

# Offshore Communications for Sharing Data and Information



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# Use cases for real-time data

## Utilities



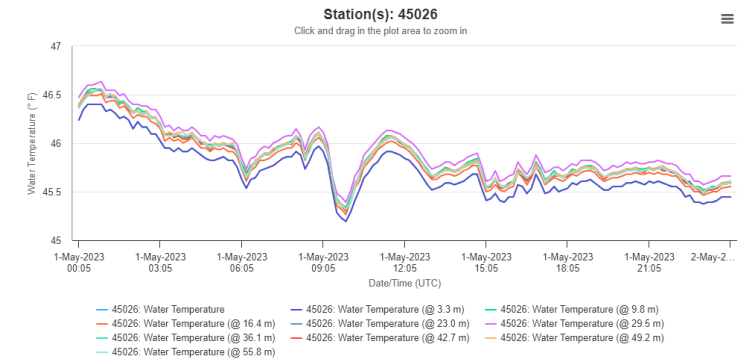
- Water treatment plants, power plants, etc.
- Interested in current lake conditions at their intake/specific location

## Recreation & Management



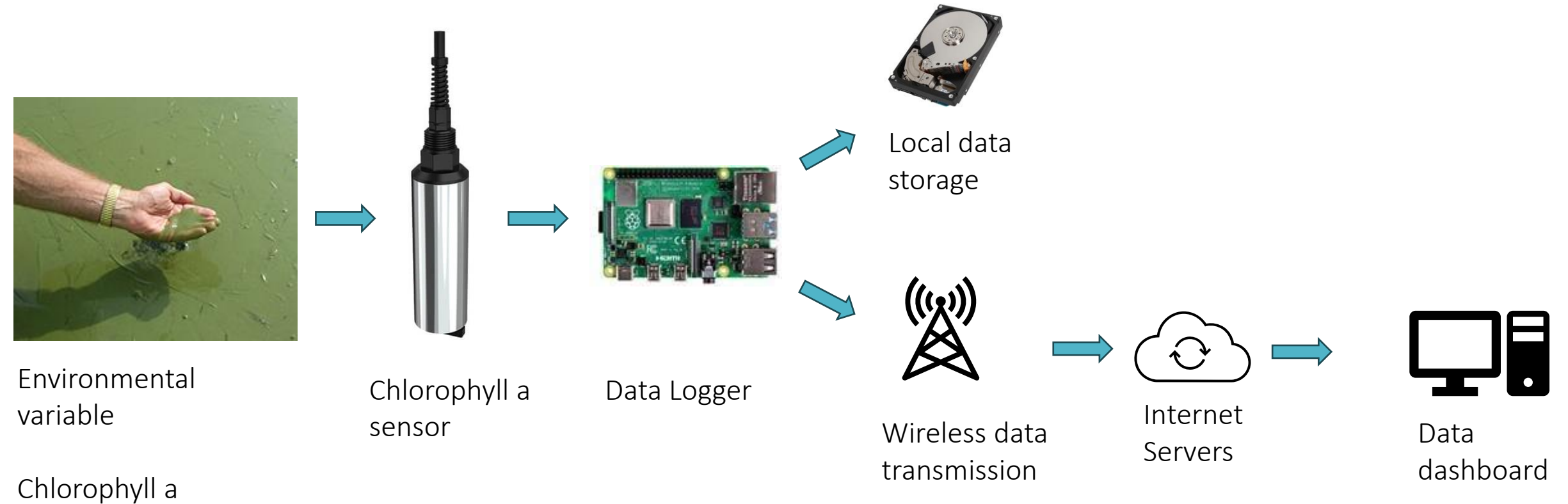
- Park managers, fishing captains, etc.
- Interested in current lake conditions in certain sections of the lake
- Determining if conditions are safe to go out

## Research



- University & agency researchers, etc.
- Ensure sensor is functioning properly
- Changes in real-time data can prompt grab samples

# Basic sensing system



# Basic sensing system



Environmental variable

Chlorophyll a



Chlorophyll a sensor



Data Logger



Local data storage



Wireless data transmission







Internet Servers

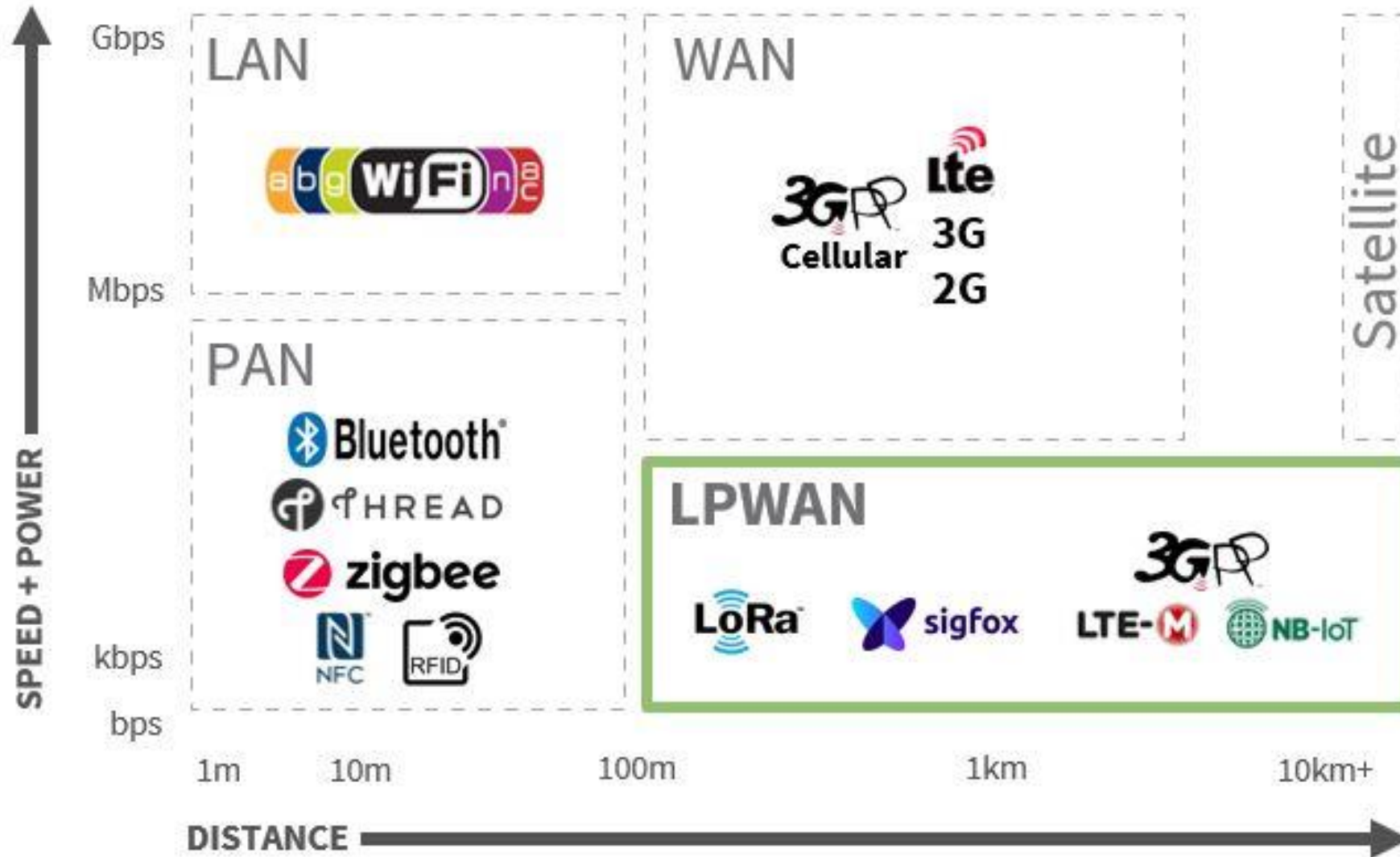


Data dashboard

# Telemetry Options

	 Cellular	 Satellite	
<ul style="list-style-type: none"><li>• Low Cost</li><li>• High reliability</li><li>• Low Availability</li></ul>	<ul style="list-style-type: none"><li>• Medium Cost</li><li>• Medium-High Reliability (coverage?)</li><li>• High Availability</li></ul>	<ul style="list-style-type: none"><li>• High Cost</li><li>• High Reliability</li><li>• High Availability</li></ul>	<ul style="list-style-type: none"><li>• Low Cost</li><li>• Medium-High Reliability (coverage?)</li><li>• Medium Availability</li></ul>

# Telemetry Options

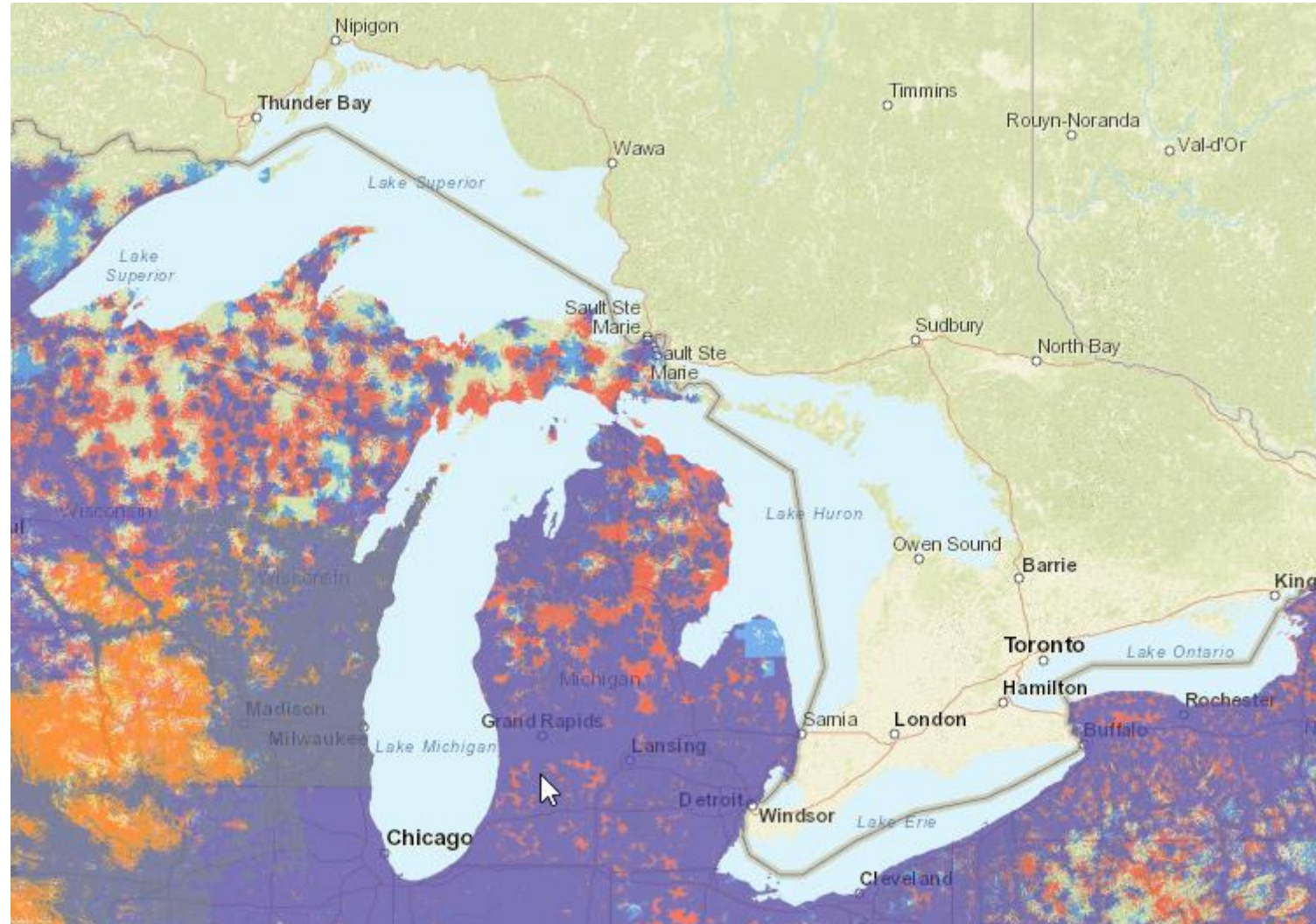


# Cellular

- Ability to send large amount of data.
  - Images, videos, etc.
- 2-way communication
  - Ability to adjust sampling intervals, programs, etc.
- No ability to expand coverage
  - Often limited coverage offshore



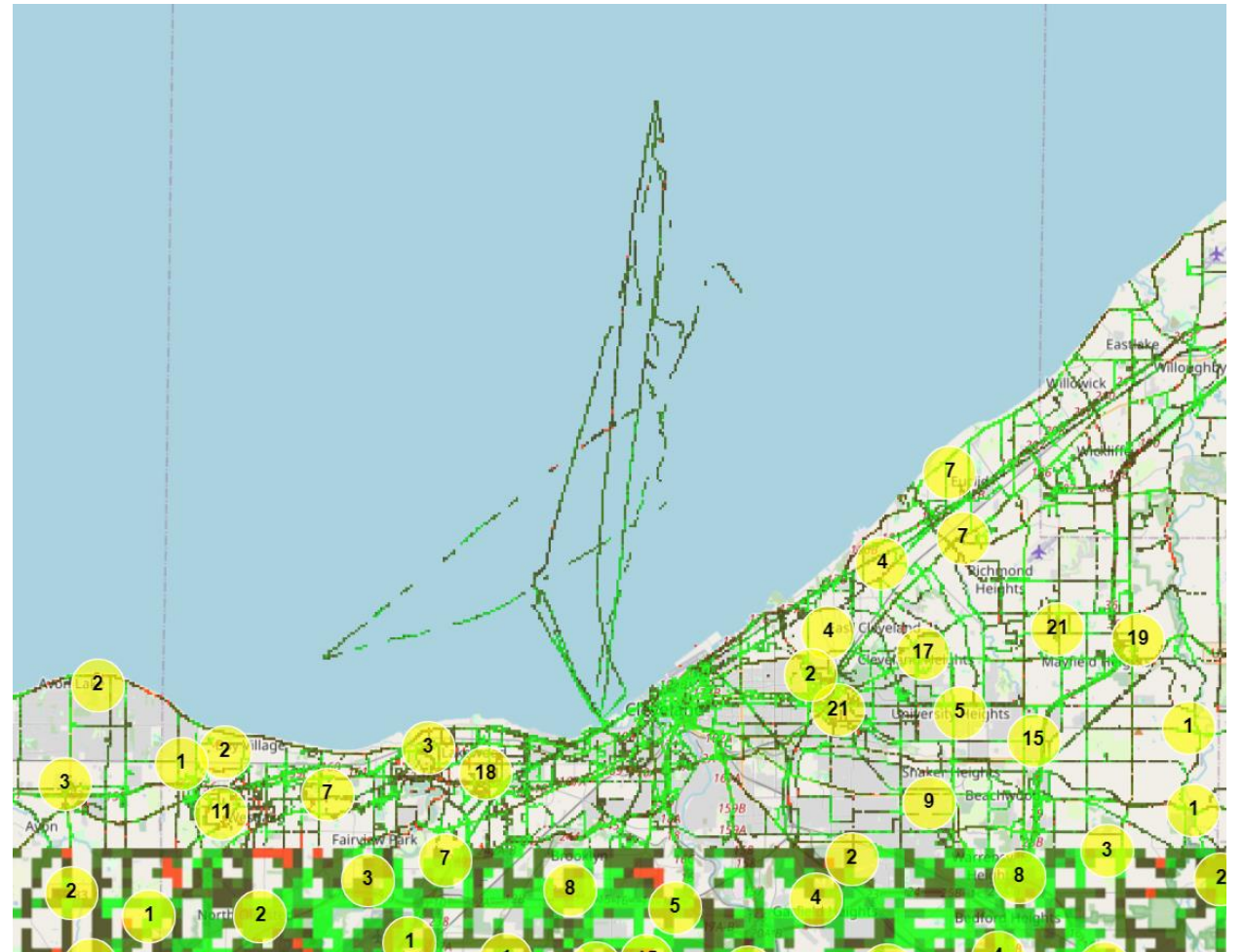
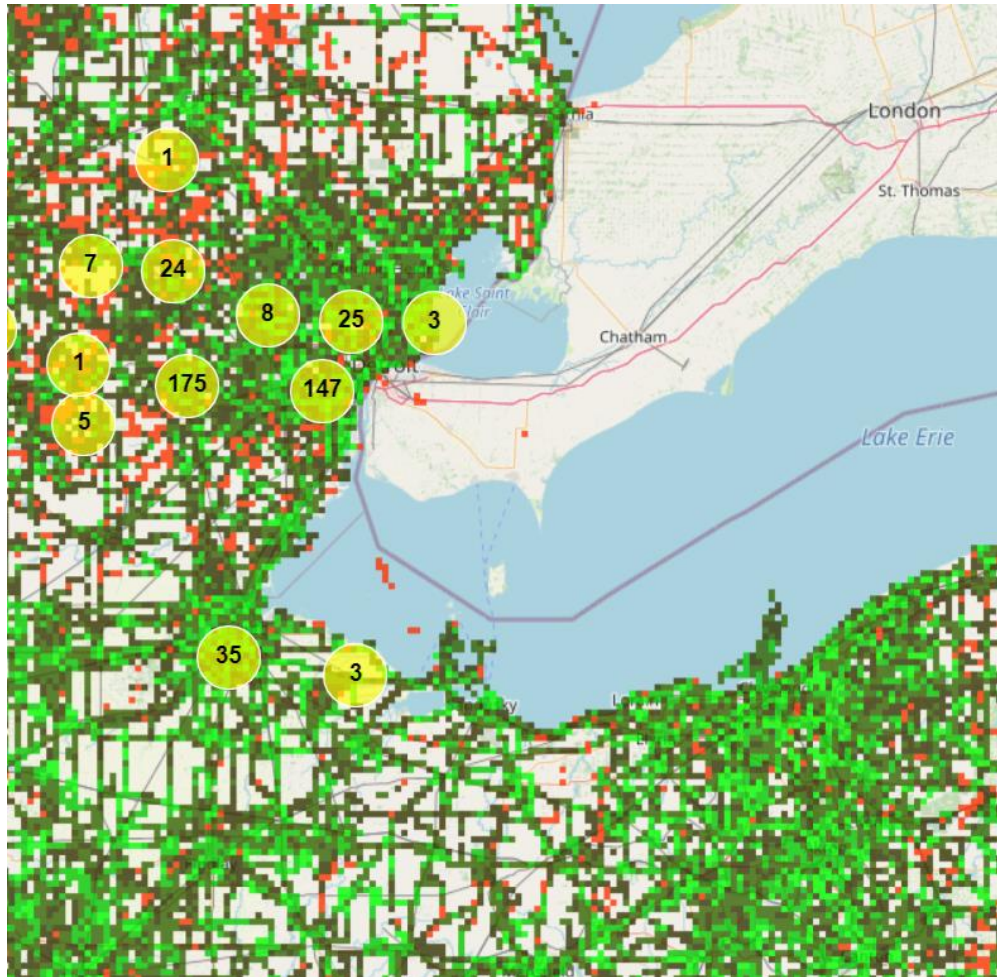
# Great Lakes Cellular Coverage – Public Map



<https://fcc.maps.arcgis.com/apps/webappviewer/index.html?id=6c1b2e73d9d749cdb7bc88a0d1bdd25b>



# Great Lakes Cellular Coverage



Cellmapper.net

# Low-cost cellular option – LTE M

- Long-Term Evolution Machine Type Communication.
- Developed for internet of things applications.
- Low bandwidth applications that use cellular network.
- Data plans that are cheaper than traditional cellular plans.



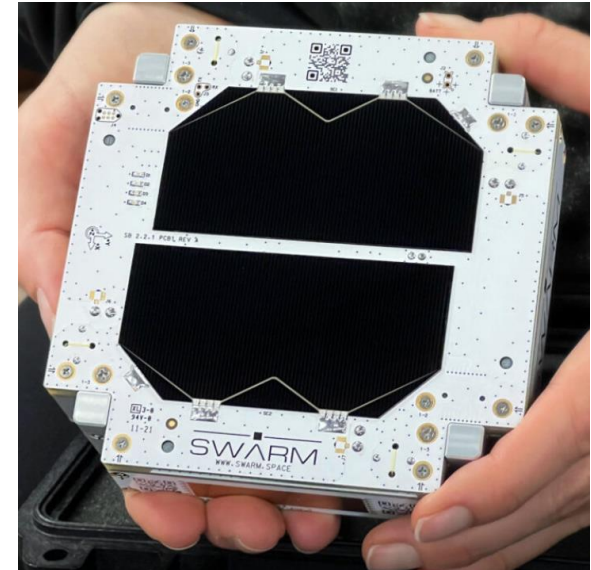
# Satellite

- Iridium maintains a network of Low Earth Orbiting (LEO) satellites.
- Coverage virtually everywhere
- Significantly more expensive than cellular.
  - Typically, only used when other options are not feasible.



# Satellite – Emerging Technology

- Cell phones roaming to satellite.
- A network of low-cost micro satellites to create a cheaper network of satellite communication.
- Micro satellites hosting LoRa gateways. Expanding the LoRa network.



# LoRaWAN

- Long Range Wide Area Network
- Operates on 915 mHz unlicensed public radio band.
- Long range communication up to 10+ miles in line of sight.
- Low power communication; battery powered sensors lasting multiple years.



# UNITED STATES FREQUENCY ALLOCATIONS THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

AERIAL TELEPHONE MOBILE	AIR FORCE SERVICES	AIR MAIL SERVICES
AERIAL TELEPHONE MOBILE SATELLITE	AIR FORCE MOBILE	AIR AND SPACE RESERVICES SATELLITE
AIRPORT OPERATIONS	AIR AND SPACE MOBILE SATELLITE	AIR AND SPACE RESERVICES
AMATEUR	MARITIME MOBILE	AIR AND SPACE RESERVICES SATELLITE
AMATEUR SATELLITE	MARITIME MOBILE SATELLITE	AIR AND SPACE RESERVICES
BROADCASTING	MARITIME MOBILE SATELLITE	AIR AND SPACE RESERVICES SATELLITE
BROADCASTING SATELLITE	METEOROLOGICAL	AIR AND SPACE RESERVICES SATELLITE
CABLE TELEVISION SATELLITE	METEOROLOGICAL SATELLITE	AIR AND SPACE RESERVICES
FIXED	MOBILE	AIR AND SPACE RESERVICES SATELLITE
FIXED SATELLITE	MOBILE SATELLITE	AIR AND SPACE RESERVICES SATELLITE
FEDERAL RESERVE	FEDERAL NON-FEDERAL BAND	STANDARD FREQUENCY AND TIME SIGNAL
NON-FEDERAL RESERVE		STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

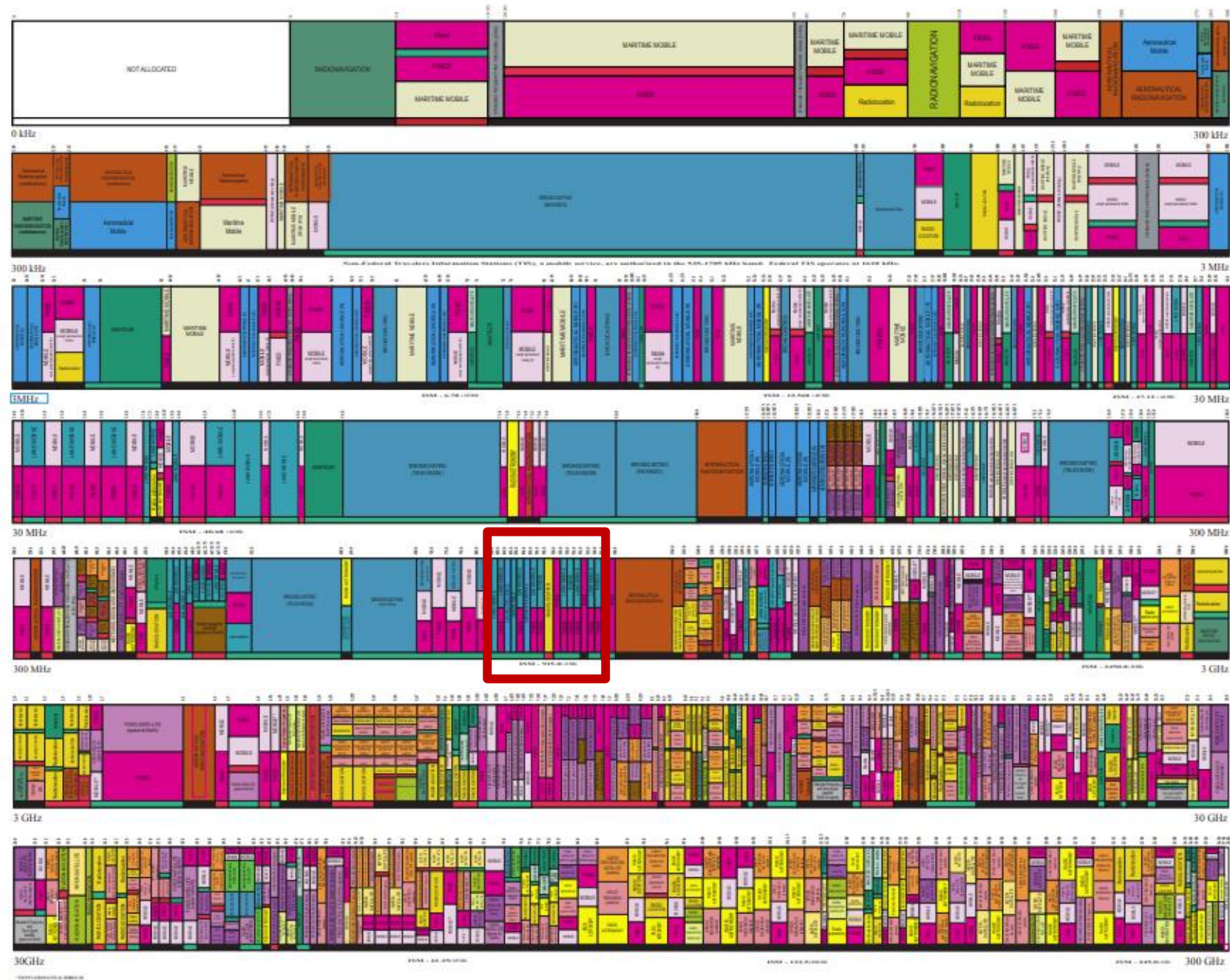
ACTIVITY CODE

FEDERAL RESERVE	FEDERAL NON-FEDERAL BAND
NON-FEDERAL RESERVE	

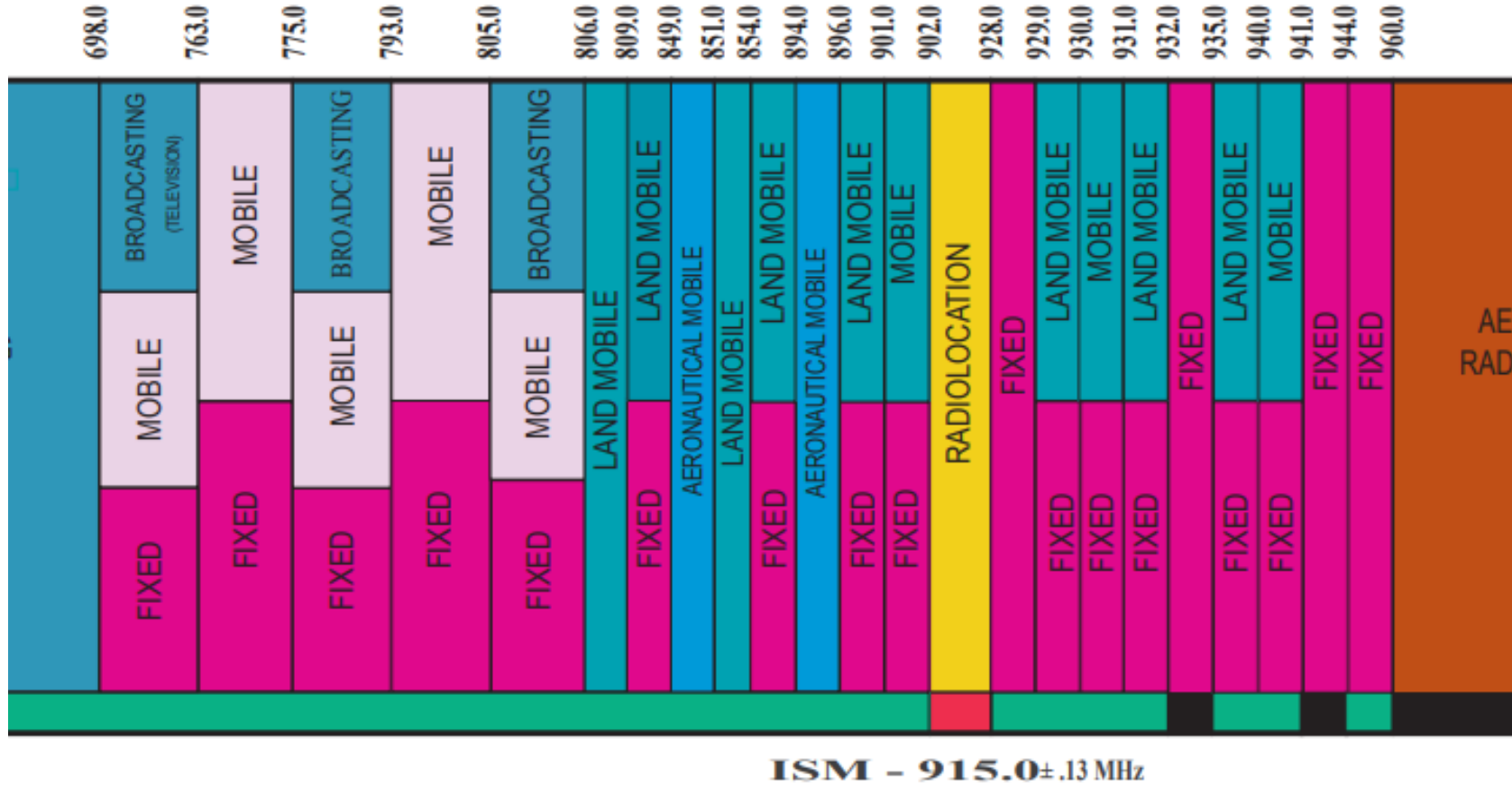
ALLOCATION USAGE DESIGNATION

MARKER	EXAMPLE	DESCRIPTION
Primary	F1:12.5	Coastal Station
Secondary	S1:25	For Coastal with 25 kHz main lobe

This is a public map and is not intended for use as a legal authority. It is subject to change without notice. For more information, visit [www.fcc.gov](http://www.fcc.gov).



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The **ISM radio bands** are [portions](#) of the [radio spectrum](#) reserved internationally for *industrial, scientific, and medical* (ISM) purposes, excluding applications in [telecommunications](#).

# LoRa – Typical Setup

## Field Deployed Sensors



DecentLab Ultrasonic Distance/Level Sensor



Dragino Temperature/Humidity Sensor



Dragino Soil Moisture

900mhz  
ISM

5+ yr  
battery

## Regional LoRaWAN Gateways

900mhz <-> "Internet"



- 100+ sensors per gateway
- 1mi to 10mi range (LOS)
- All gateways can receive all sensor messages

## Cloud LoRaWAN Server

Public Internet  
Cell/LAN/WiFi



- Packet decoding
- Security & User Management
- Connection to other LoRaWAN Networks
- Webhook links

## Dashboard, Alert, & Archive



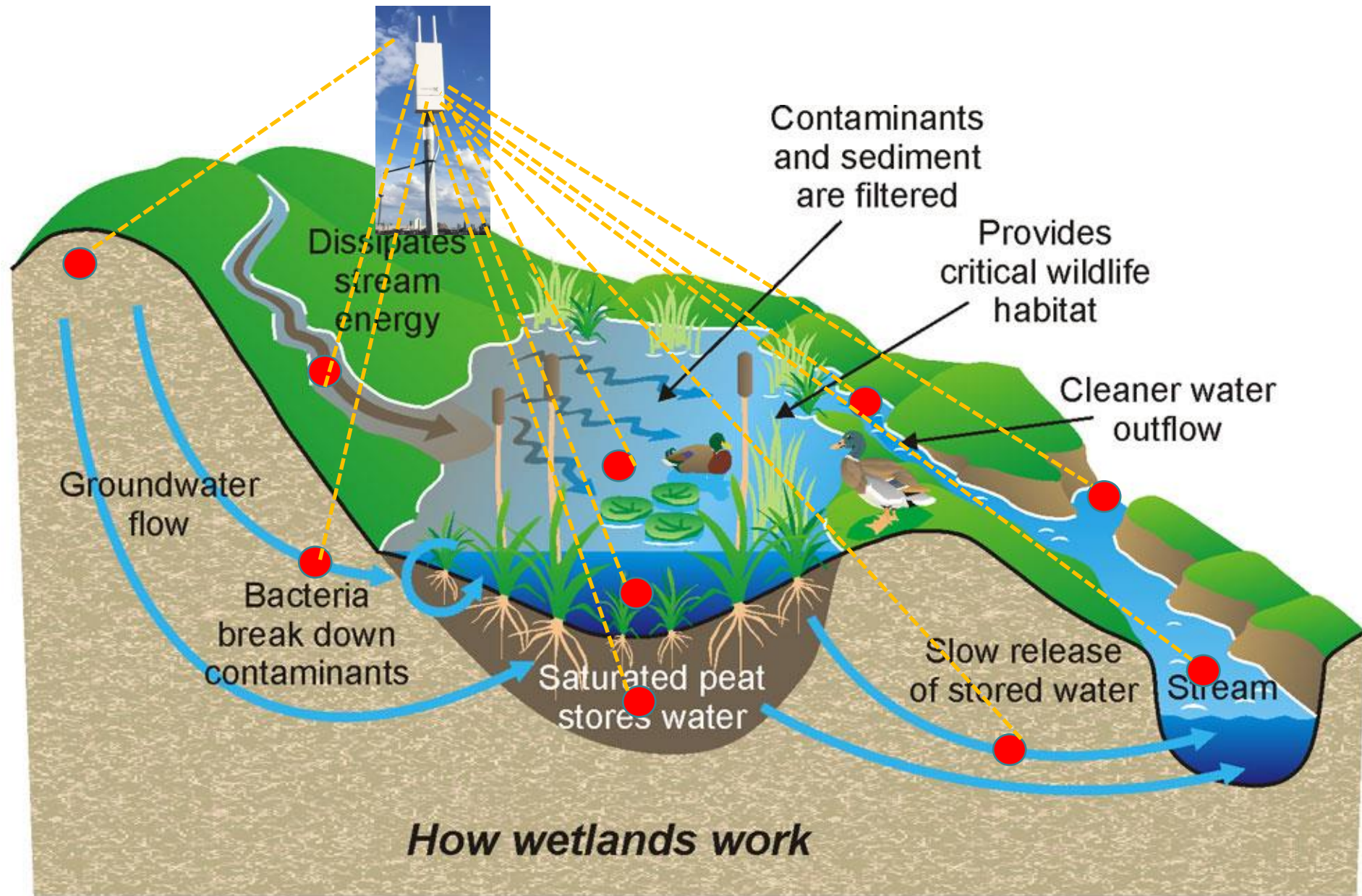
- Packet decoding
- Security & User Management
- Connection to other LoRaWAN Networks
- User alert
- Archive & Sharing



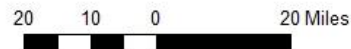
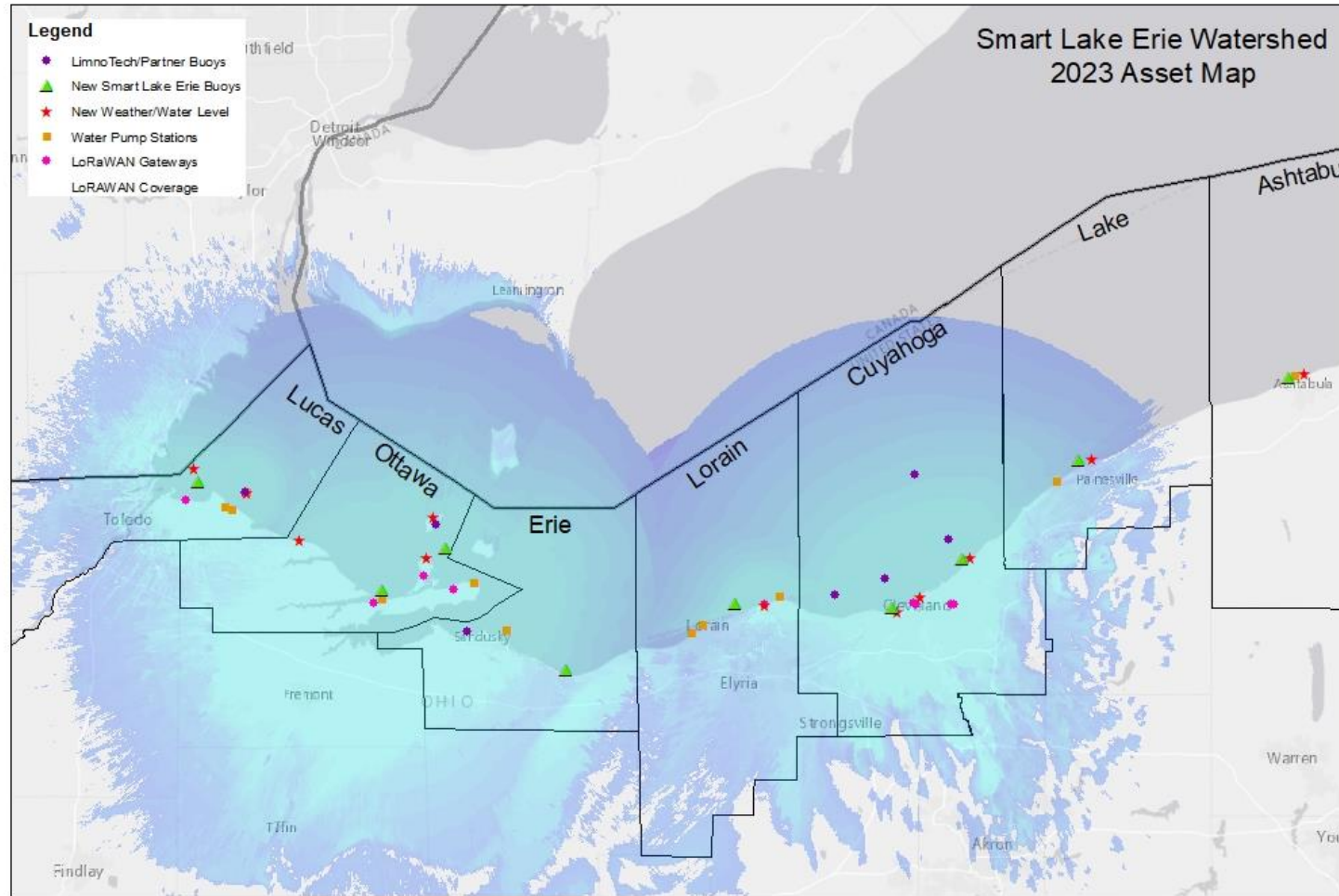




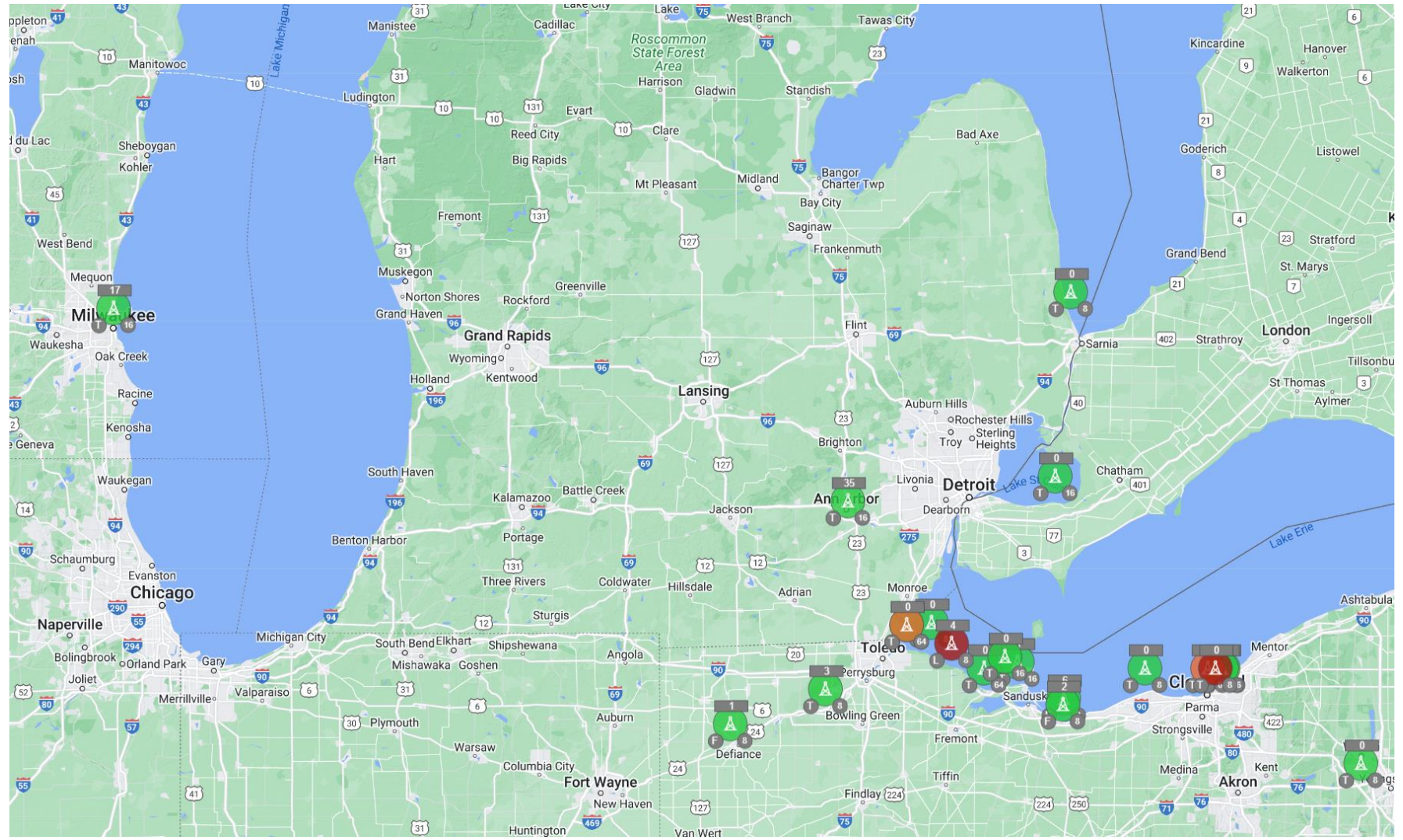




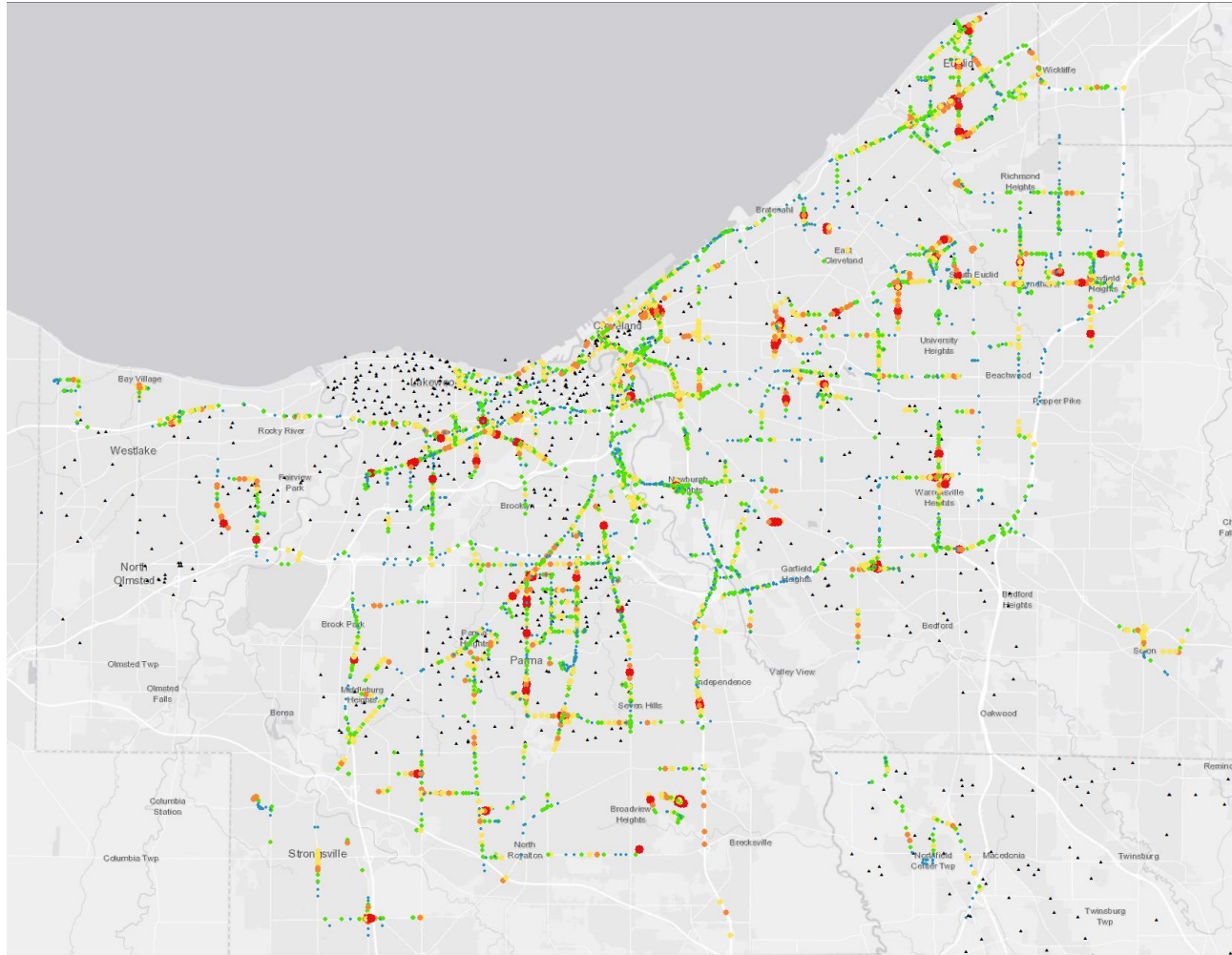
# LoRaWAN – Smart Lake Erie



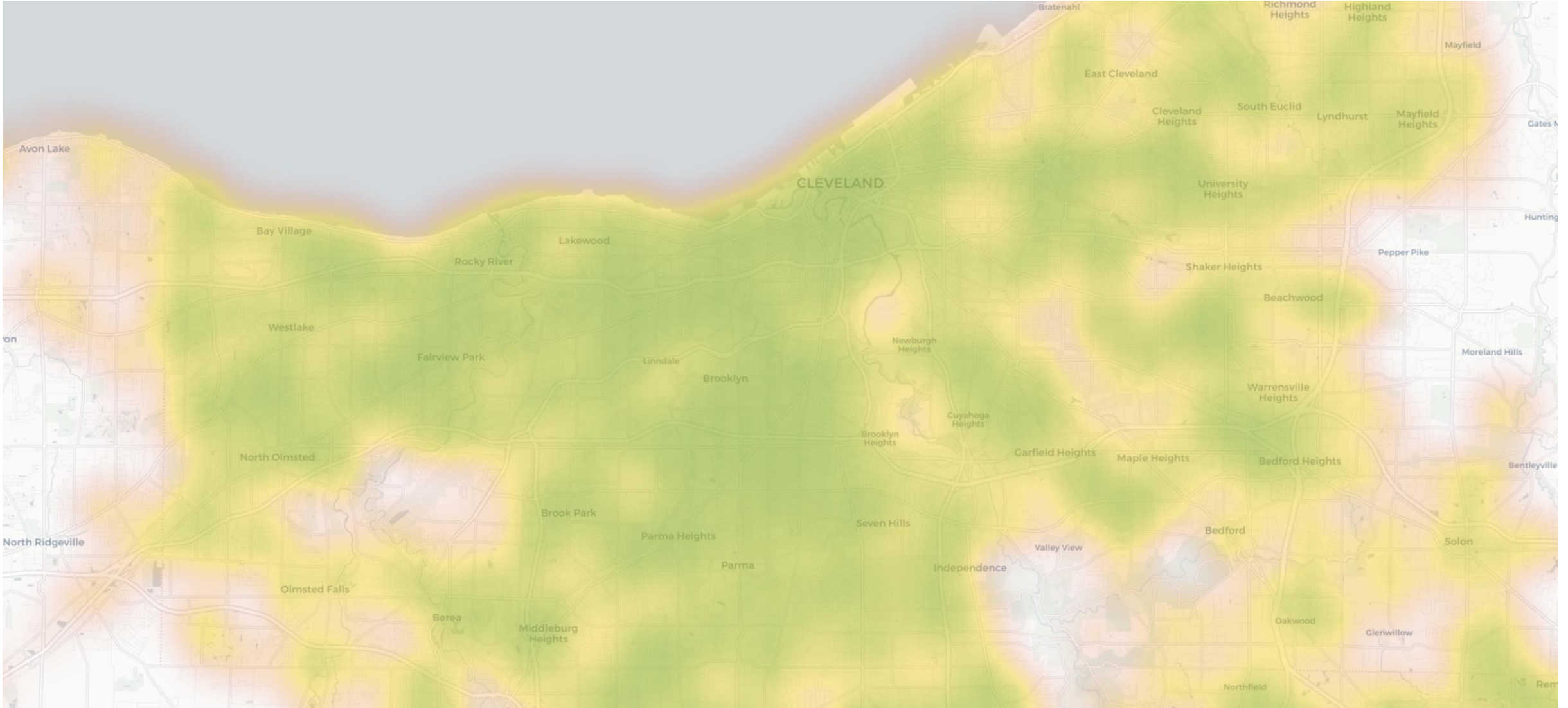
# LoRaWAN – LimnoTech Maintained Network



# LoRaWAN Mapping



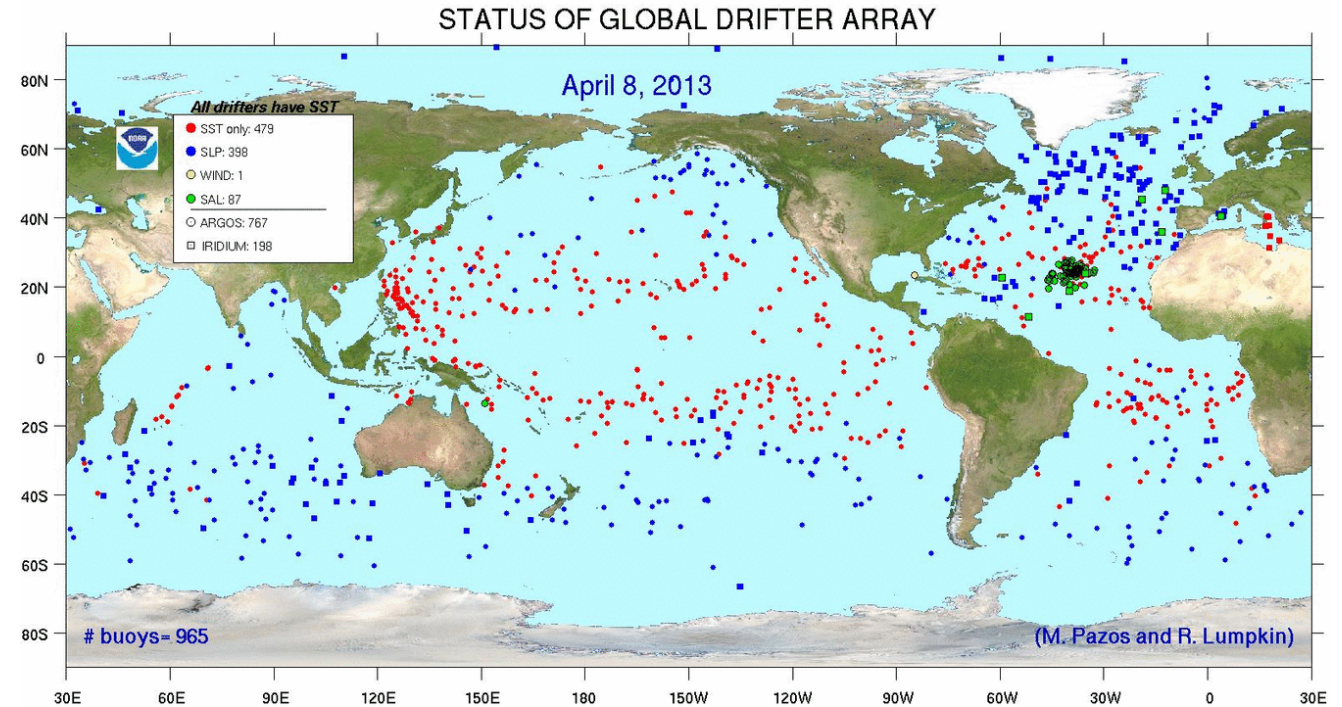
# LoRaWAN Mapping





# LoRaWAN – Drifter

- Deploy hundreds of drifters to measure surface currents.
- Could be rapidly deployed during a spill to detect plume.



# Getting Involved

- Hosting a LoRa Mapper or Gateway on your vessel
- Adding LoRa to your offshore monitoring equipment
- Downloading [cellmapper.net](https://cellmapper.net) application



# Summary

- Cellular networks are best suited for high bandwidth, limited number of data loggers, and/or areas with existing coverage.
- Satellite can be used where there is no coverage.
- LoRaWAN is best suited for low bandwidth, high sensor density, and/or areas with existing coverage or areas that you'd like to add coverage to.



# THANK YOU

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