ForestField
First Defense Against Wildfires

Wireless Remote Wildfire Detection System

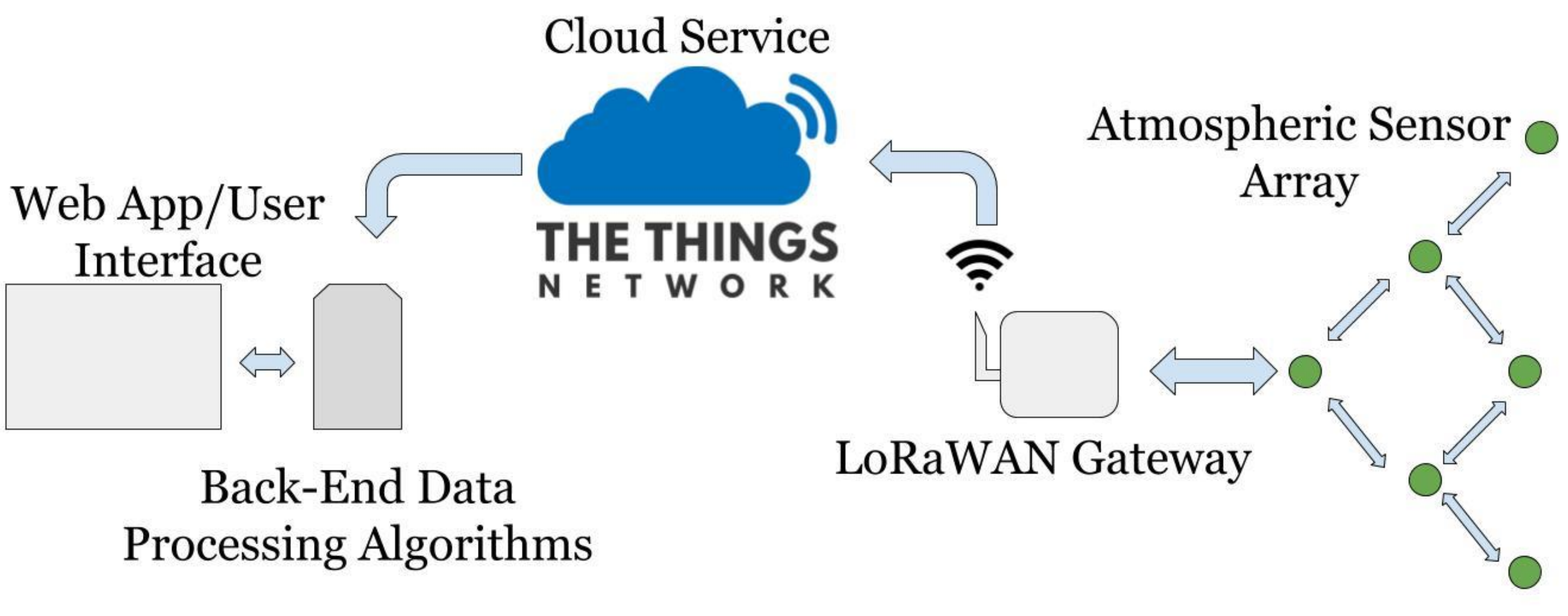Prathamesh Nagnoor | Ryan Phan | Jeremiah Ford | Jeffery Li

Background

Recent times have seen a drastic increase in erratic and highly destructive wildfires. In order to reduce their destructive impact, we need to decrease the response time for first responders and localize efforts to the areas where these wildfires first start.
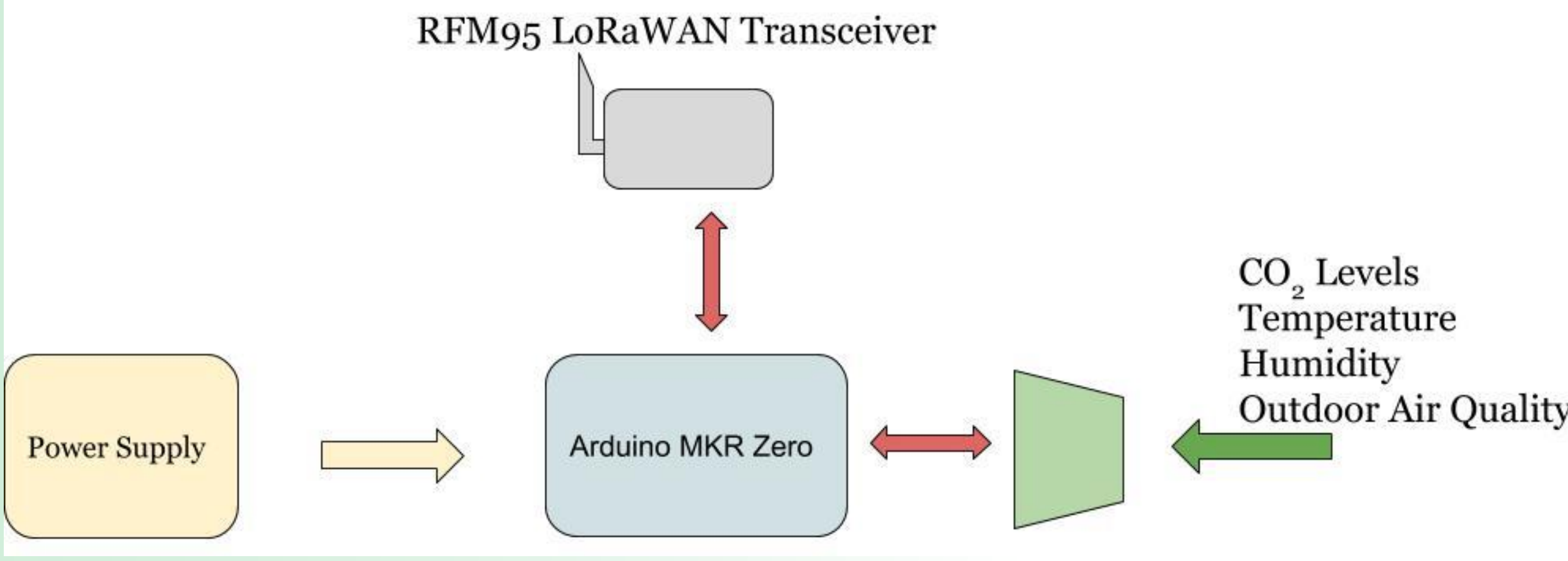
Overview / Design Specs

Forest Field is a wireless forest fire communication system that monitors and detects fires in rural or inaccessible places. Our solution consists of three parts:
- An atmospheric sensor array
- A wireless mesh network communication protocol which uplinks to a cloud base server
- User-friendly web application featuring an interactive map for simple data visualization and processing
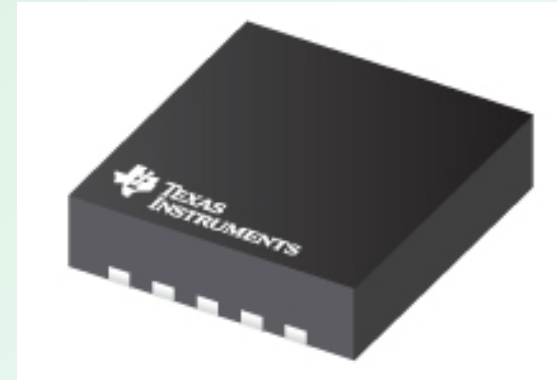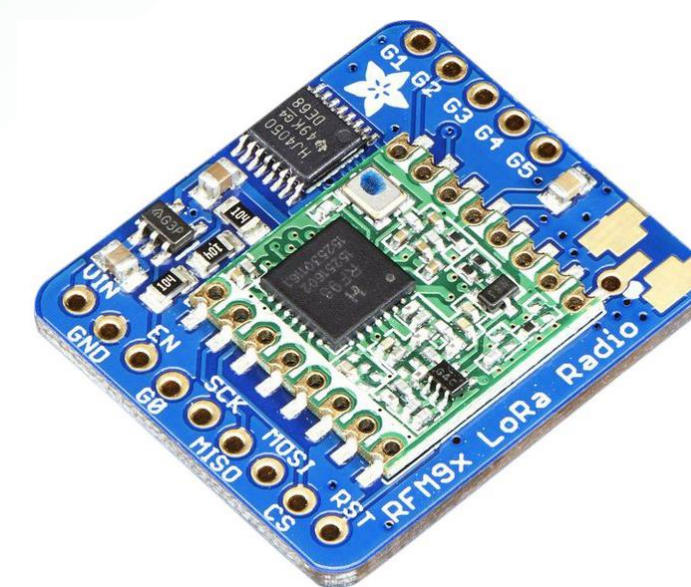
System Flow Chart

Cloud Service — THE THINGS NETWORK

Web App/User Interface

Back-End Data Processing Algorithms

LoRaWAN Gateway

Atmospheric Sensor Array

Sensor Node Flow Chart

RFM95 LoRaWAN Transceiver

Power Supply — Arduino MKR Zero

CO_2 Levels
Temperature
Humidity
Outdoor Air Quality

Sensor Node Hardware & Specs

TPS6300
- Buck-Boost Converter
- High Power Efficiency

ZMOD4510
- Outdoor Air Quality Sensor
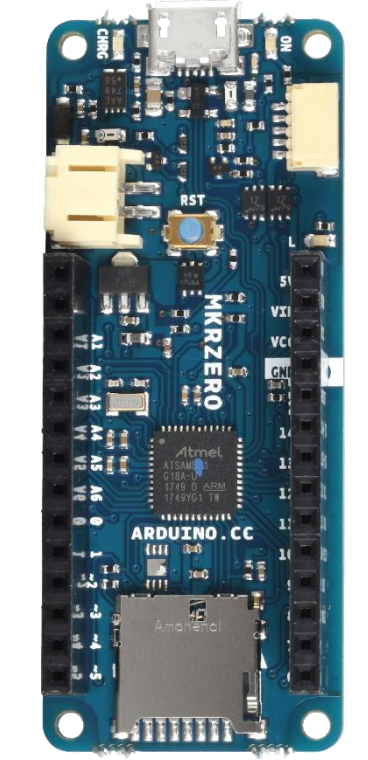
SCD30
Measures:
- CO_2
- Temperature
- Humidity

RFM95
- LoRa Wireless Transceiver
- 2 km range

uFL Antenna
- 1.2 dBi
- 2 km range

Arduino MKRZERO
- Low Power Use
- Sleep Mode
- I2C and SPI

Arduino PCB Shield Design

Power Management Circuit
- 5V DC Supply

Sensor Array
- Air Quality Sensor
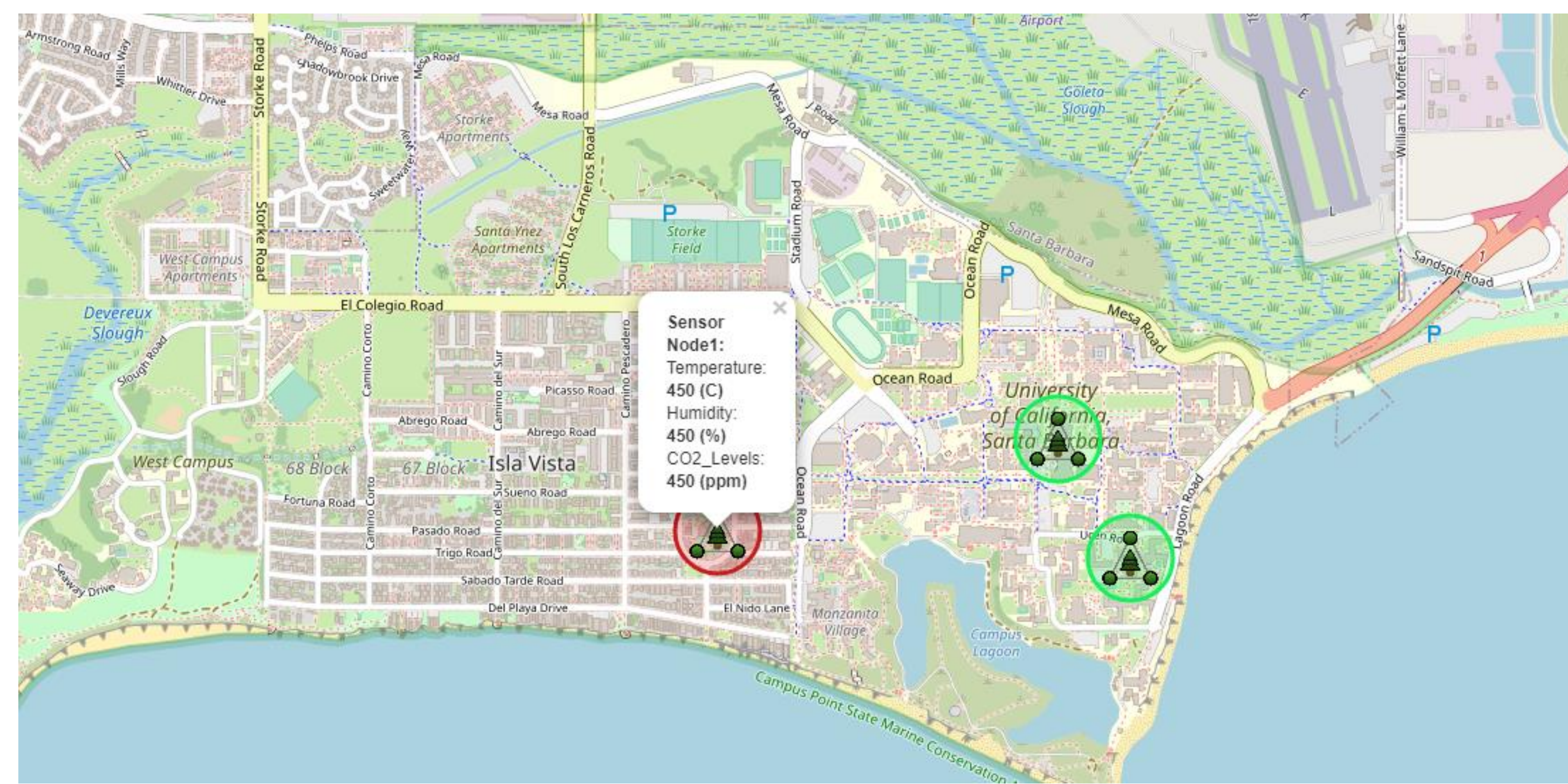- Carbon Dioxide Sensor

Wireless Communication Network
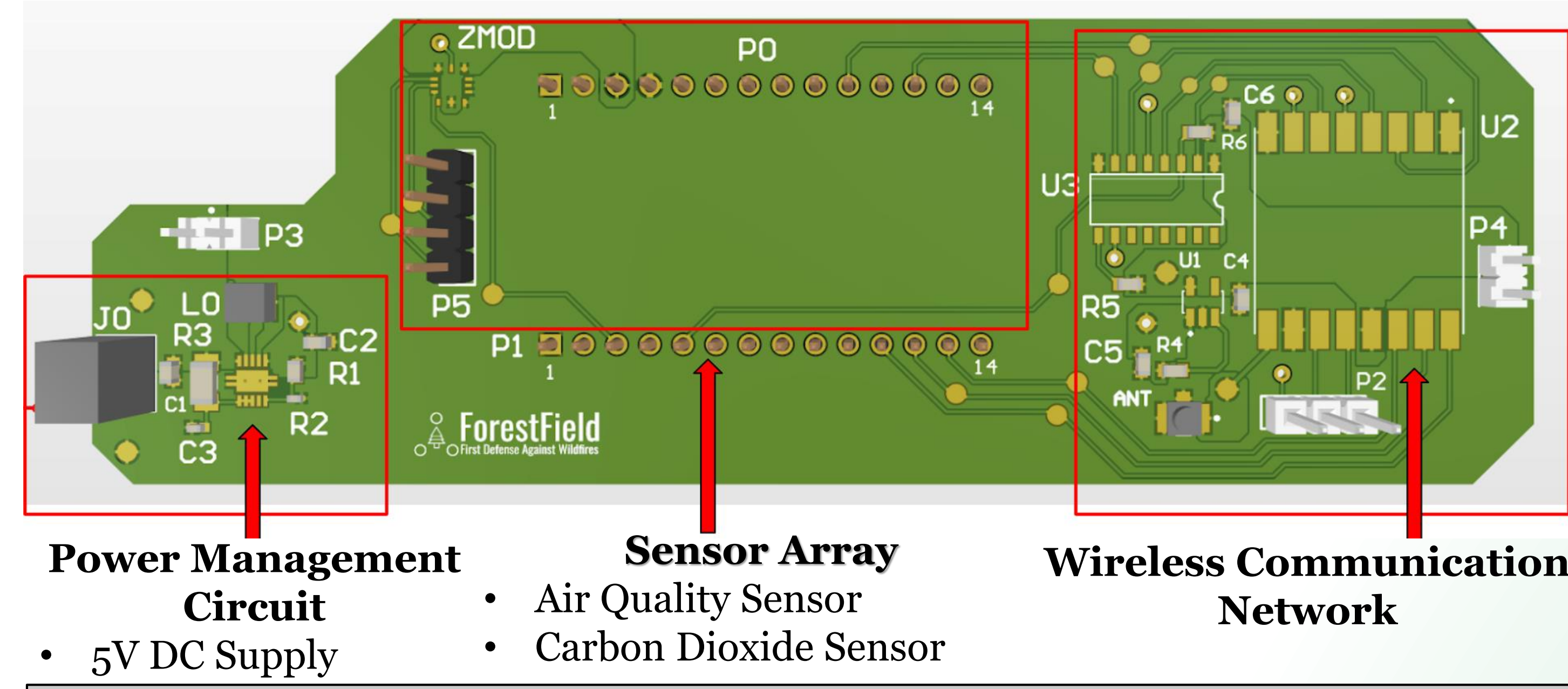
Mesh Networking Capabilities

- Mesh network topology enables individual nodes to connect to the central processing node by routing messages through other sensor nodes.
- Increases network scalability nodes can be continuously added
- Enables a self-healing network which can form routes to the base station dynamically

message for node 2

Node 1 discovers a route to node 2 via node 3
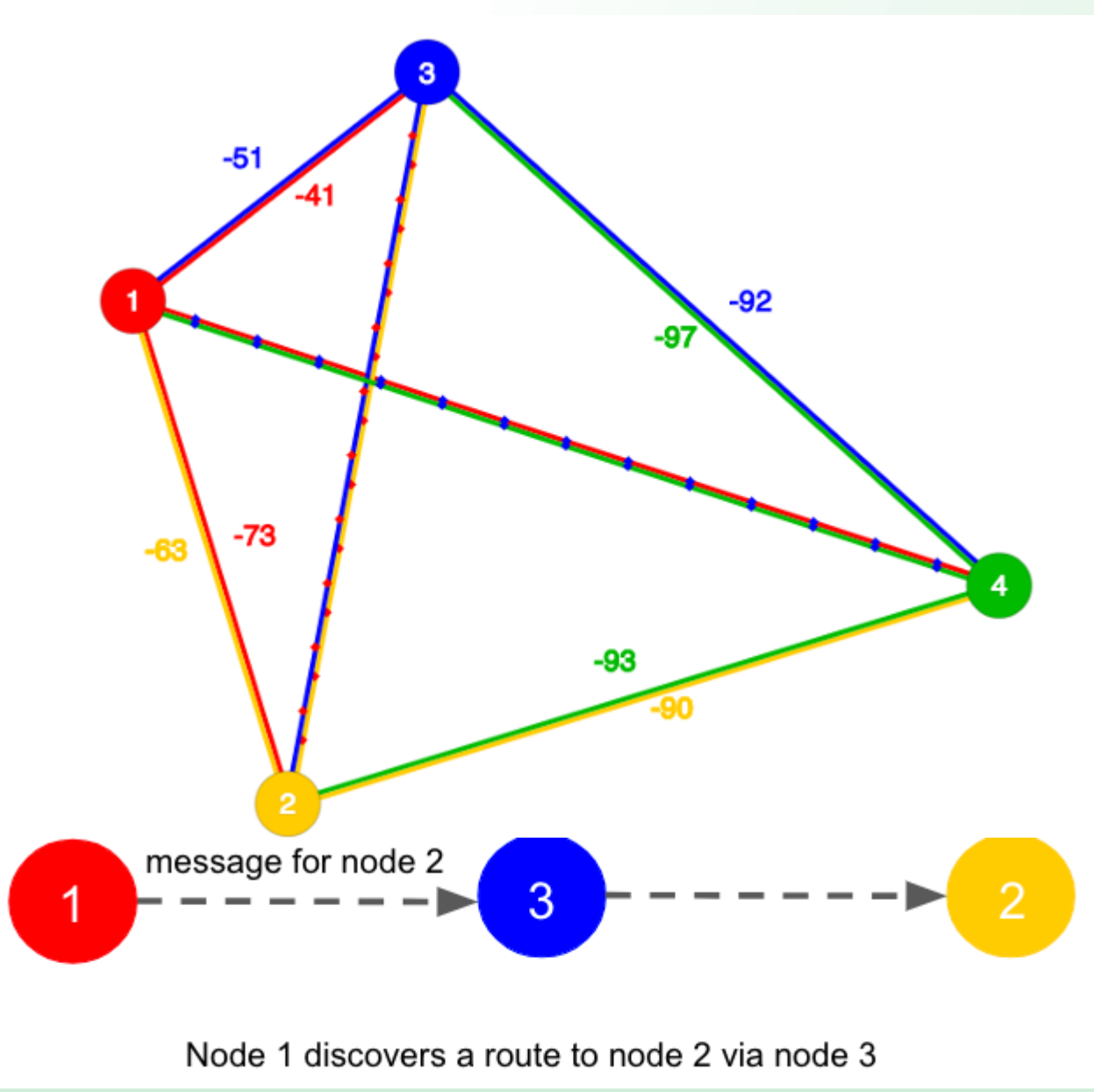
User Interface & Data Visualization

Sensor Node1:
Temperature: 450 (C)
Humidity: 450 (%)
CO2_Levels: 450 (ppm)

- Interactive Map that shows sensor location as well as real-time sensor data updates
- Downstream messaging for controlling sensor data collection rates

Field Implementation and Network Topology

10 meters

1km
0.707km
1km
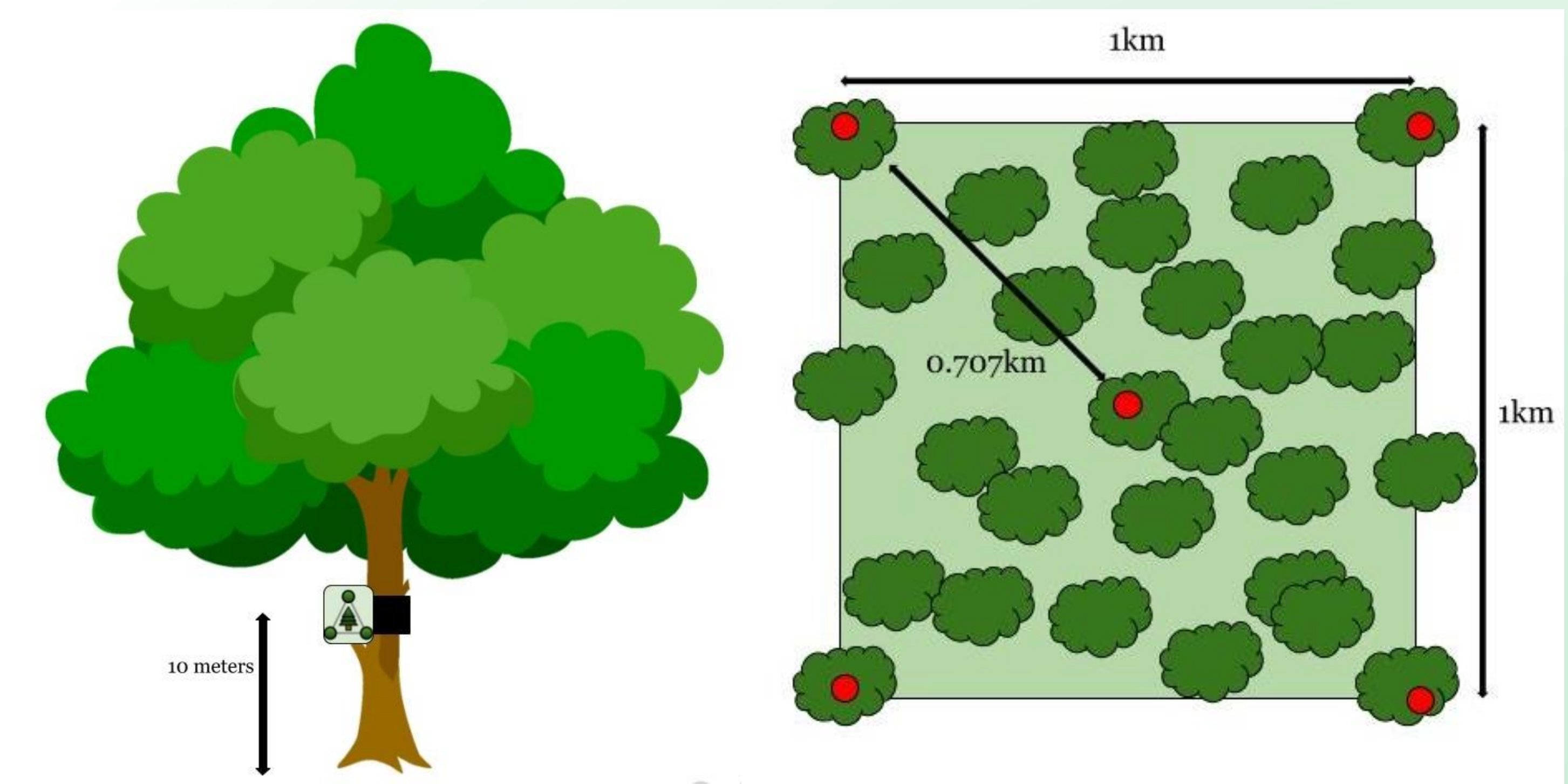
- Tall forests would require 15-20 meters installation, while for less dense regions, 5-10 meters is adequate
- Topology can be scaled dynamically, depending on consumer application and terrain requirements

Future Steps and Enhancements

- Downlink functionality for adjusting sensor transmitting modes
- Integrate weather data for fire risk & fire propagation algorithms
- Custom-built microcontroller board for consolidating hardware
- Transfer Network to a dedicated cloud-based server

Senseeker

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