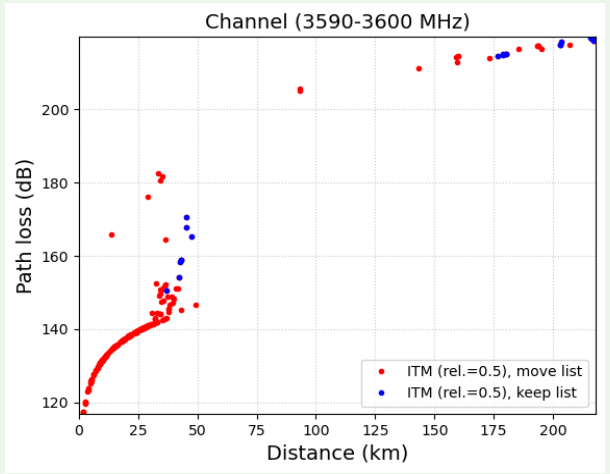
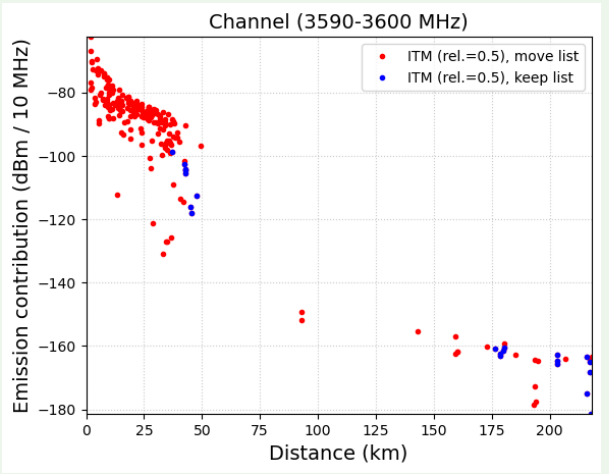


- Randomized CBSD deployment generated from 2024-01-01 obfuscated FAD data
- With DPA changes:
  - CBSD neighbor list size is decreased due to smaller neighborhoods
  - CBSD move list size is also decreased due to EIRP reduction, clutter, ITM median loss

Example – East-1 Aggregate Emission Calculation

		Prior DPA Changes	Post DPA Changes
Protection Point			
Sensor Location			

Example – Hampton University Sensor Location Calculation

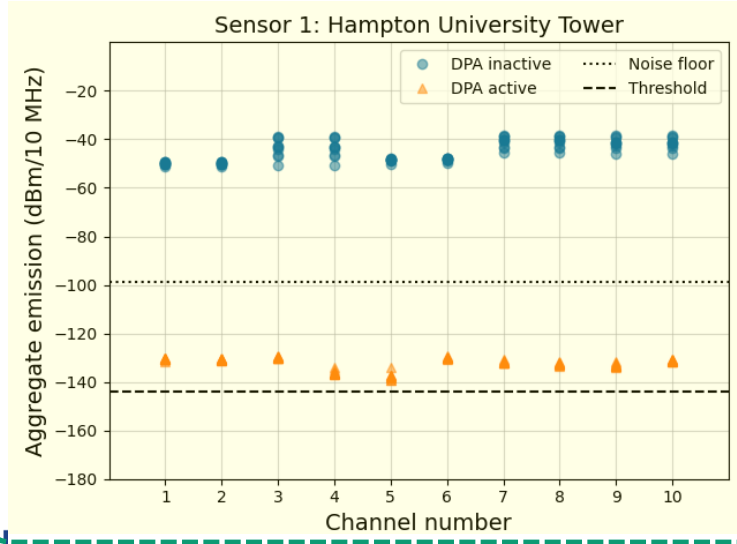
		Path Loss	Emission Contribution
Prior DPA Changes			
Post DPA Changes			

Correlation between Modeling Results and Sensor Measurements

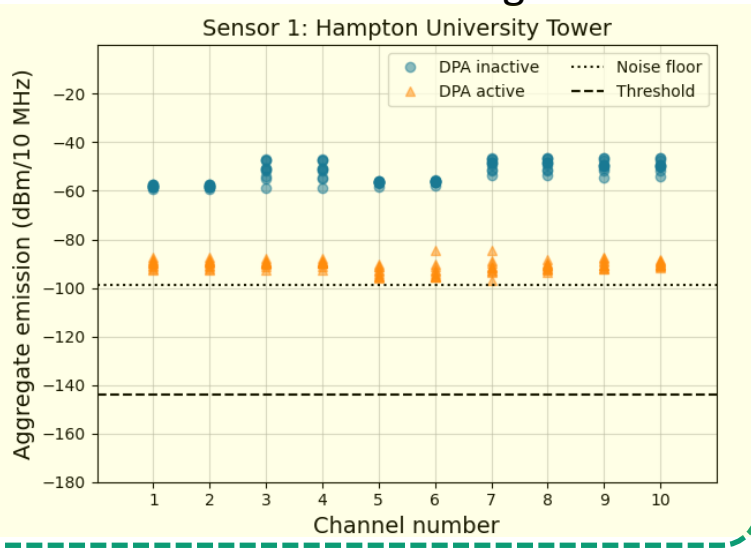
- Correlate modeling results and sensor measurements at Hampton University (HU)
  - Utilize 2024-01-01 obfuscated FAD data (10 randomized CBSD deployments)
  - Extract sensor measurements collected on 2024-01-01
- Understand the offset between modeling results and measurements
  - Provide insights into key technical challenges and assumptions with the current modeling

Modeling Results

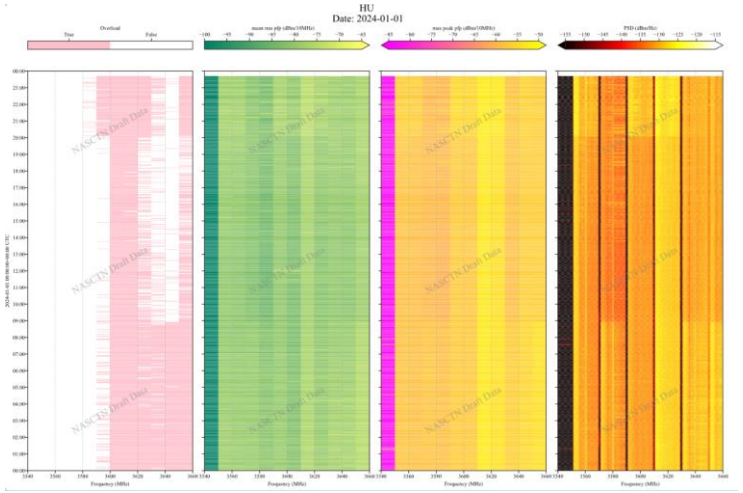
Prior DPA Changes



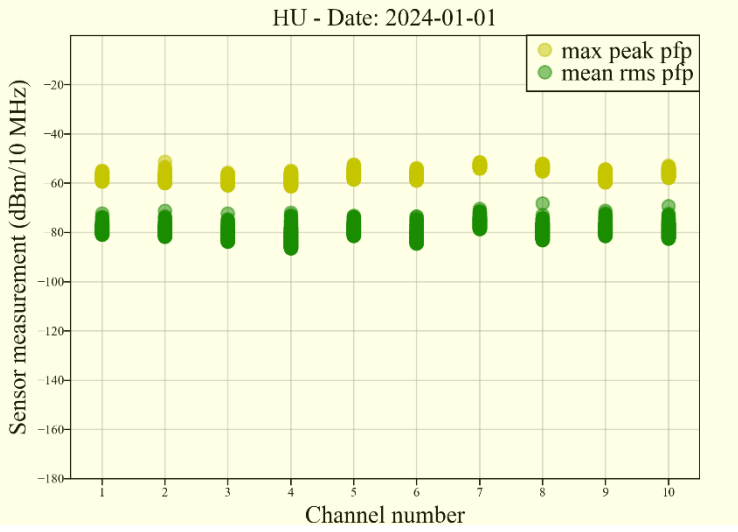
Post DPA Changes



Sensor Measurements



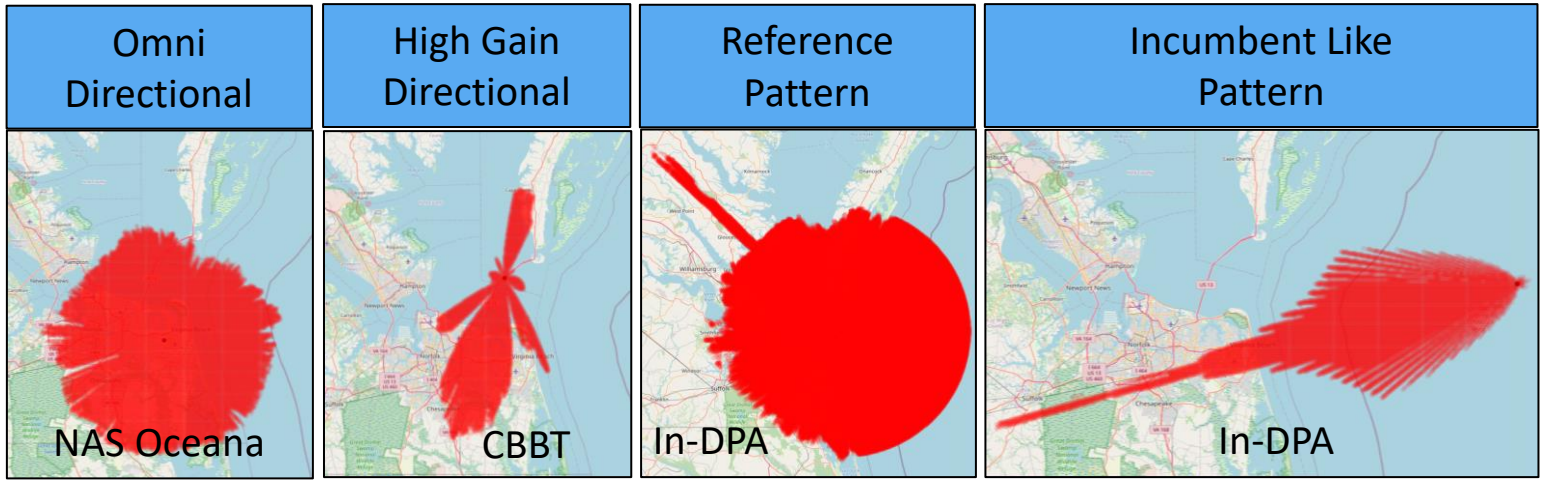
'max peak pfp'
'mean rms pfp'

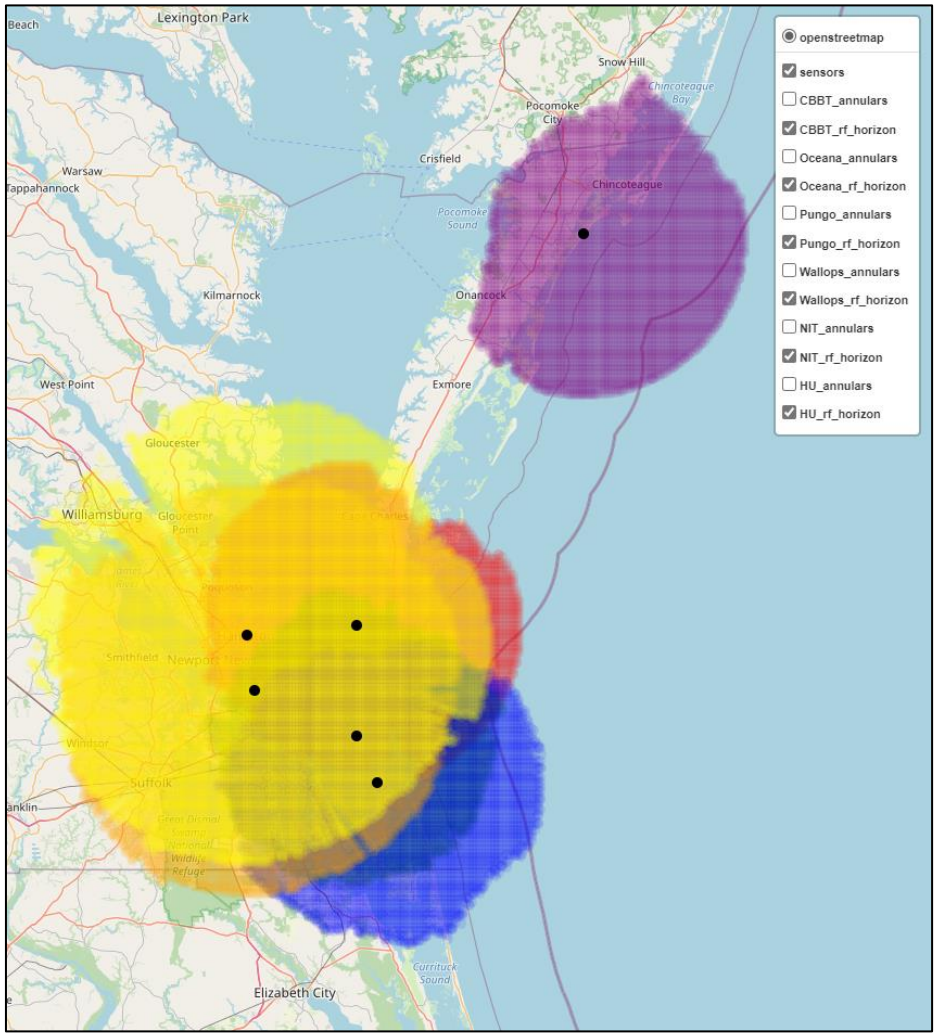


Other Modeling Tools (1)

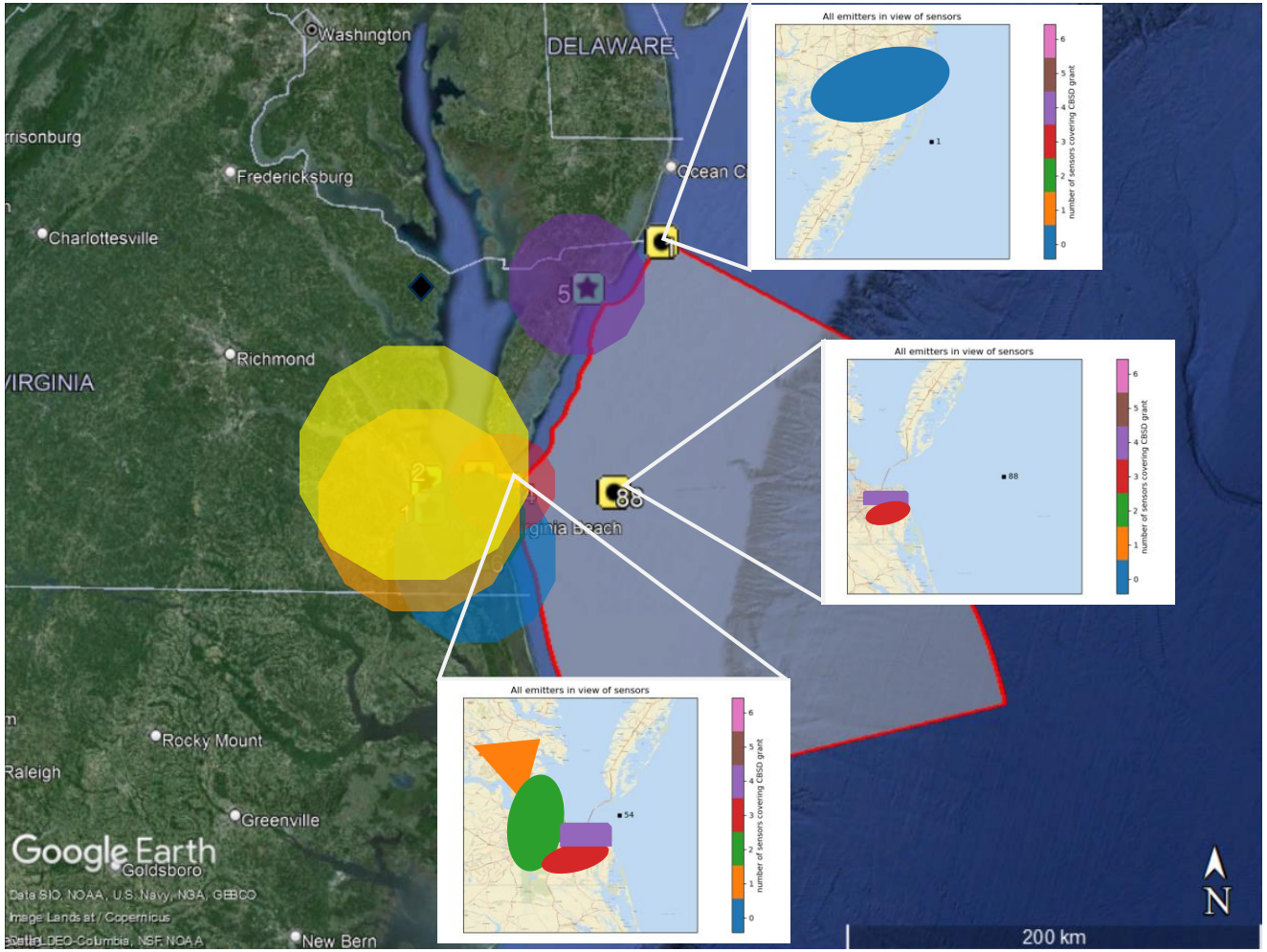
RF Horizon Coverage Visualization

- Estimate NASCTN sensor's detection area of CBSDs to inform site selection for Task 1 and Task 2
- Leverage WInnForum's approach for computing ESC's "whisper zone"
- Adjust parameter configurations suitable for NASCTN sensor design and deployment



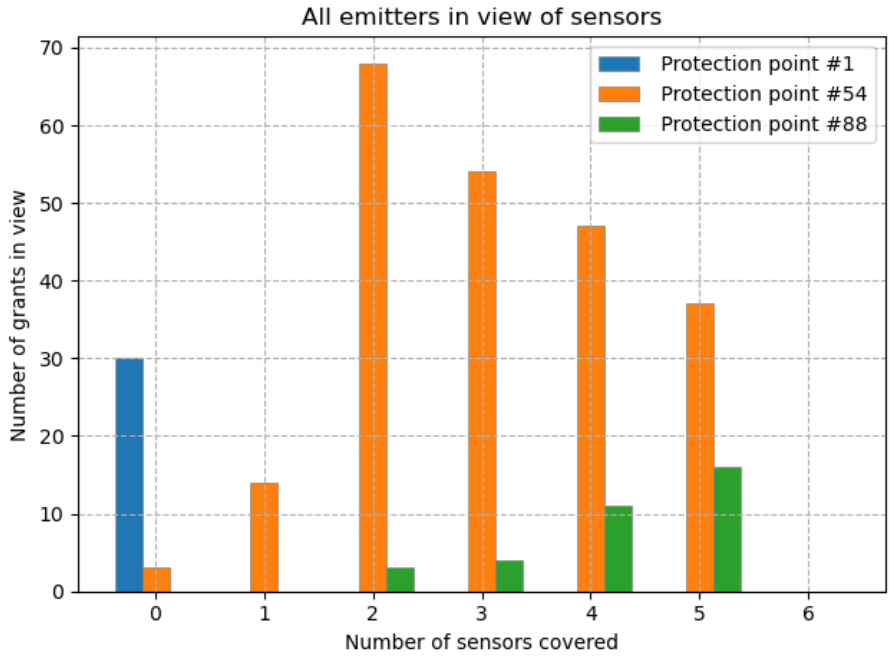


Other Modeling Tools (2)



Emitter Coverage Check

- Assess emitter coverage of a potential SEA sensor deployment laydown in the vicinity of a DPA
- Compare Grant IDs within view between the sensors and the Protection Point prioritized list of Grants
- Examine coverage 'redundancy'



Modeling Uncertainties and Concerns

Technical challenges and assumptions
Derived CBSD deployment from quarterly obfuscated FAD data for each 10 MHz channel
ITM P2P propagation model + P.2108 clutter model
WInnForum's reference DPA move list algorithm
WInnForum's reference aggregate interference check
Aggregate emission model for sensor
Set of 2-D receive antenna patterns/gains
Projected noise floor of sensor

Deviated from real FAD data (CBSD location, height, maxEIRP, channel occupancy, etc.)

Imperfect representation of real-world environment

SAS implementation variations of reference DPA move list algorithm (?)

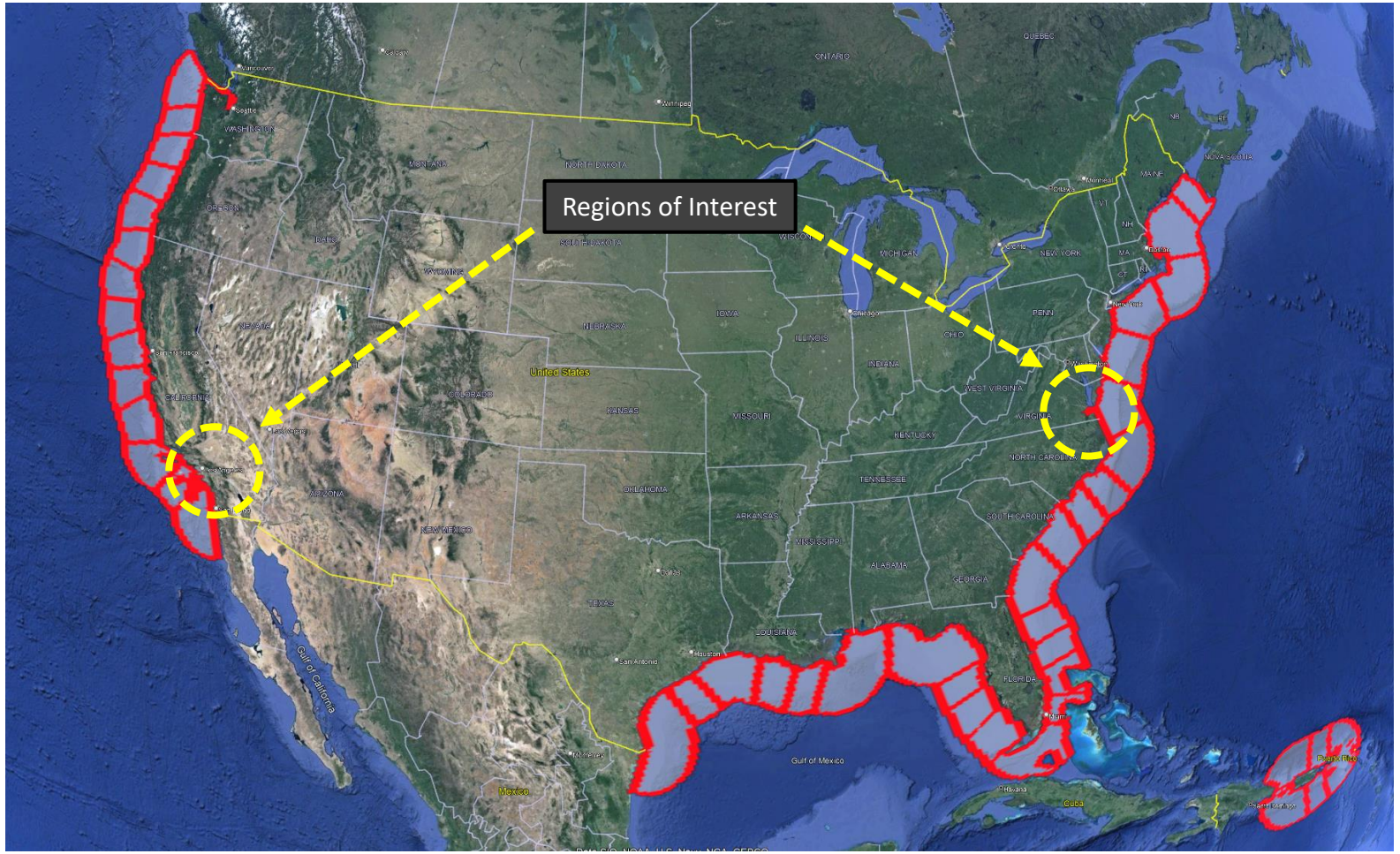
Inaccurate aggregate emission calculation due to:

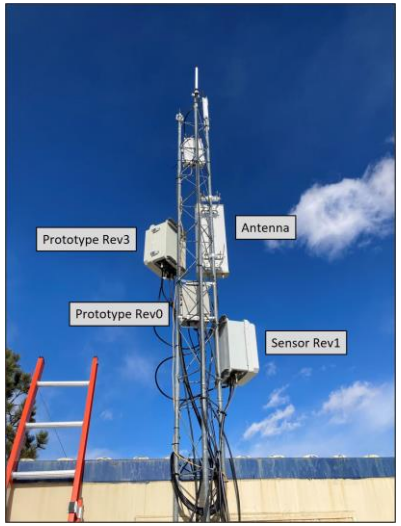
- Unknown CBSD's actual transmit power, on/off state, antenna spatial pattern and orientation, etc.)
- Inaccurate path loss calculation
- Incoherent transmissions of CBSDs
- Sensor measurement may be dominated by a single nearby CBSD in frequency at a given time
- The calculated power is a protection criteria and not an expected measured power

WInnForum Can Help!

Field Update

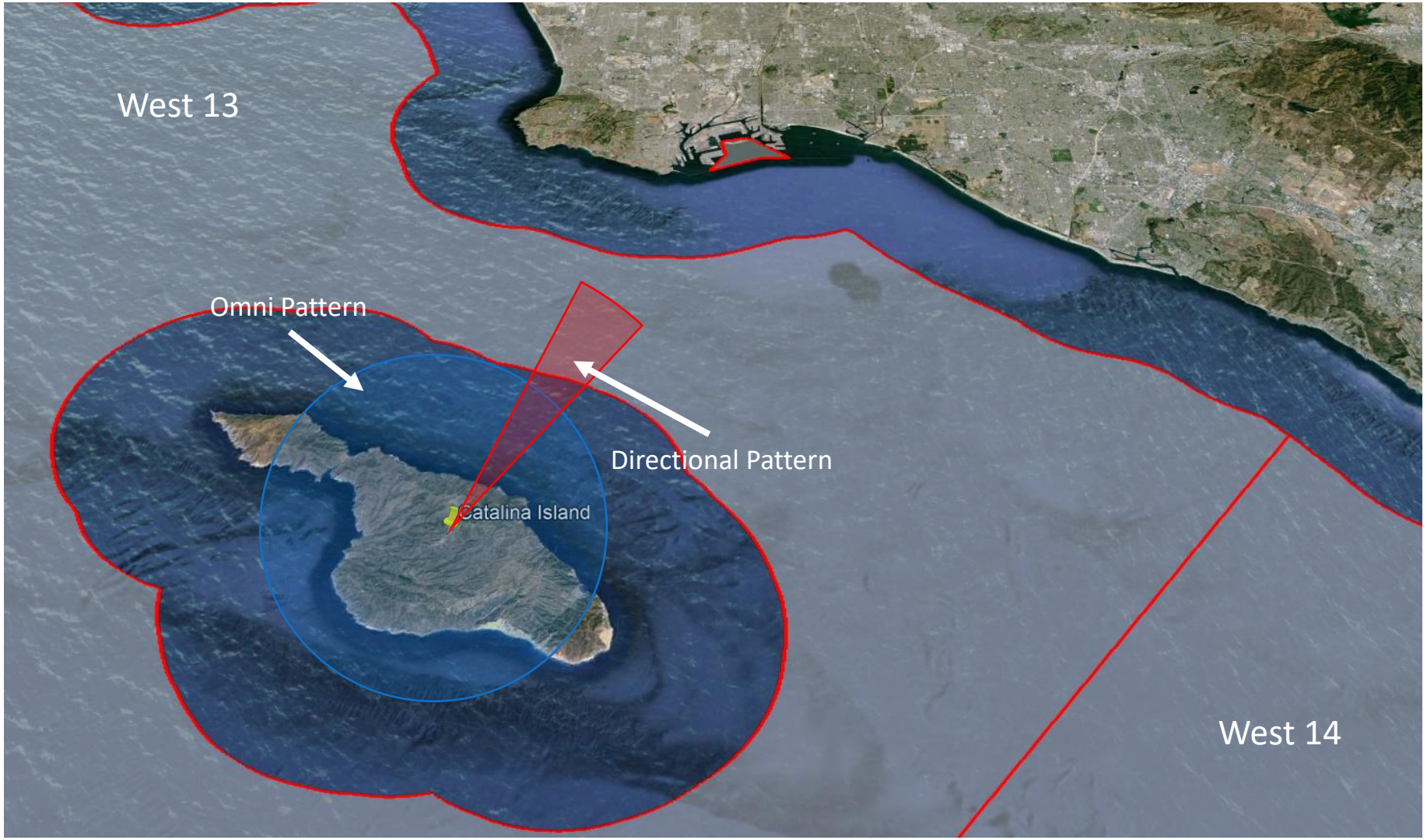
Current and Planned Deployments





Deployment Methodology

Deployment Methodology (cont.)



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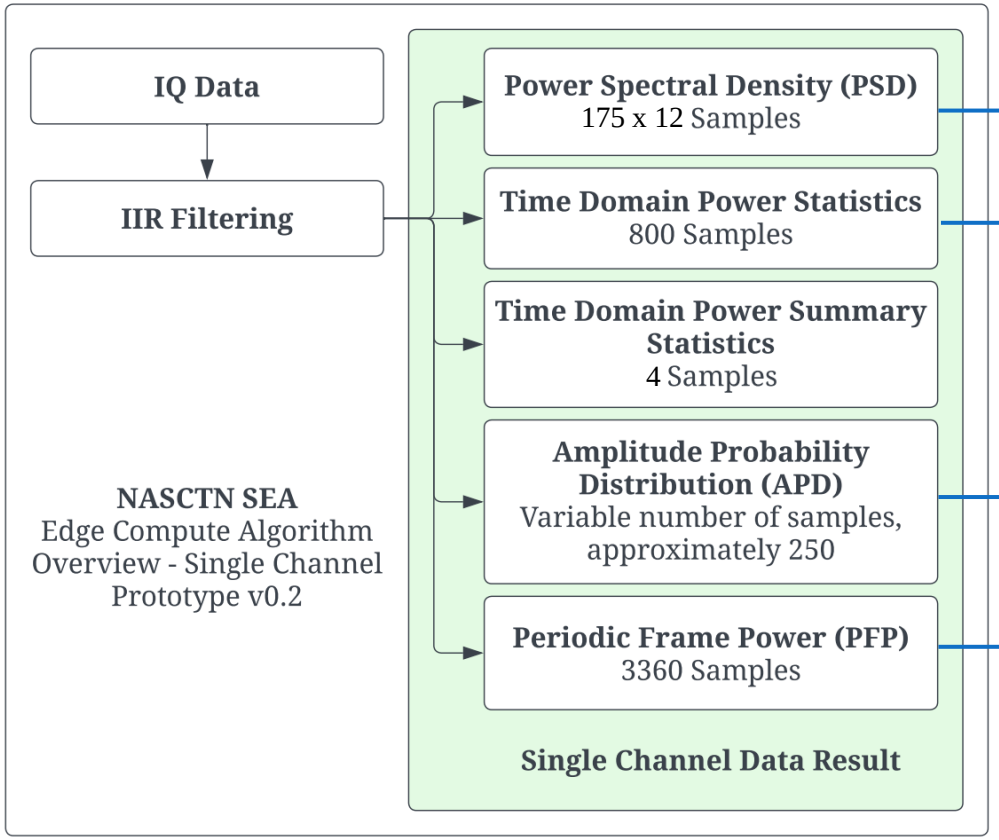
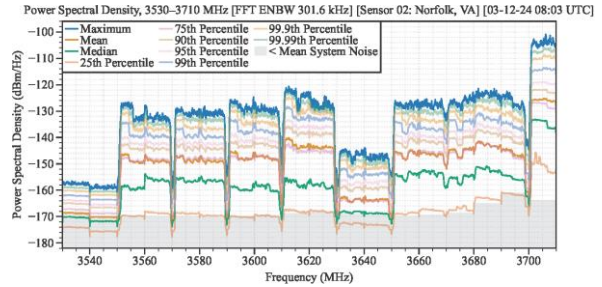
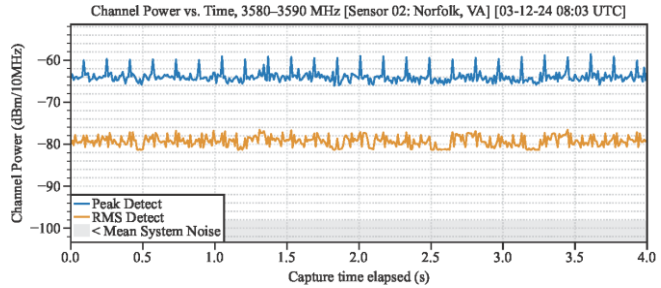
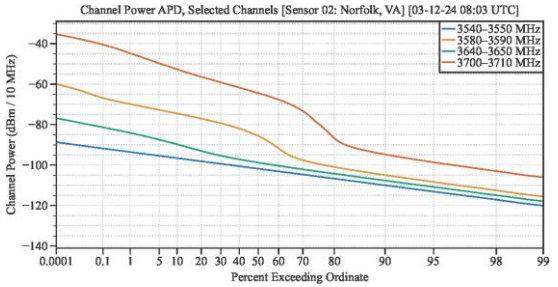
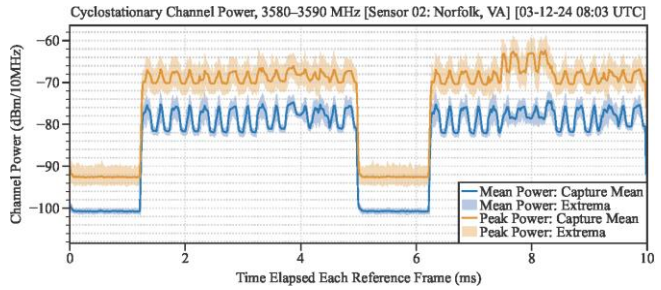
Data Products











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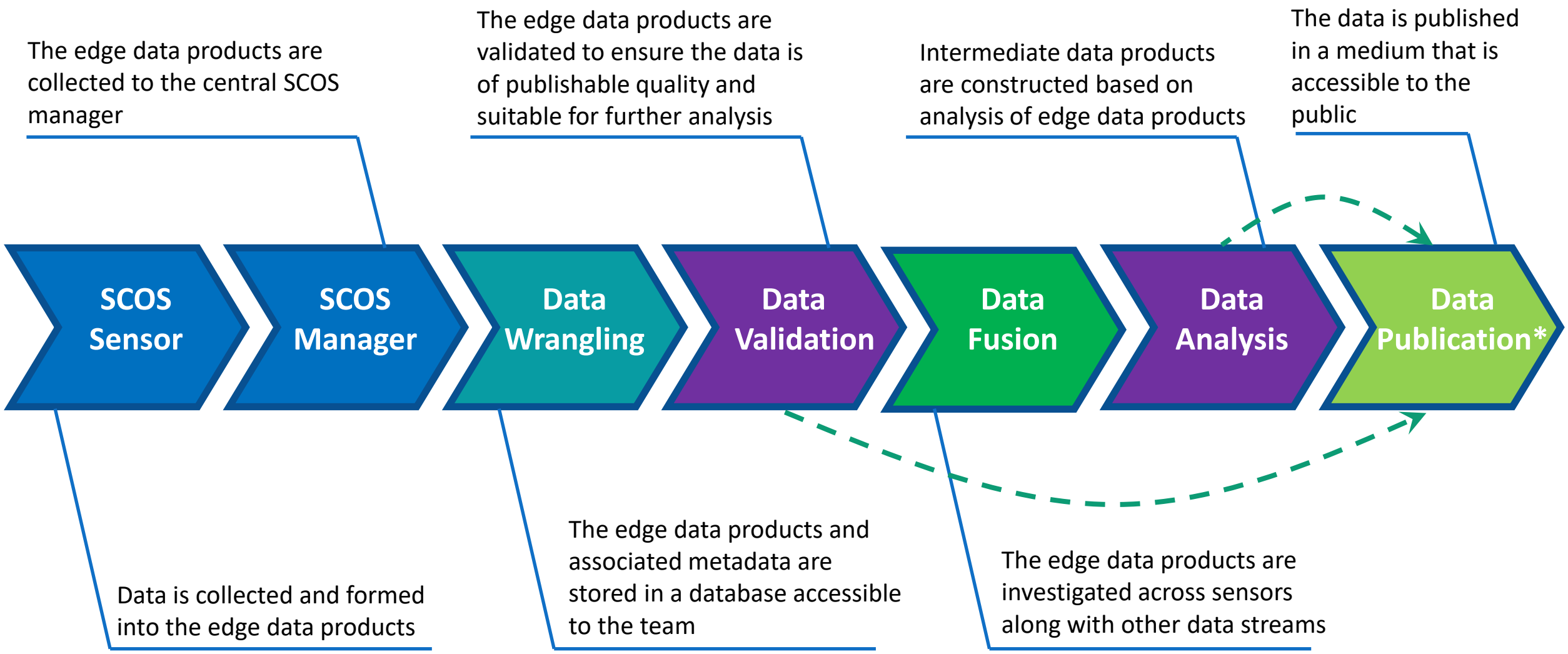
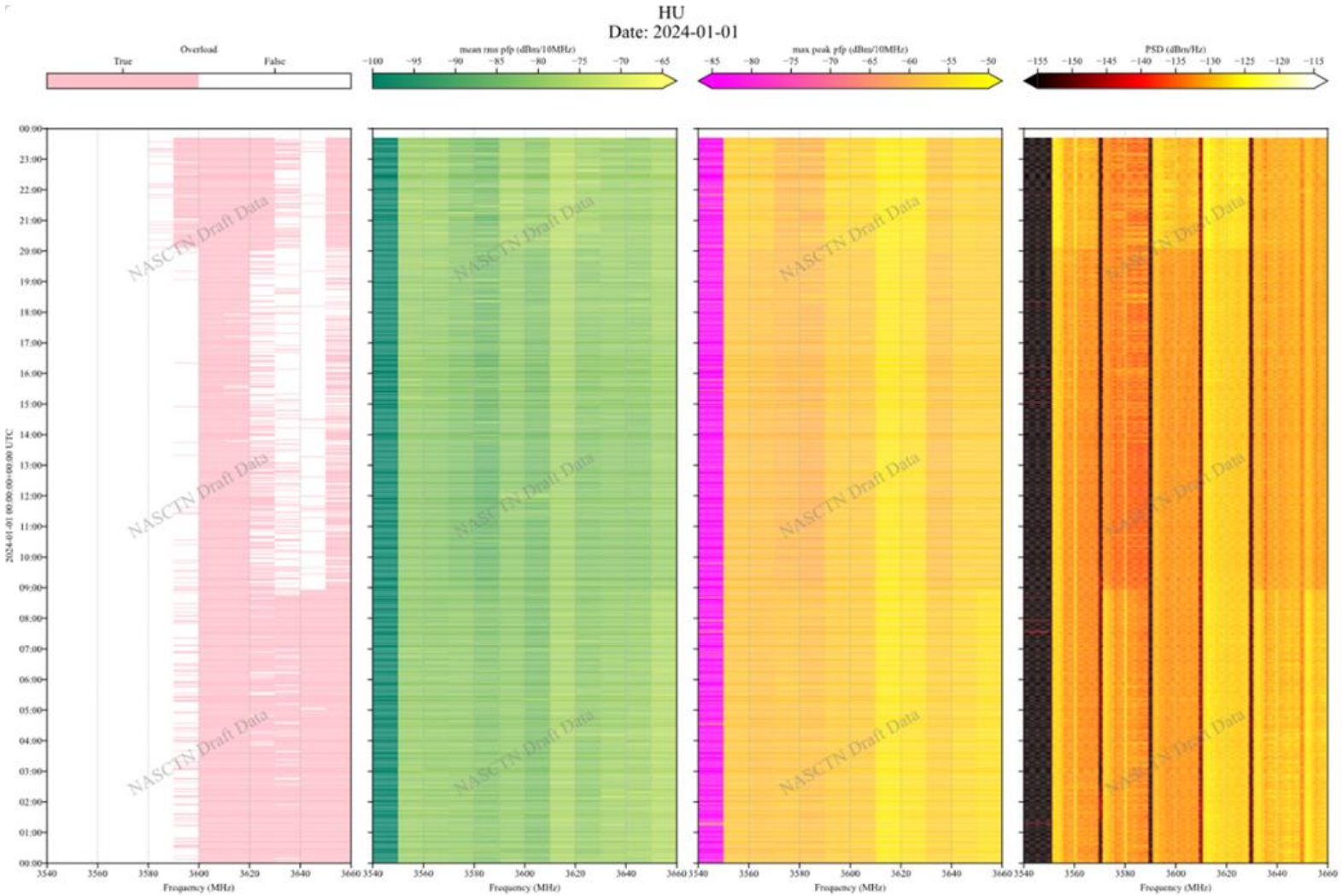
Data Publication Framework



* Data publication follows the NASCTN review process, where every contributing agency of the project has the opportunity review the technical report, code, and associated data.

Example Analyses – Day Plots



- Day-cycle trends from the ecosystem
  - Local dynamics
  - Shorter-time view
- Sensor by sensor and location by location

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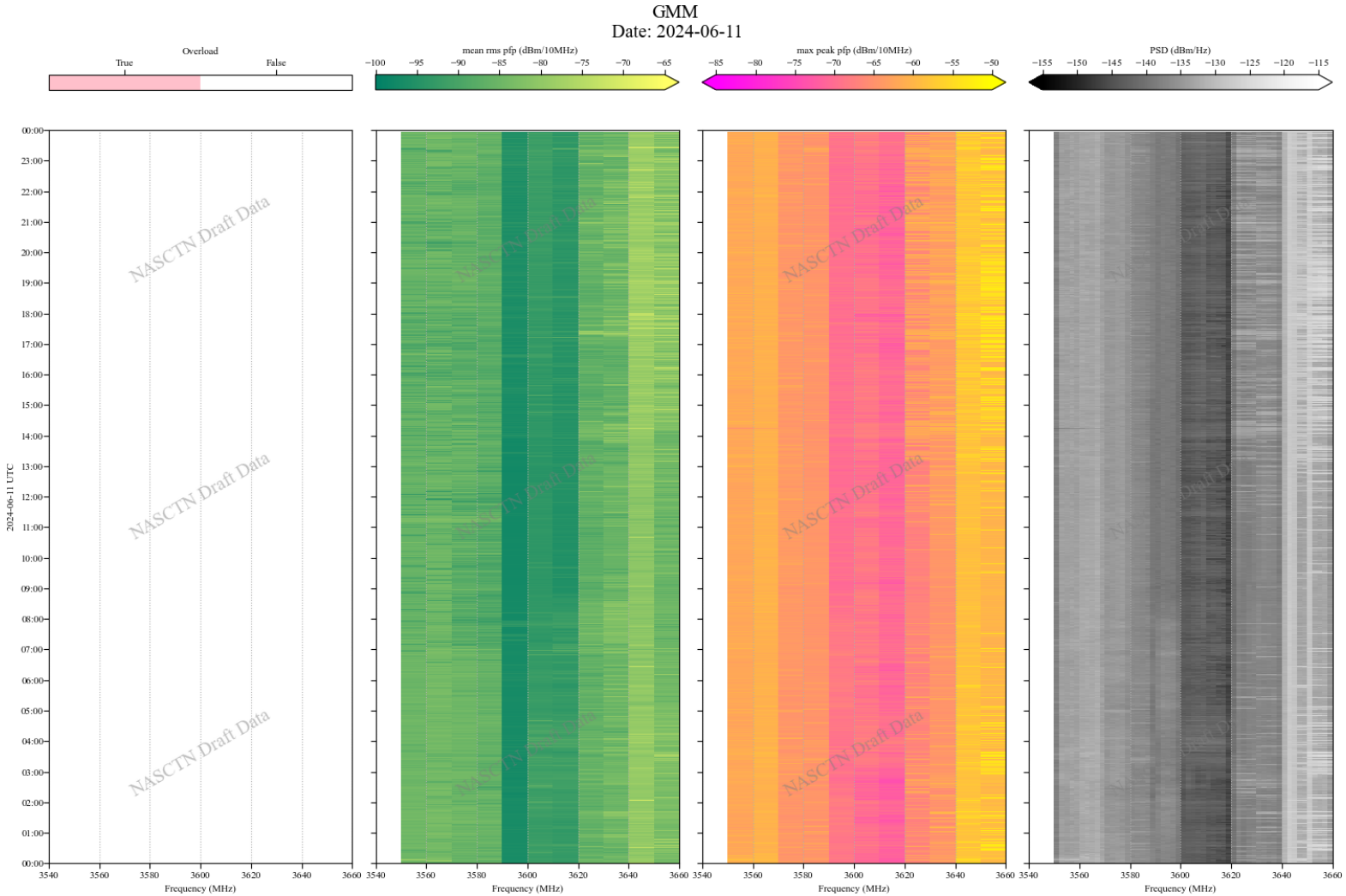
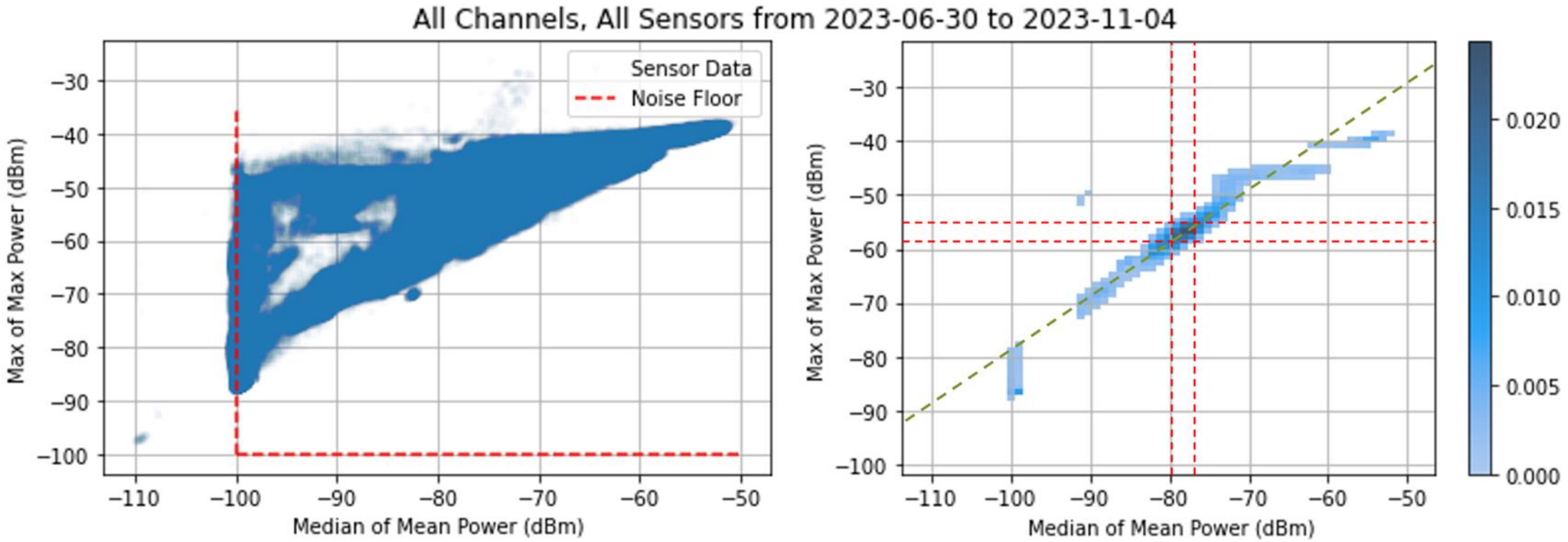
Example Analyses – Day Plots



- Day-cycle trends from the ecosystem
  - Local dynamics
  - Shorter-time view
- Sensor by sensor and location by location

Example Analyses – Longitudinal Trends



Longitudinal looks at the ecosystem across time, frequency, and location

Data Sharing Plan

Data Sharing Plan

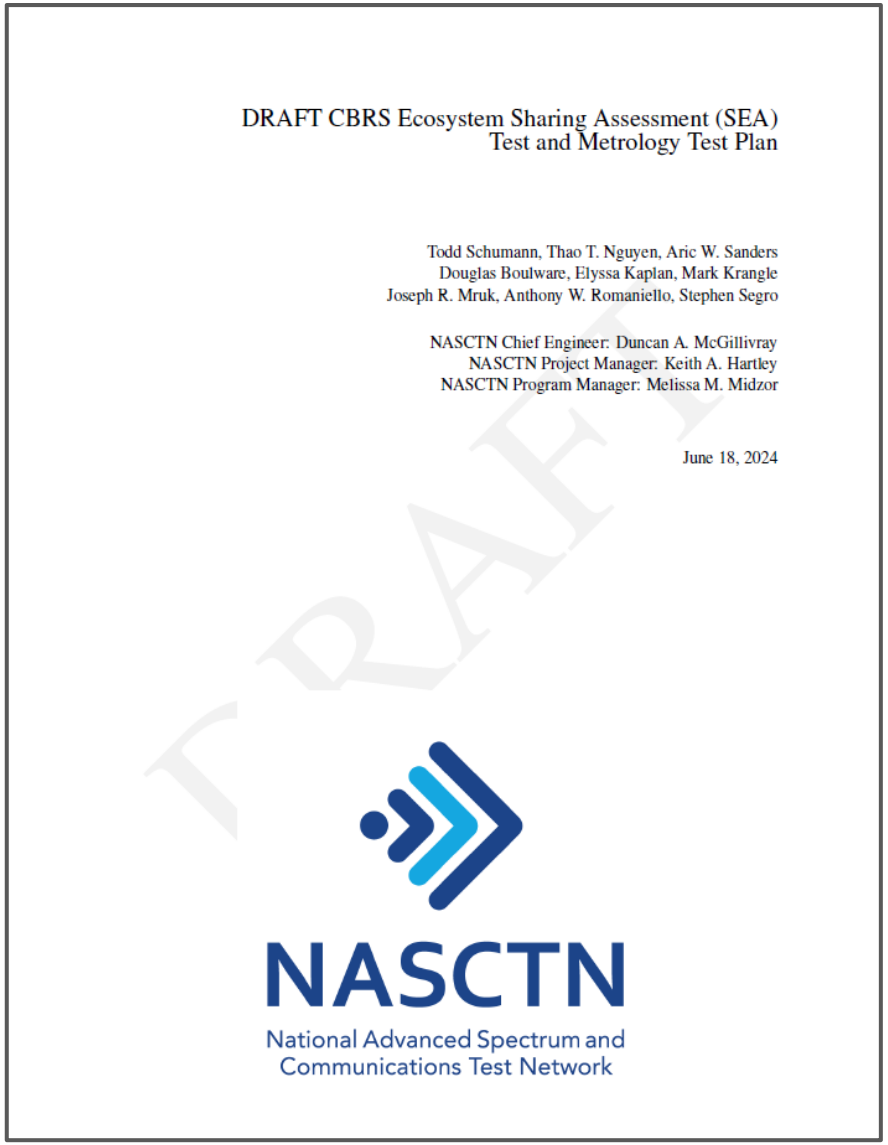
- NASCTN created a Data Transfer Agreement (DTA) to share working data with interested CBRS Stakeholders.
- Allows Stakeholder access to interim and pre-publication measurement data before the publicly released final report in late 2025.
- NASCTN is actively collecting data and will announce when the first set of data is available - expected in September/October of 2024
  - NASCTN will make a separate announcement when the data is ready and details on how interested Stakeholders can complete the DTA to request access.

Email nasctn@nist.gov for more information!

Task 1 Test Plan for Review

Task 1 Test Plan

- Task 1 Test Plan available for review
  - Please email nasctn@nist.gov if you did not receive a copy
- Welcome all comments (submitted in writing)!
  - https://www.nist.gov/programs-projects/cbrs-sharing-ecosystem-assessment
  - Search for "NASCTN CBRS"
- Comment period: **06/17/2024 – 07/10/2024**
- Community briefing: **TBD** *(mid-July)*
- All comments will be adjudicated in writing in comment matrix on website



DRAFT CBRS Ecosystem Sharing Assessment (SEA)
Test and Metrology Test Plan

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June 18, 2024

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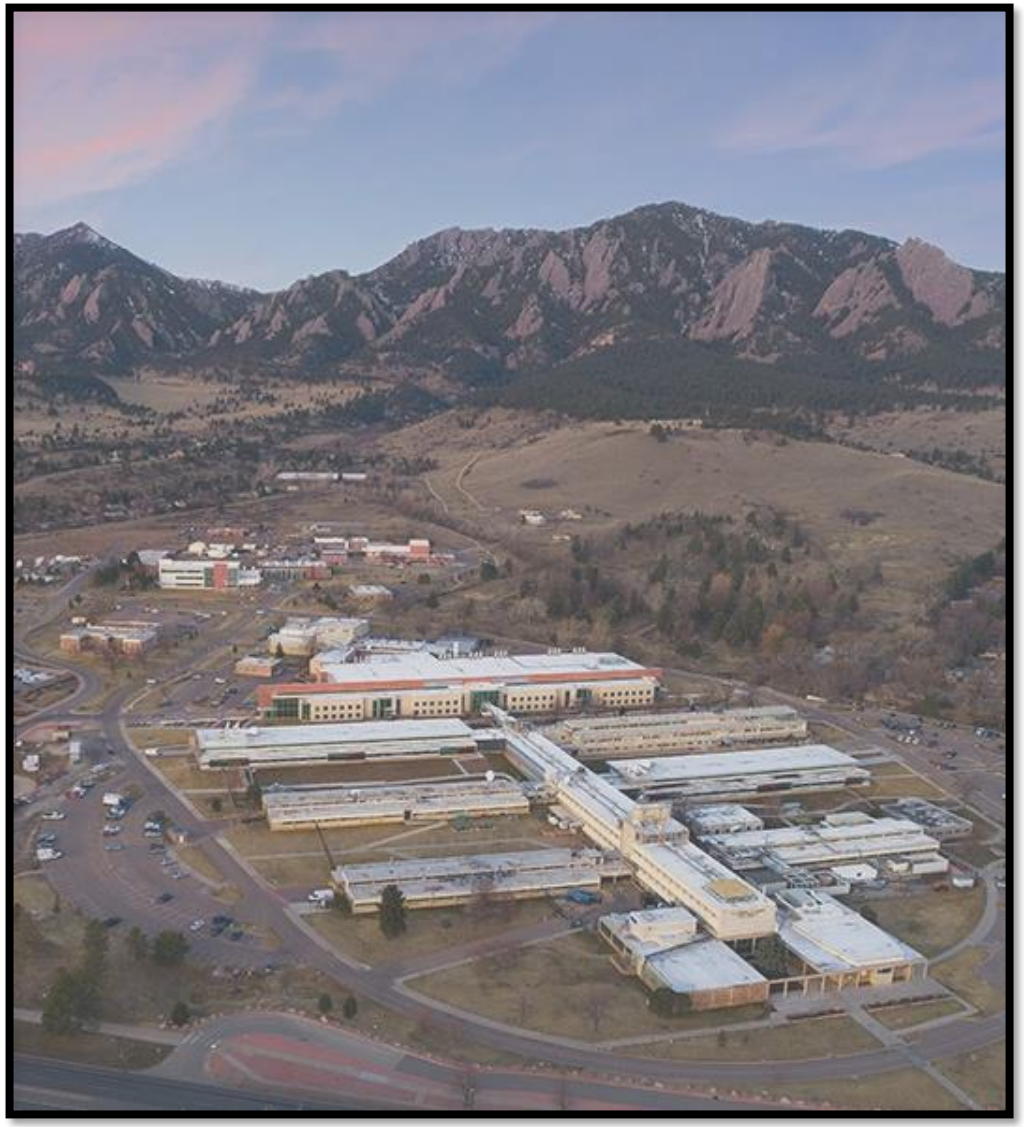
Next Steps and Schedule



Contact Us

nasctn@nist.gov

NASCTN Program:

- https://www.nist.gov/ctl/nasctn

Updates on the Project:

- https://www.nist.gov/programs-projects/cbrs-sharing-ecosystem-assessment

BACK-UP SLIDES

Sensor Planning and Locations

East-1
1. **Norfolk International Terminal (NIT), VA (CBSD cluster)**
2. **Hampton University (HU), VA (CBSD cluster)**
3. *Chesapeake Bay Bridge Tunnel, VA (aggregate view)*
4. Naval Air Station Oceana, VA (possible aggregate view)

West-13/14
1. **Camp Pendleton, CA (GB-DPA, possible aggregate view)**
2. **Midway Museum, CA (CBSD cluster)**
3. *Cabrillo National Monument, CA (aggregate view)*
4. *Catalina Island, CA (aggregate view)*

Other Locations
1. **Green Mountain Mesa (GMM), CO* (non-DPA controlled)**
2. Miramar, CA (West-14, GB-DPA, possible aggregate view)
3. Pungo, Virginia Beach, VA (East-1, possible aggregate view)
4. MITRE McLean or **MITRE Bedford** (non-DPA controlled)

NASCTN
National Advanced Spectrum and Communications Test Network

* One sensor will remain in Boulder, CO to both serve as a “non-DPA” baseline sensor as well as a local development sensor to test future software fixes before pushing to remote sensors. The other Boulder based sensor can be redeployed as needed to new locations.