

First Annual Partners' Meeting Presentation Decentralized, Asynchronous Sensor Networks for Arctic Regions

Arctic Domain Awareness Center (ADAC)
A DHS Center of Excellence



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AWARENESS CENTER

A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

at  UNIVERSITY of ALASKA ANCHORAGE

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University of Alaska Anchorage

June 29 & 30, 2015

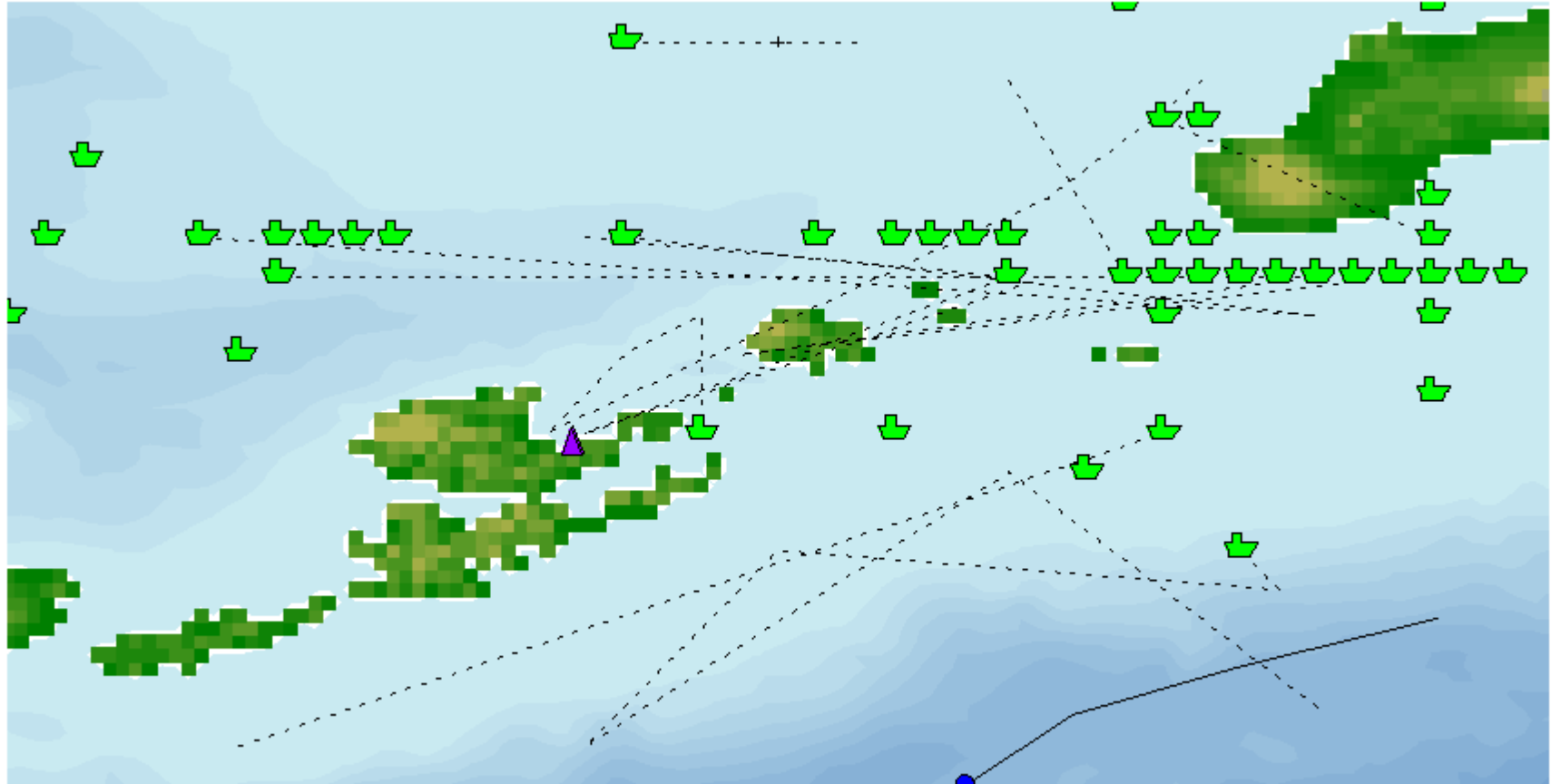


Motivation

Date: 21-May-2015 00:00:00 to 23-Jun-2015 23:59:59

Platforms: **56**

Observations: **41949**



Suppressing ship observations for most recent 48 hours

Unimak Pass
Marine traffic and congestion monitoring



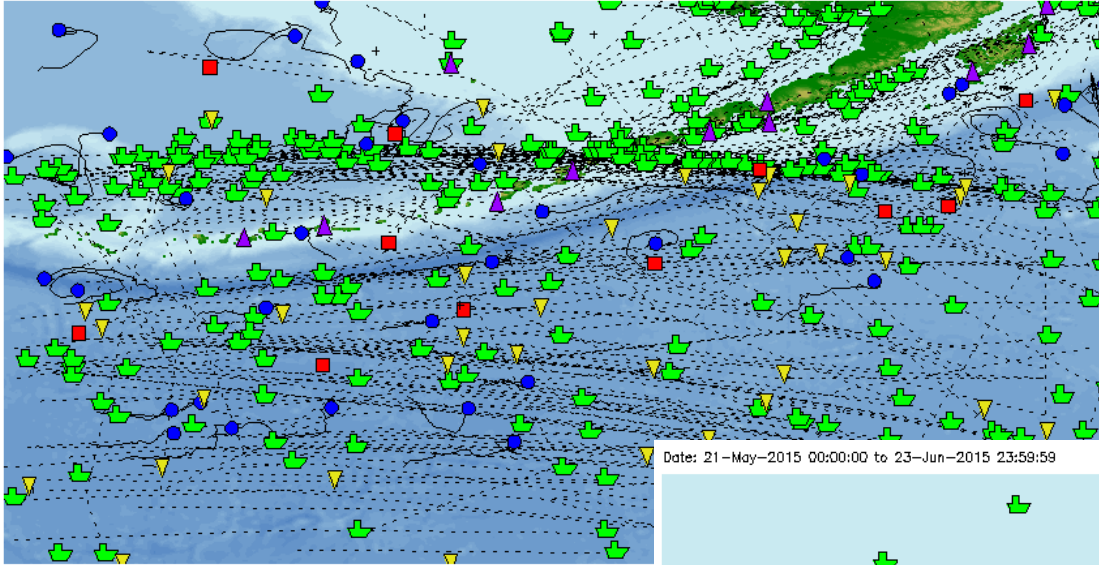
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Motivation

Date: 21-May-2015 00:00:00 to 23-Jun-2015 23:59:59

Platforms: **393**

Observations: **645408**

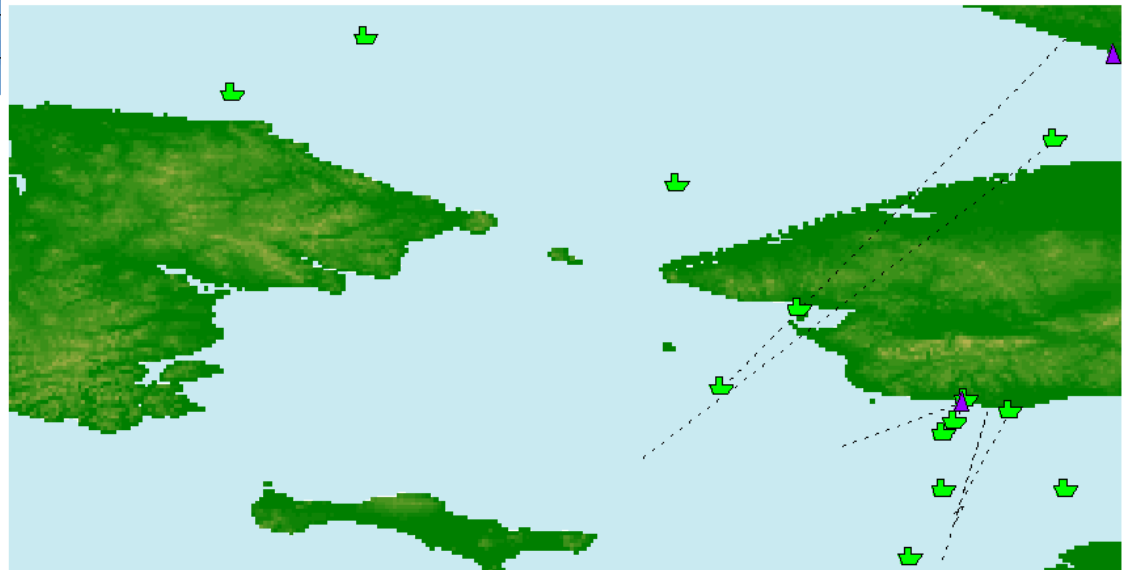


Suppressing ship observations for most recent 48 hours

Date: 21-May-2015 00:00:00 to 23-Jun-2015 23:59:59

Platforms: **15**

Observations: **72642**



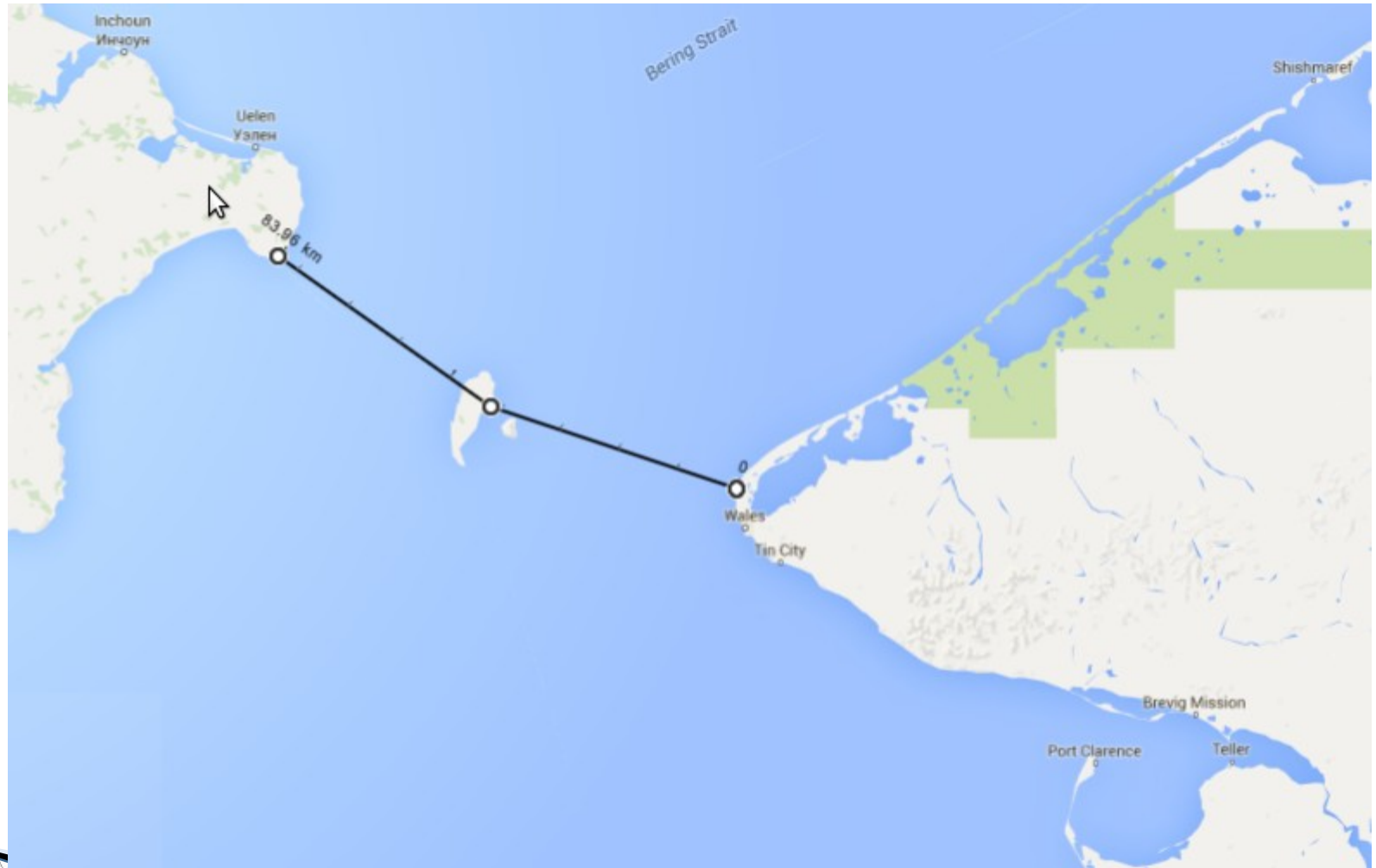
Suppressing ship observations for most recent 48 hours

Marine traffic and congestion monitoring



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Motivation

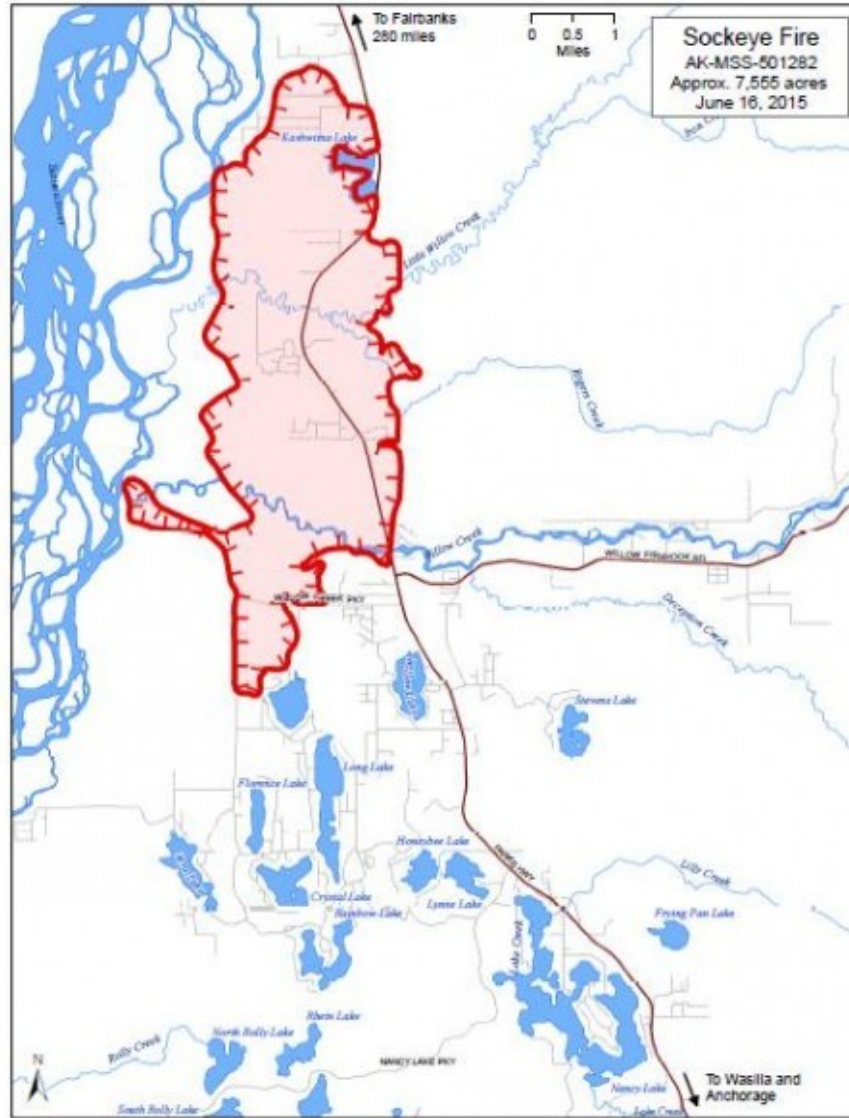


Marine traffic and congestion monitoring



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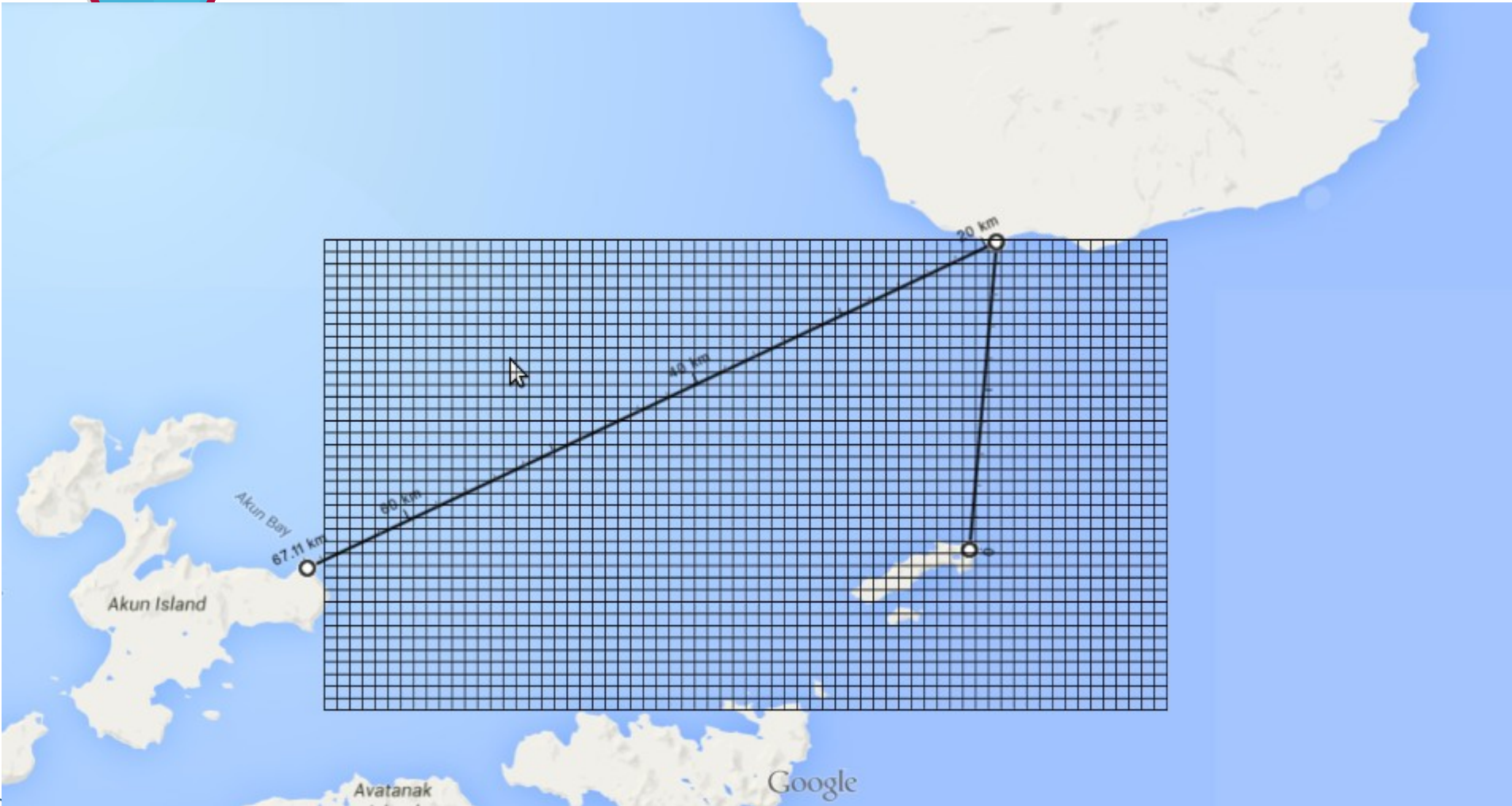
Motivation



Wildfire monitoring



Case Scenario



Marine traffic and congestion monitoring



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Case Scenario

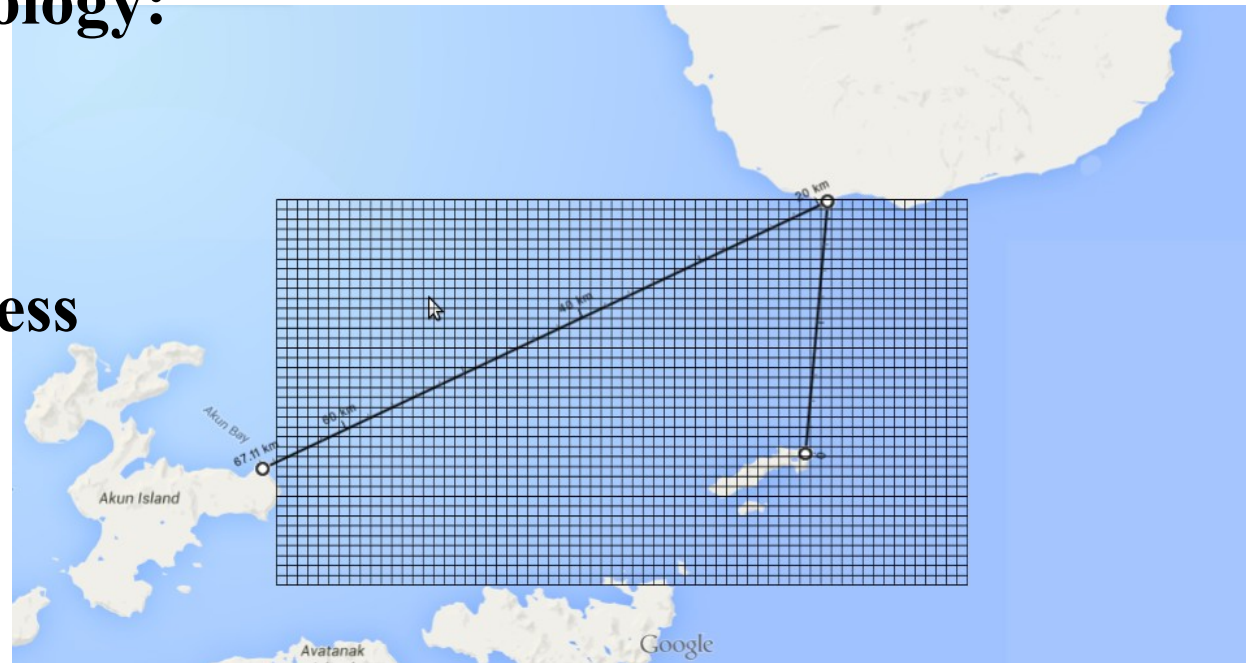
Challenges

Geography/Technology:

- ♦ Large
- ♦ Remote
- ♦ Power-less
- ♦ Communication-less

Monitoring:

- ♦ Unmanned
- ♦ Areal/Satellite
 - ♦ Unreliable
 - ♦ Sparse
- ♦ Good Samaritan





Case Scenario

Proposed Solution

Sensor networks for event sensing in the Arctic region

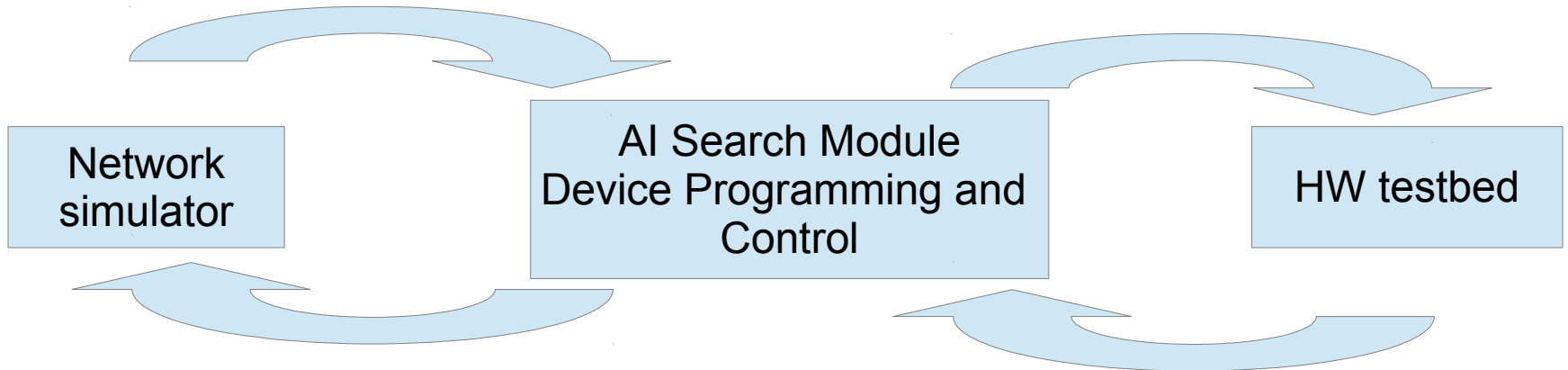
- Large number of simple, power-aware sensors
- Locally connected
- Parallel
- Potentially faulty
- Decentralized, aspatial
- Asynchronous - clockless
- A sub-system for
 - Secondary system (SamCam)
 - UAV, Kite



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Architecture

Proposed Solution





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Case Scenario

Reality

✓ Large number of simple, power-aware sensors

✓ Locally connected

✓ Parallel

✓ Potentially faulty

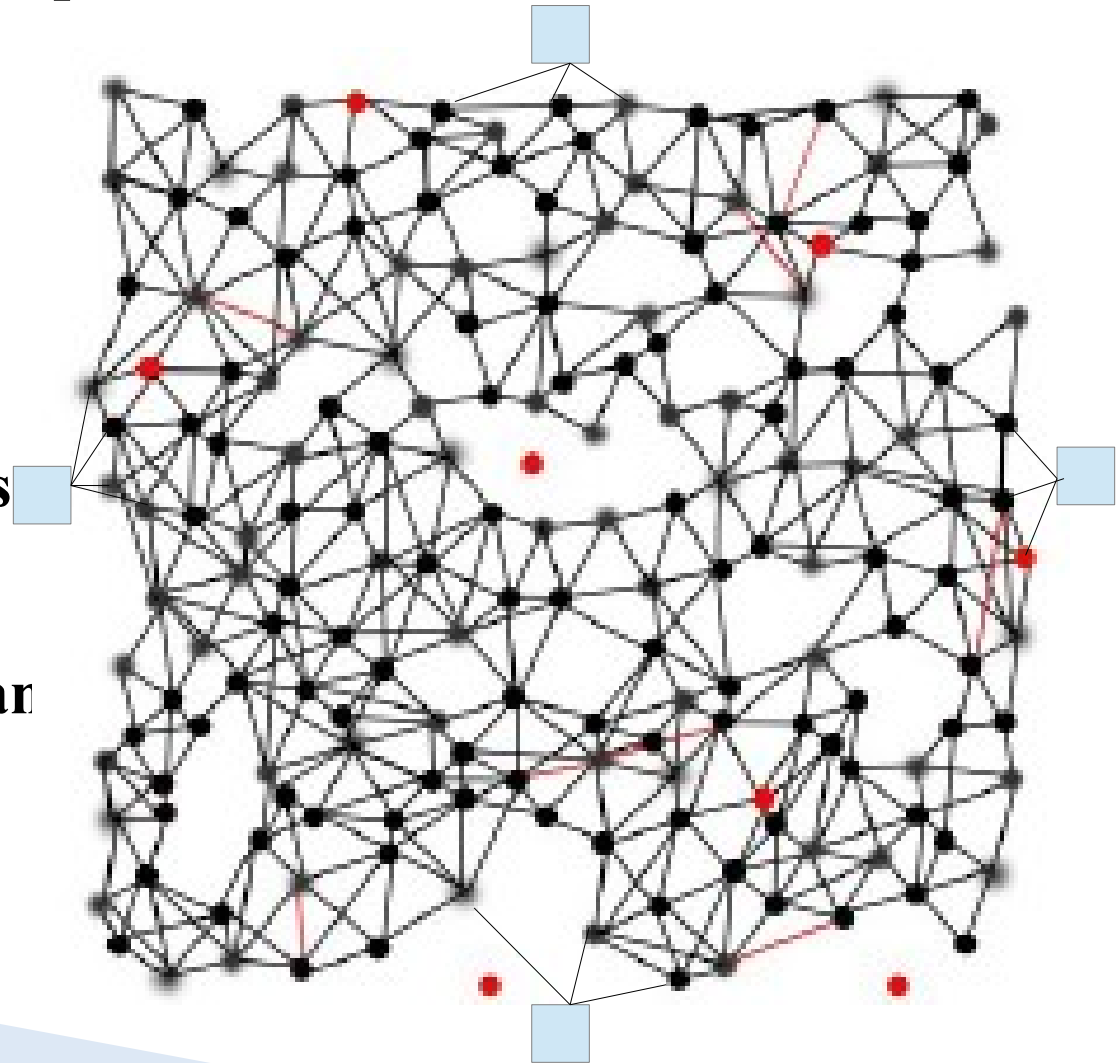
✗ Decentralized, aspatial

✗ Asynchronous, clockless

• A sub-system for

➤ Secondary system (San

➤ UAV, Kite





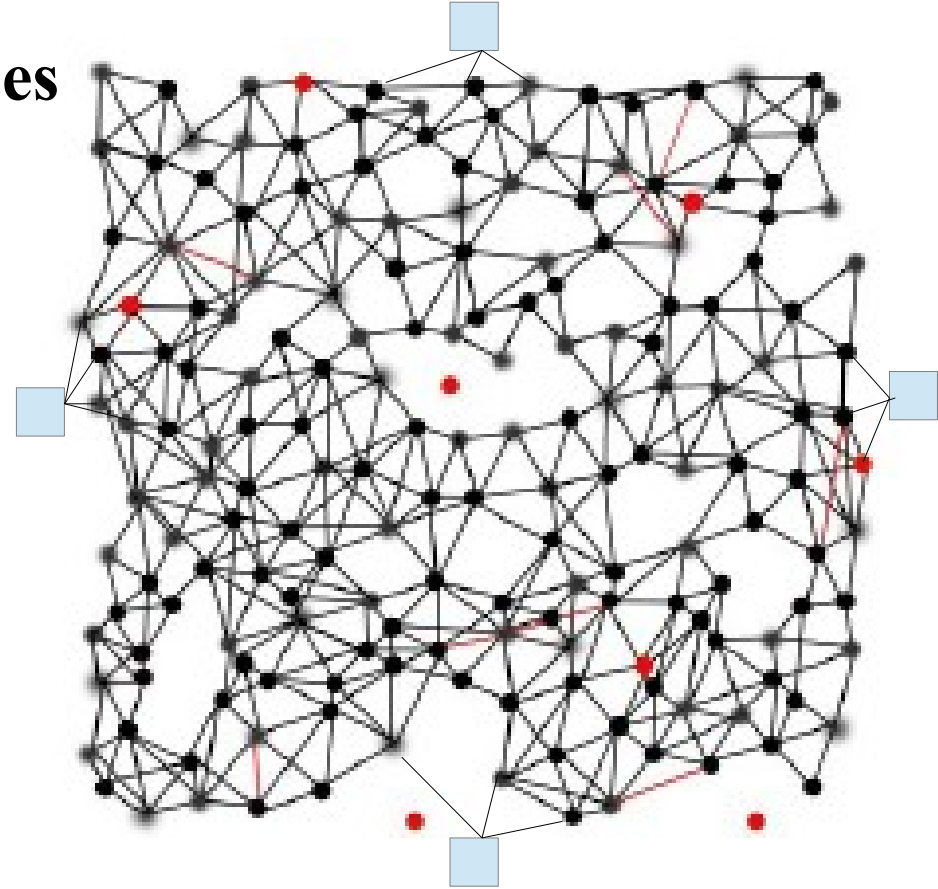
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Status Report

”80 hours”

In-progress / 50% done

- ✓ Soldered connected 60 devices
- ✓ Sensor network simulator
- ✓ Proof of concept network
- ✓ Device power profile
- ✓ Device transmission profile
- ✓ Communication protocols

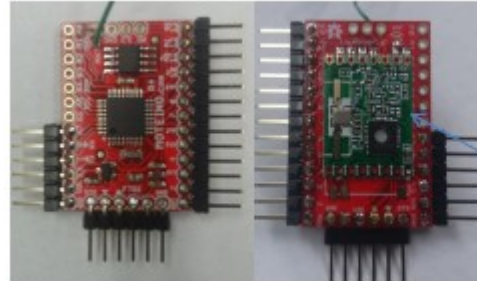
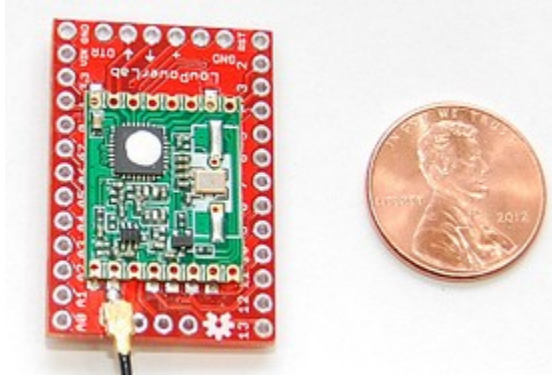




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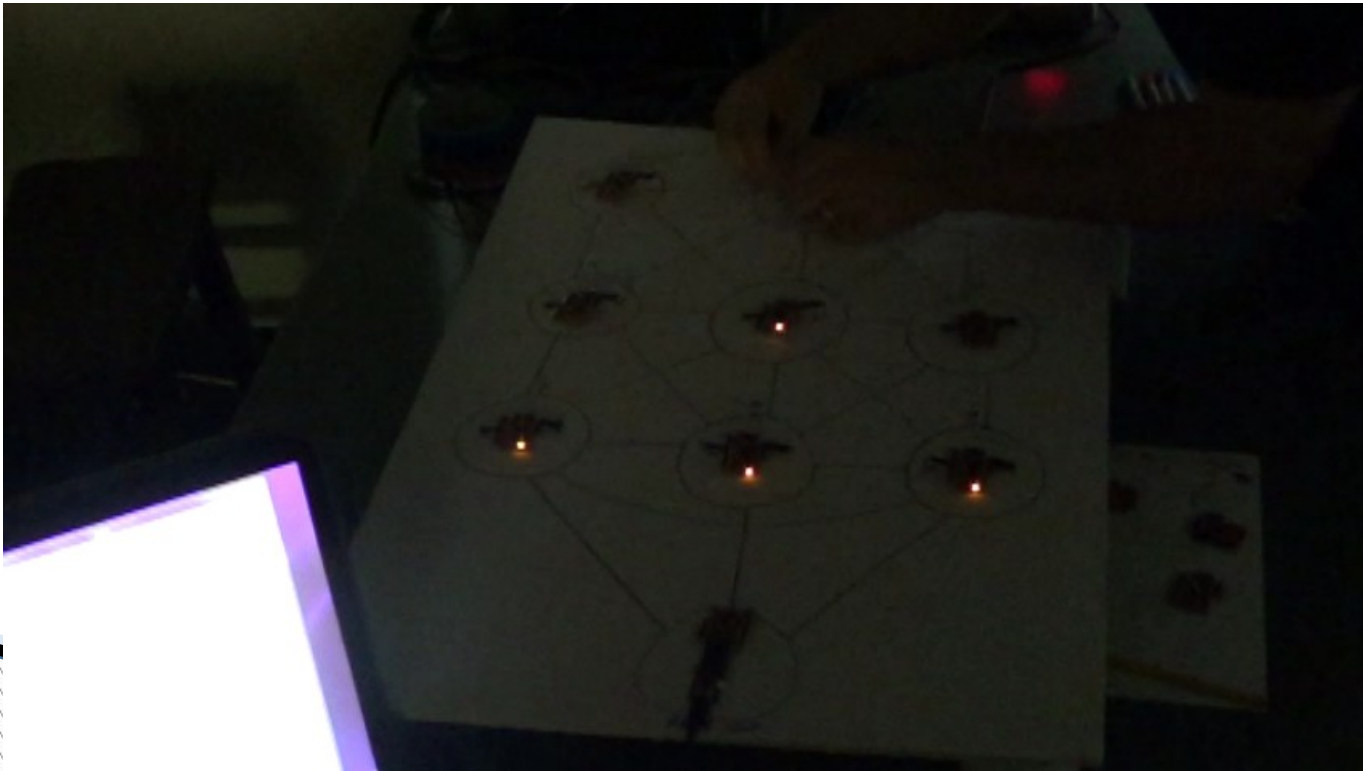
Status Report

Device/HW POC



Moteino with added pins and quarter wave wire antenna

Integrated RFM69 transceiver (green board)



?Demo?



Status Report Network Simulator

The screenshot displays the Network Simulator interface. At the top, there are tabs for 'Interface', 'Info', and 'Code'. Below these are control elements: 'Edit', 'Delete', 'Add', a dropdown menu with 'abc Button', a speed slider set to 'normal speed', a 'view updates' checkbox, and a 'continuous' dropdown. A 'Settings...' button is also present.

The main workspace features a 7x7 grid with a blue and black checkerboard pattern. A network graph is overlaid on the grid, with nodes represented by colored circles (yellow, red, green, blue) and edges by thin lines. A central node is highlighted with a blue circle. The top right of the workspace shows 'ticks:' and a '3D' button.

On the left side, there are several control panels:

- 'setup' and 'clear' buttons.
- A 'GRIDSIZE' slider set to 7.
- A 'TRANSMISSIONRANGE' slider set to 1.9.
- 'Find Lines' and 'findShortestPaths' buttons.
- A 'Send Message' button.
- A 'MESSAGESTARTNODE' input field containing '25'.
- 'WaveProp' and 'createFile' buttons.

At the bottom, the 'Command Center' contains a text area with the following text:

```
observer> watch turtle 27
observer> watch turtle 25
observer>
```

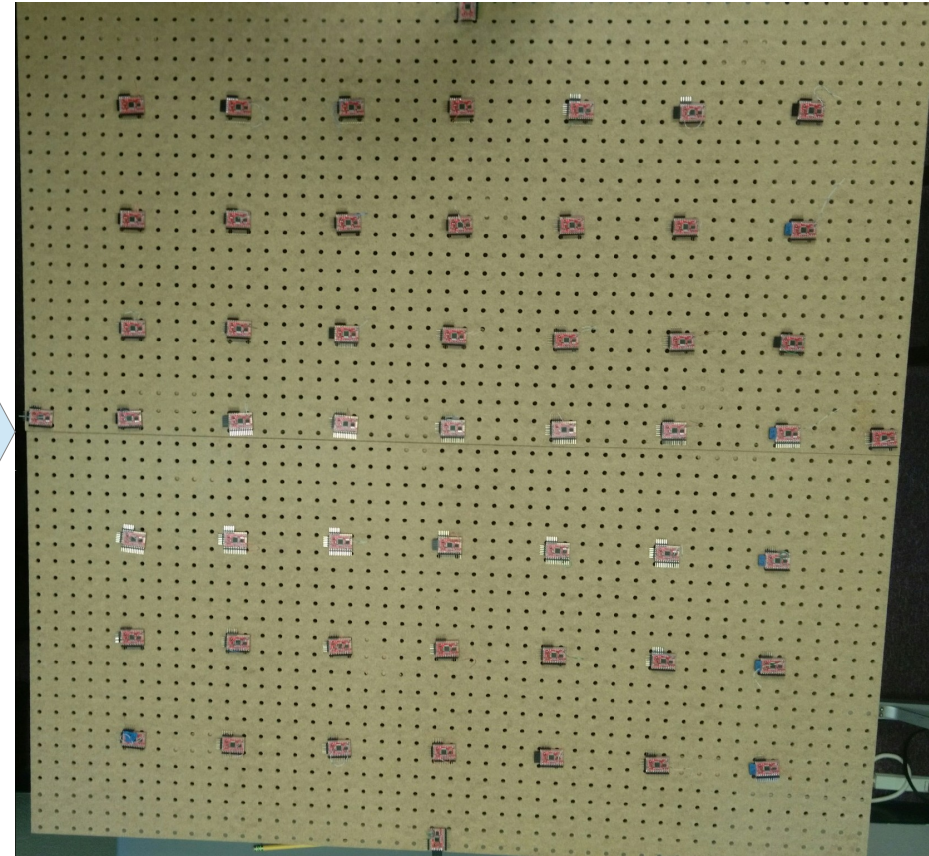
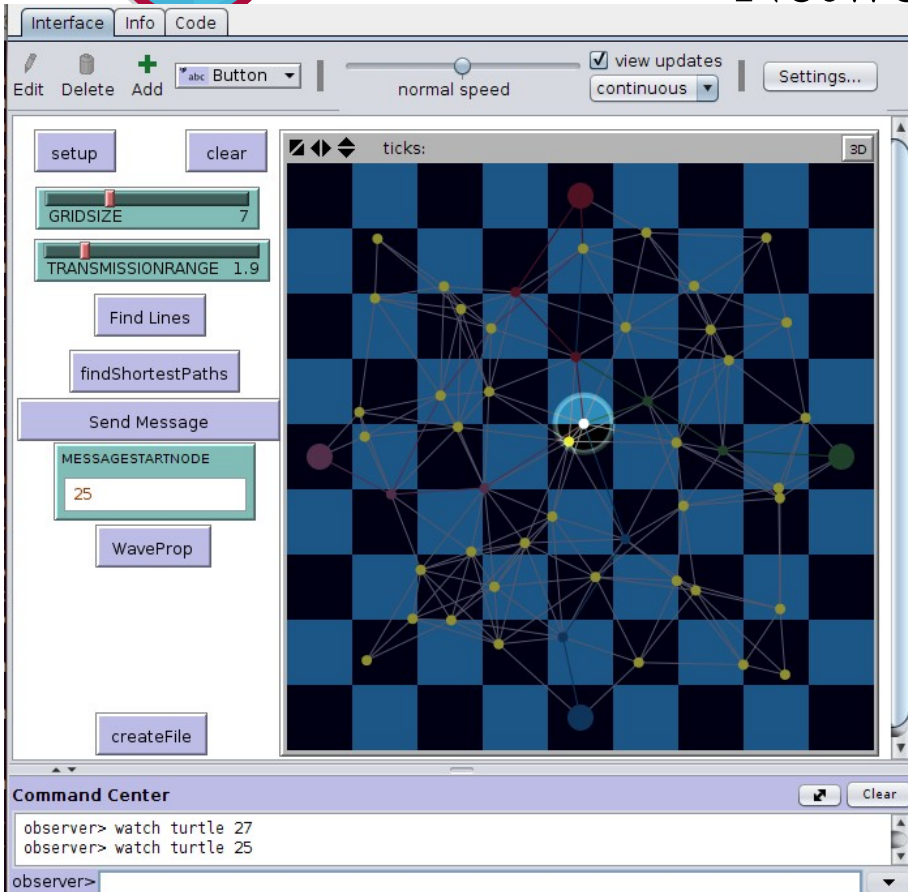
?Demo?



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Status Report

Network Simulator → HW substrate



Network
simulator

AI Search Module
Device Programming and
Control

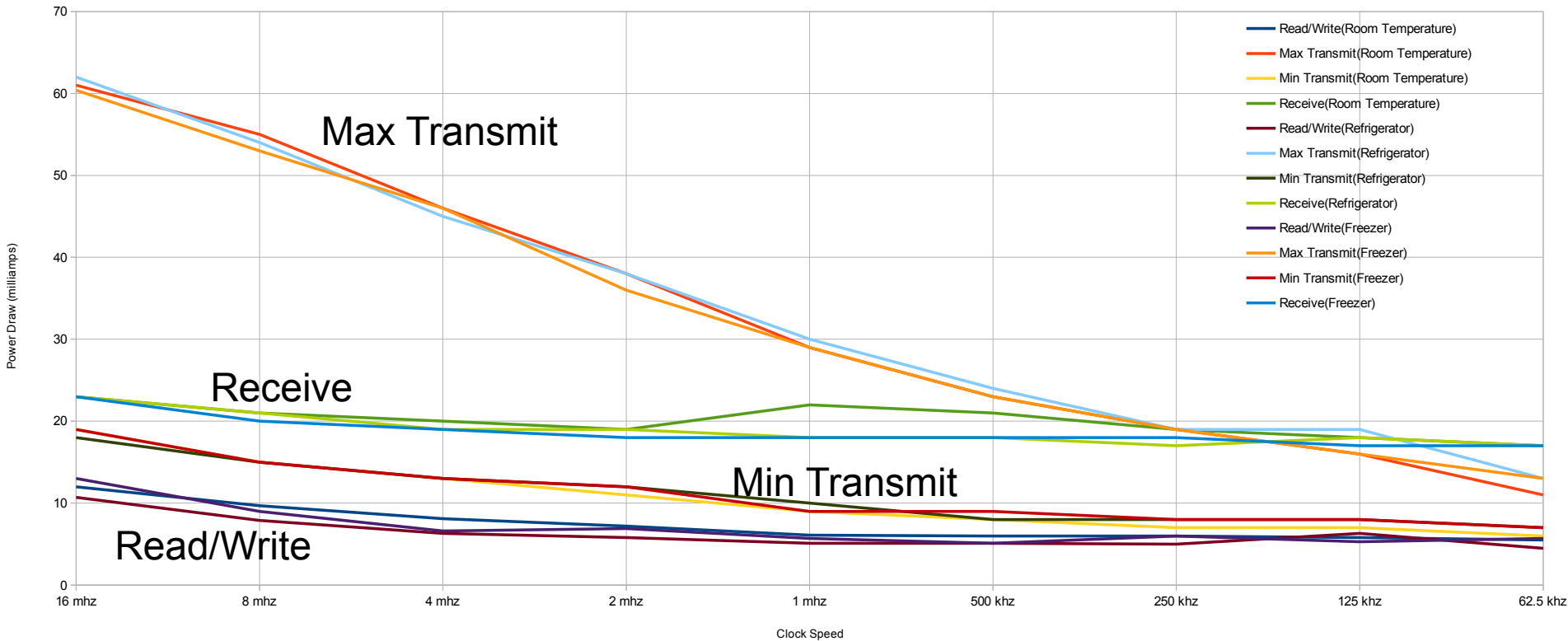
HW testbed



Status Report

Power Profile

All Tests/All Temperatures Compared





Next Steps

? Robust emergent event processing by decentralized spatial computation

? AI search

? $e \rightarrow E$ (noise vs. signal)

? Event triangulation

? Sensors

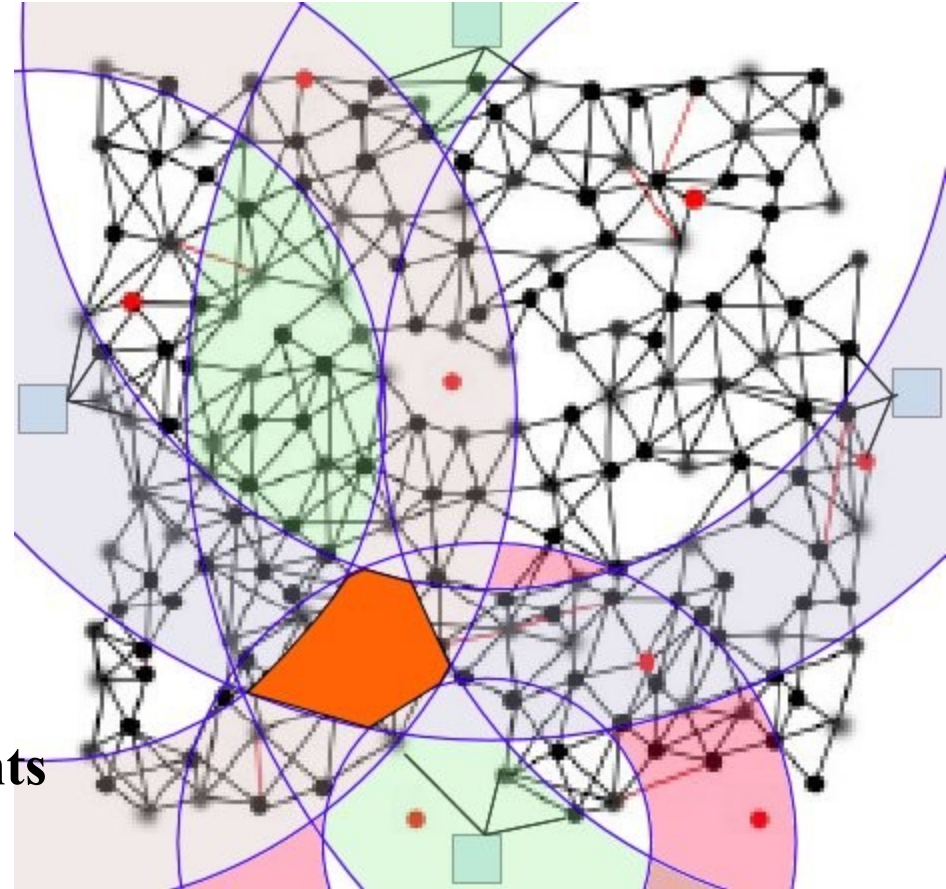
? Network/Protocol power profile

? Subsystem integration

? 'Eyes on the ground'

? Event activation in noisy environments

? Power supply





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Stakeholders

Sub-system flexibility



MCK
CORE BRANDS
CORPS VALUE





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Demo and questions