INCUBATENERGY LABS

2022 DEMO DAY

Powered by: Xcel Energy®

October 26
Minneapolis
Minnesota

EPRI

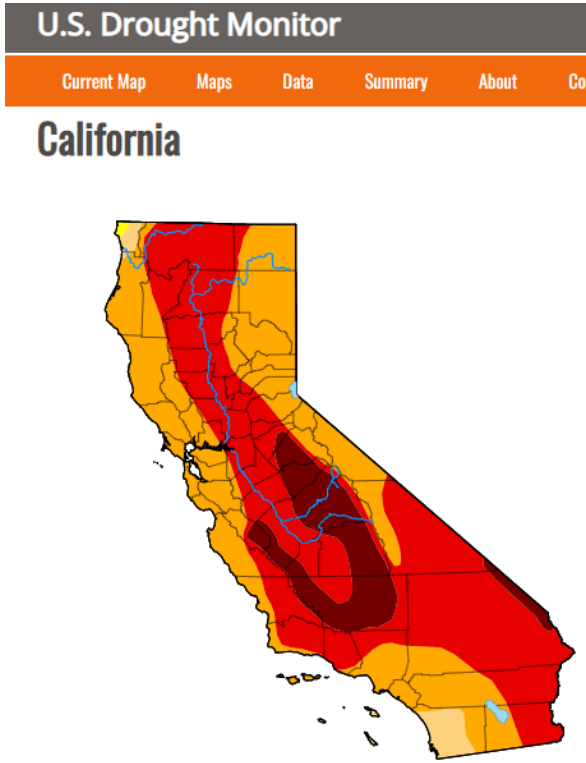
Silvanet AI Utility Equipment Fire Detection Pilot

Midpoint Review
October 26, 2022

Ben Banerjee
Co-founder and SVP, Worldwide Sales
Dryad Networks GmbH
Ben@dryad.net

About the Need/Opportunity

PG&E is committed to finding solutions to help mitigate wildfire risks from utility assets in our climate changing environment.



About Dryad Silvanet

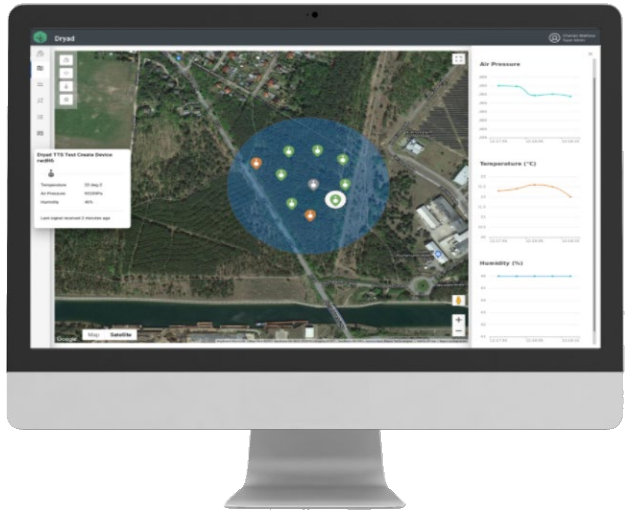
Ultra-early detection of wildfires using AI-driven solar-powered sensors in a mesh network infrastructure

Sensor

Solar-powered gas sensors detect wildfires even during the smoldering phase

Gateways

Distributed LoRa Gateways provide a large-scale mesh network infrastructure

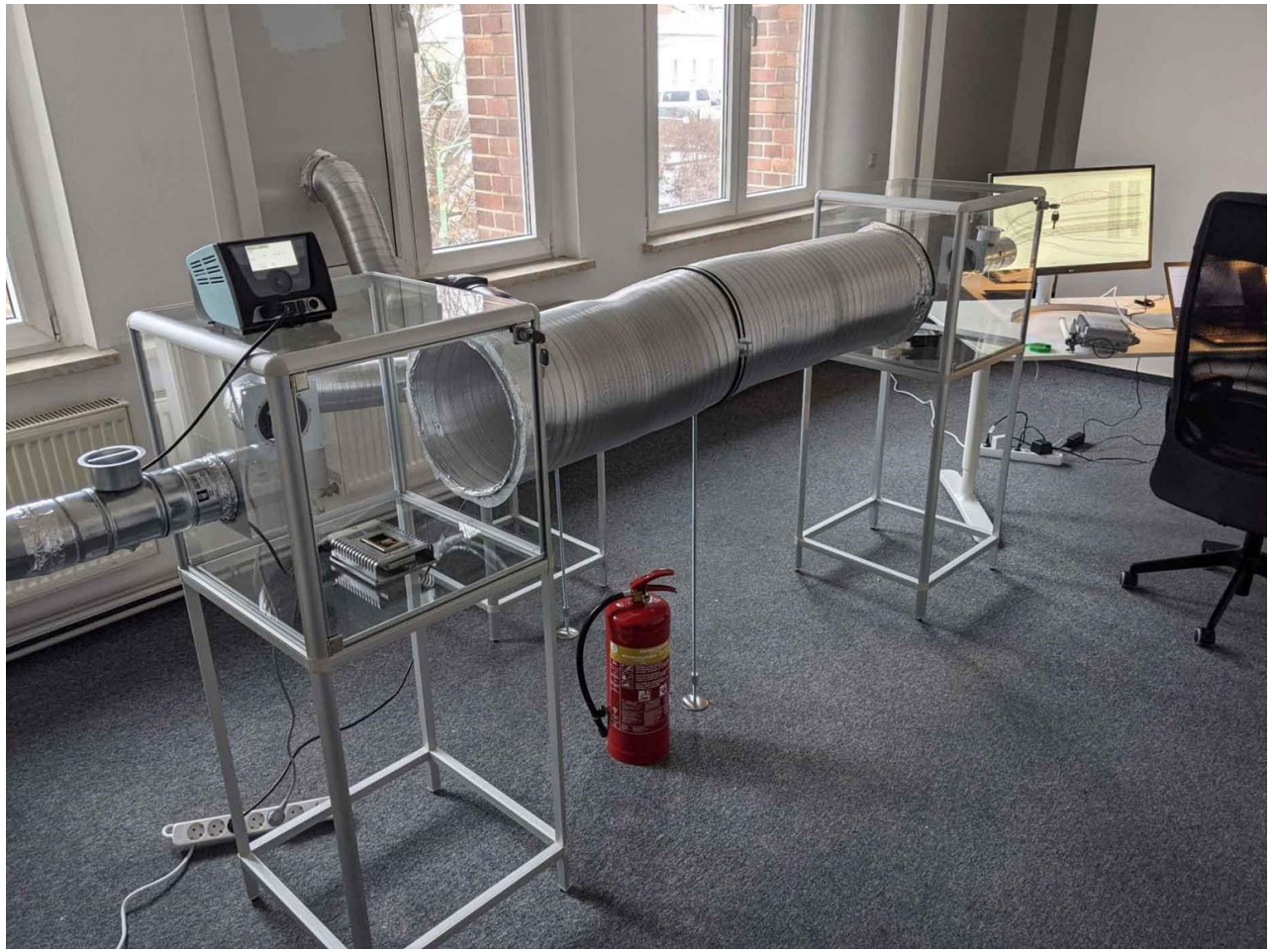


Monitoring

Cloud-based platform for device management, monitoring and alerting

Challenge: Adapting Sensors to Utility Use-Cases

Training of the artificial intelligence (AI) sensors to recognize specific smells and avoid false-positives



AI Training

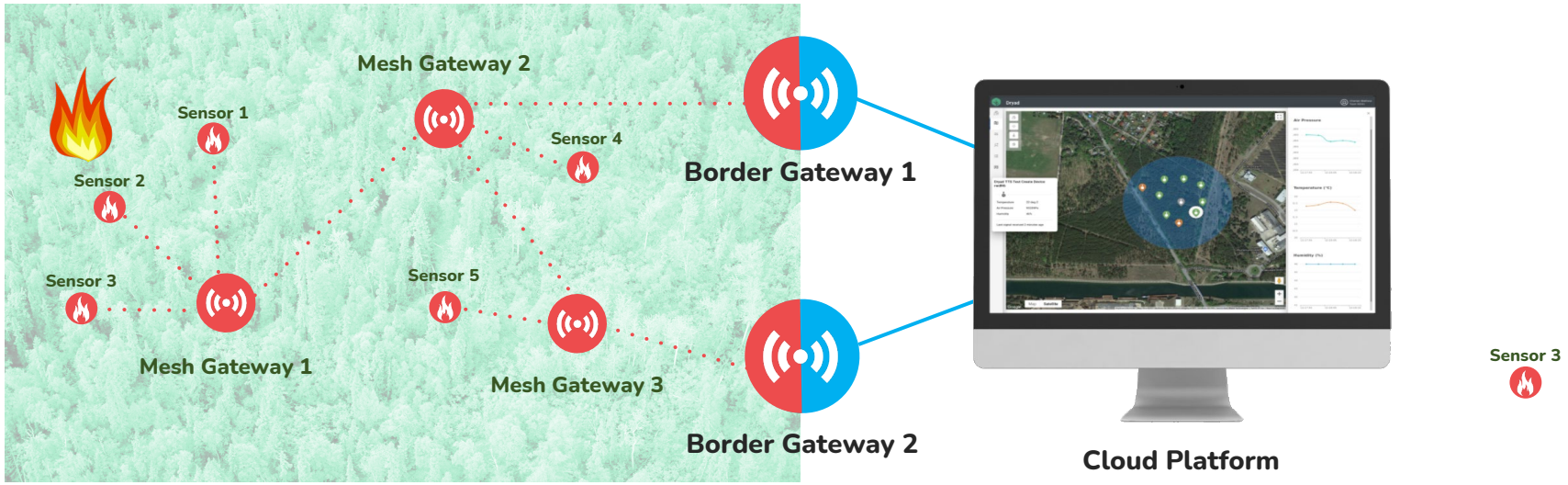
Samples of target material (e.g. forest samples, poles, transformers) are heated up

VOC / gas emitted from material

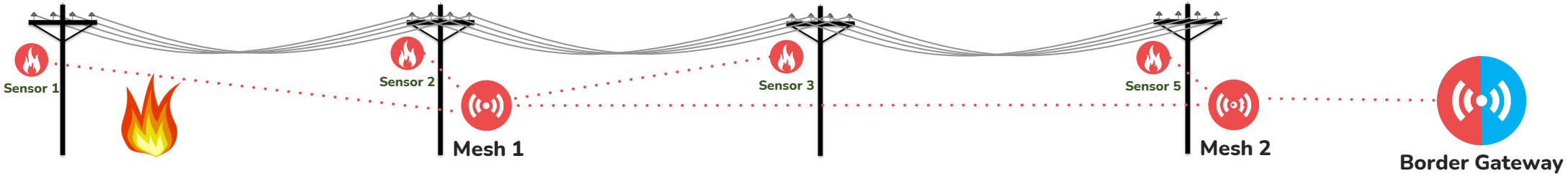
Sensors are trained to detect the specific smell

Challenge: Deploying Mesh Network in Linear Scenario

Silvanet was designed to work in large-scale off-grid scenarios in the forest



Deploying in a network in a linear distribution pole-pole-pole topology



Challenge: Radio communication range

Sensor -> Gateway Communication

Sensor id	Distance from MG	Message rate	Total nb. of messages sent	Packet loss %
2n444	510m	1 every 10m	171	0.0
2n525	510m	1 every 10m	161	0.5

Sensor id	Distance from MG	Message rate	Total nb. of messages sent	Packet loss %
2n435^{up}	989m	1 every 10m	171	0.5
2n437^{up}	989m	1 every 10m	171	0.5

Mesh Gateway -> Border Gateway Communication

Gateways	Distance from MG	Total nb. of messages sent	Packet loss %
BG17, MG7	764m	480	4.1

Gateways	Distance from MG	Total nb. of messages sent	Packet loss %
BG17, MG7	1.14km	300	8.3

Project Scope At-a-Glance

Key Objective: What is being tested / proven?

1. Test AI sensors to detect vegetation fires; train sensors to detect wood pole fires
2. Test Dryad's Silvanet LoRaWAN mesh network in a linear distribution pole-pole-pole topology
3. Test Dryad Web & Mobile software applications to manage sensor network health and provide over-the-air update to sensor detection models

Monthly Milestones:

June: Project scope & schedule finalization; logistics

July: AI learning of wood samples; linear network validation; system validation and setup

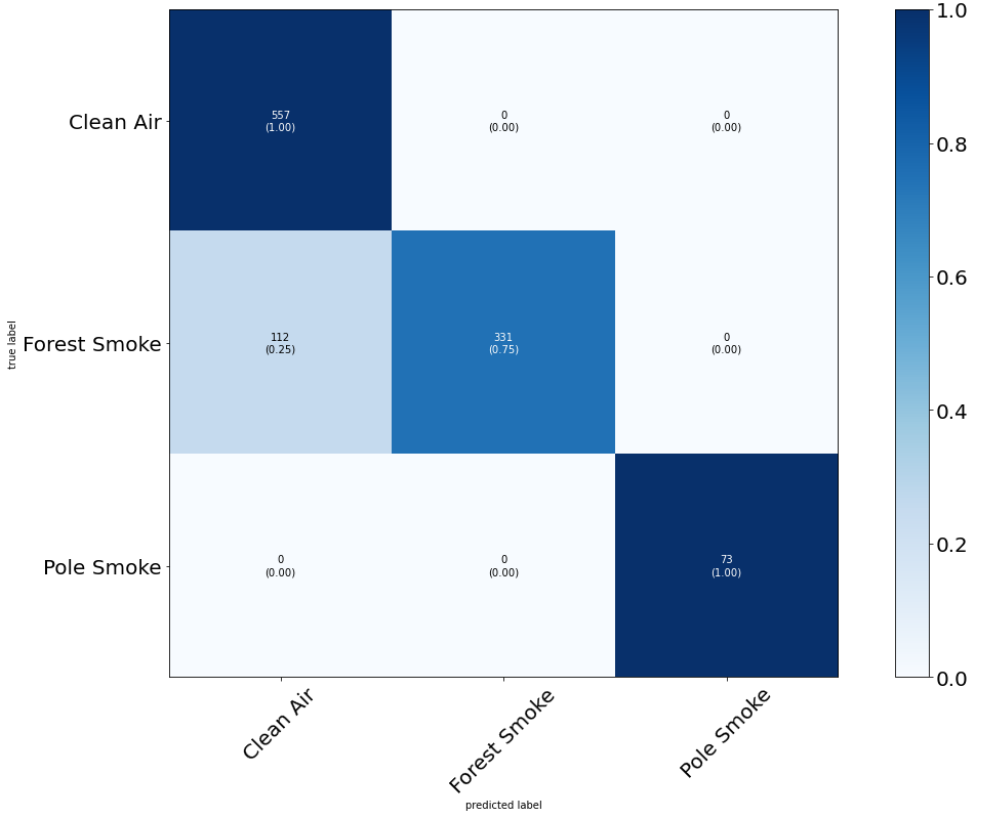
August: Test planning and logistics

September: Testing

October: Final Project Report

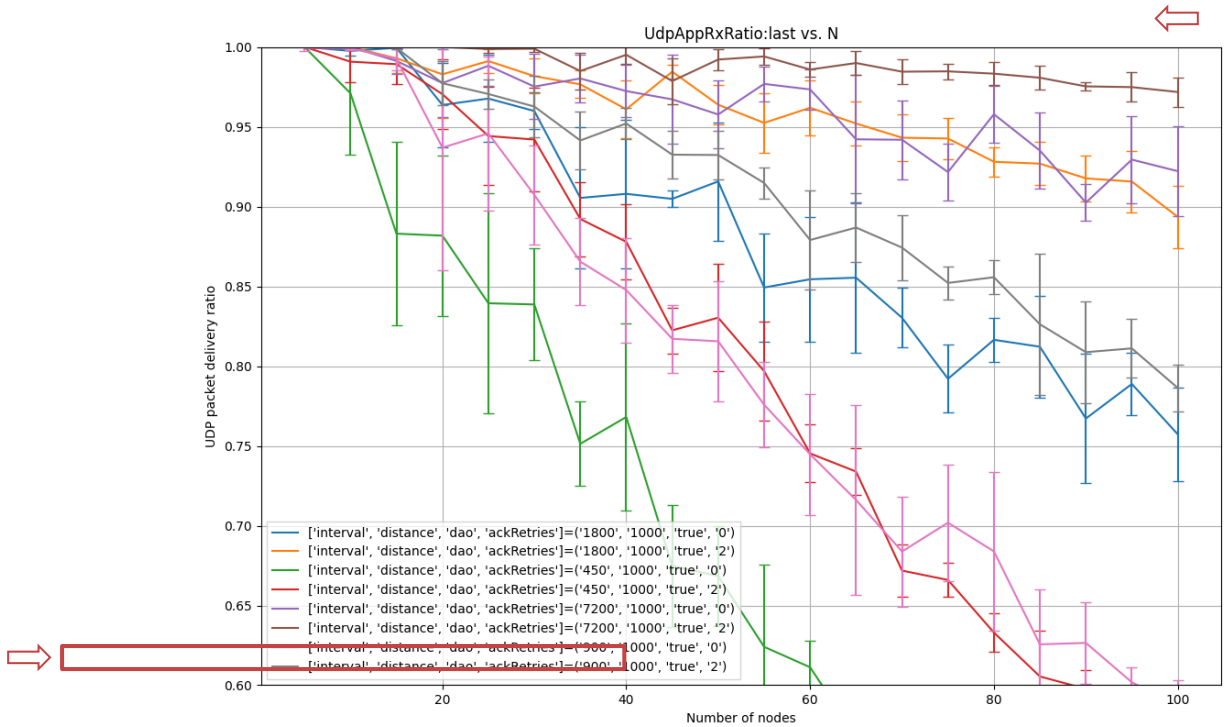
ML/AI Results with Poles (Smoke Chamber)

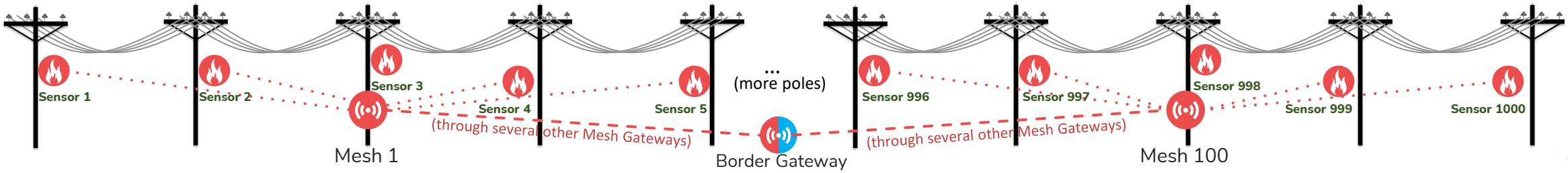
- New model that classifies smoke from poles in addition to clean air and forest smoke.
  - 100% accuracy on clean air and pole smoke (test set)
  - 74.7% accuracy on forest smoke (test set)
  - Can even identify type of pole which generated the smoke !
- Main model has 95%+ accuracy on forest smoke (test set)
  - Lower accuracy due to limited training data (avoid class imbalance)



MESH Simulations With Pole Deployments

- Simulated up to 1000 poles covered by one Border Gateway
  - Assuming 100m avg. pole distancing
  - 10 sensors served by each Mesh Gateway
  - 100 Mesh Gateway served by one Border Gateway
- Main result: 1000 poles can be served by one Border Gateway with
  - The target sensor reporting rate of once every two hours
  - Data accumulation is needed (a mesh message needs to convey messages from multiple sensors)
- Multiple of the above setup can be deployed





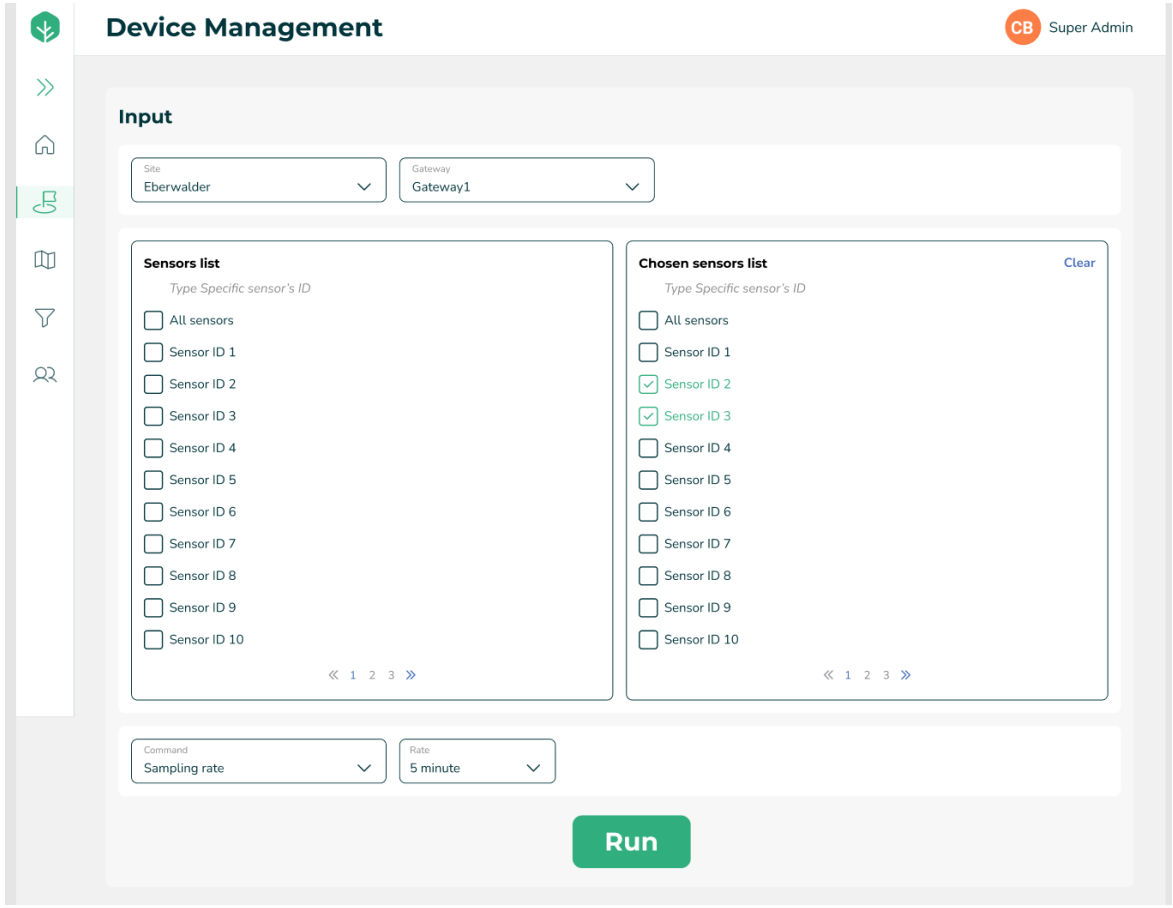
Cloud Enhancements

Downlink Commands - CLI to UI (50 % Done)

includes ..

- basic commands
- composite commands
- firmware over the air updates

./all_send_cfg.sh ./pge_sensors.txt -c bg22 --iaqrate IAQLP



Multi-Classification Alerts (100 % Done)

smoke from wooden poles vs forest fire

- **web application alerts (maps + central alert page)**
- **email alerts**

Learnings to Date

What have the team learned to date ?

- MESH Topology scales well
- Machine Learning pipeline capable of handling multiple classifications

What are successes so far ?

- MESH Topology results
- Range Test results
- Cloud platform nw handles multi-class smoke detection
- Machine Learning model capable of distinguishing in controlled environment (smoke chamber)
  - wooden pole smoke vs wildfire smoke
  - various types of wooden pole smoke

What are the barriers so far ?

- Machine Learning model not as efficient in outdoor environments
- Wooden pole smoke vs Wildfire smoke data imbalance
- UI based automation of over-the-air update of the Machine Learning model is not fully implemented

Our Team

Utility Representative:

Gavin Fong, Dave Chua, Omar Mahmoud (Wildfire Risk Management)

Damian Inglin (Emerging Technology Strategy & Programs)

Startup Representative:

Carsten Brinkschulte, CEO, Dryad Networks GmbH

Cherian Mathew, Cloud Platform Lead, Dryad Networks GmbH

Ben Banerjee, SVP Worldwide Sales, Dryad Networks GmbH

Host Utilities

and collaborators

Thank You