Lafayette Engagement
& Research Network

LEaRN: Lafayette Engagement and Research Network & the EPA Smart City Air Challenge

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CGI Federal

Making Sense of Sensors
Sept. 27-78, 2017
South Coast AQMD

Plan

1. About Lafayette Engagement and Research Network (LEaRN)
   - What is Lafayette, LA all about?
   - Where did LEaRN come form?
   - What is LEaRN trying to do?
2. LEaRN Air quality sensor platform;
3. Sensor validation methodology;
4. Software architecture of the Kinota™ open source data management solution;
5. LEaRN network topology;
6. Siting sensors in the community; and
7. Sensor fabrication and STEM education.

About Lafayette Engagement and Research Network

LEARN
Lafayette Engagement & Research Network

Lafayette
CONSOLIDATED GOVERNMENT

UNIVERSITY of LOUISIANA LAFAYETTE

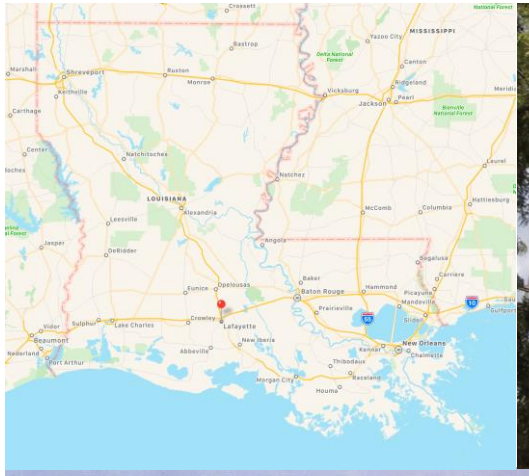
CGI

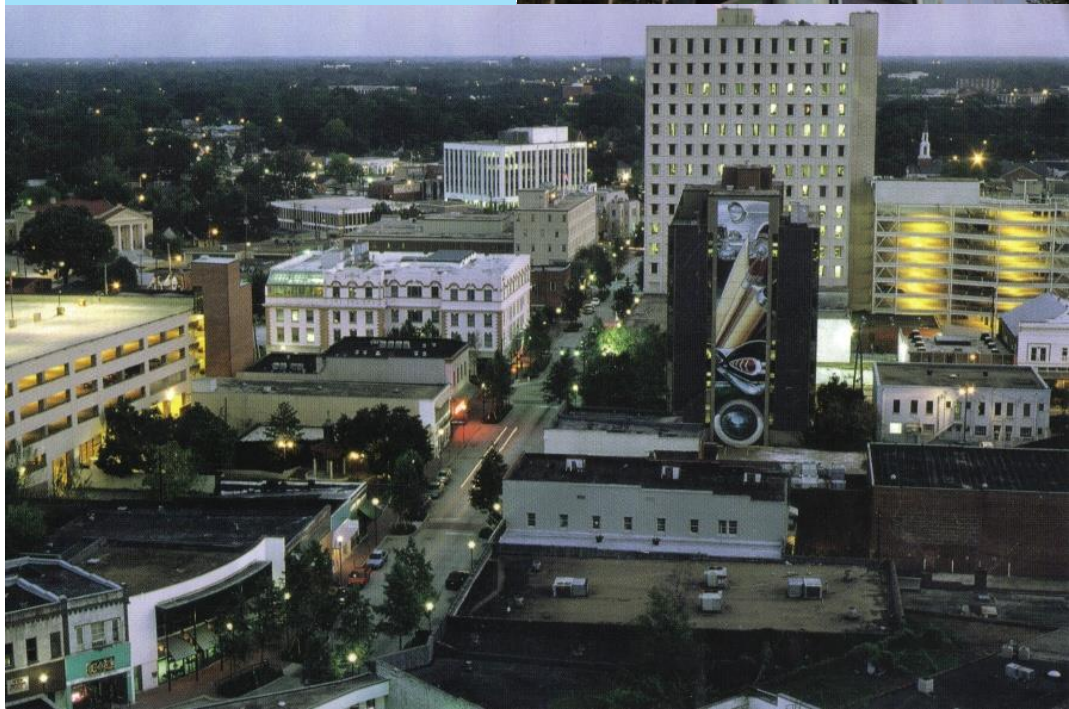
LAFAYETTE ECONOMIC DEVELOPMENT AUTHORITY

ONEACADIANA

What is Lafayette, Louisiana all about?

- Cultural capital of Acadiana
- Heart of Cajun and Creole Louisiana
- Population ~127,000
- Est. growth ~90,000 new people by 2030
- Lafayette economy GDP: ~$20 billion/year
- Major industries:
  - Energy Sector
  - Medical / Healthcare
  - Information Technology
  - Tourism and Culture





http://acadianatable.com/2013/03/11/no-soup-in-my-etouffee/

usignite

SMARTGIGABIT COMMUNITY

CAJUN code fest 5.0

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March 29 - April 1, 2017

REGISTER

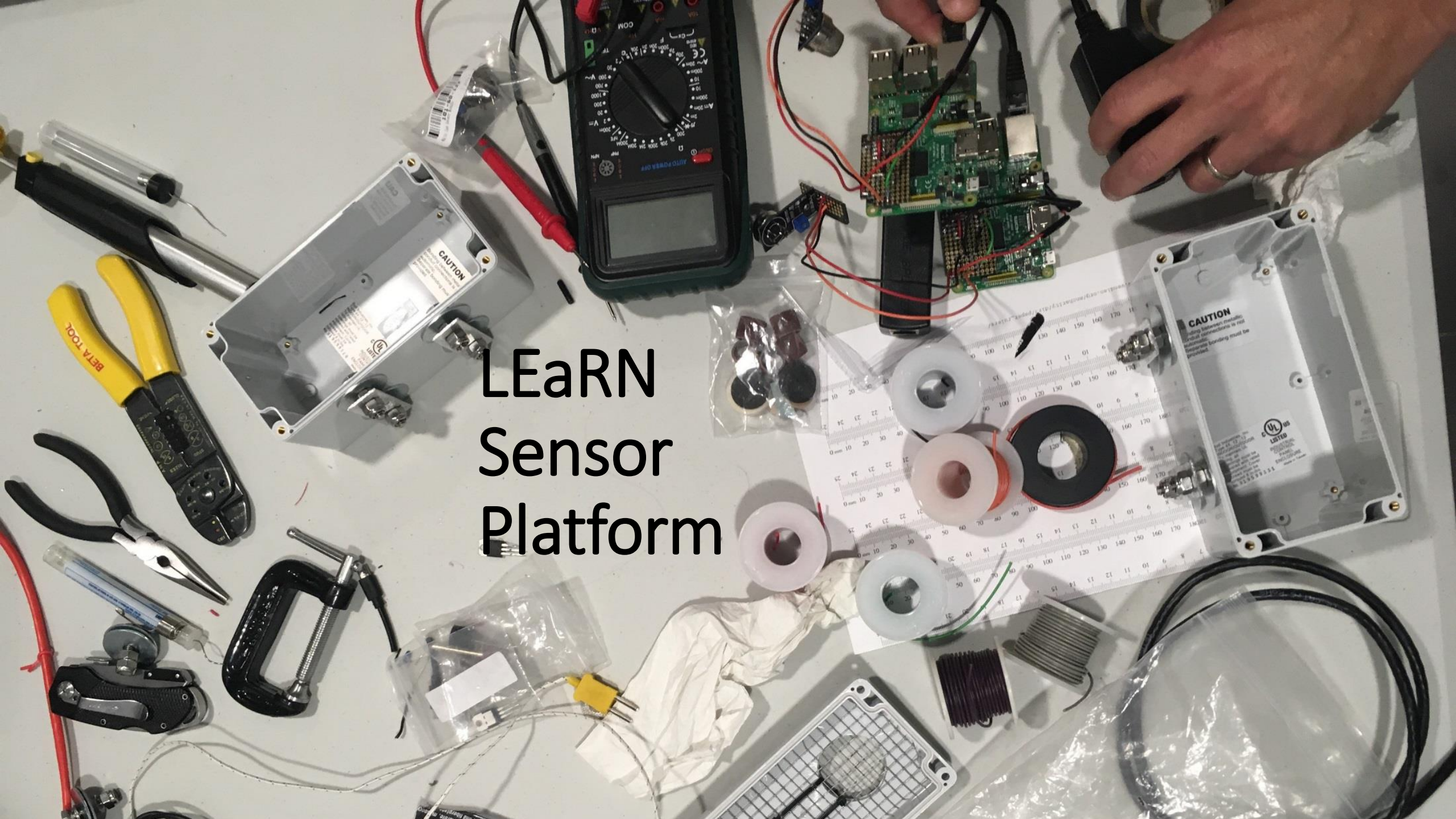
What Is CajunCodeFest?

Who Can Participate?

Why Participate?

Where did LEaRN come from?

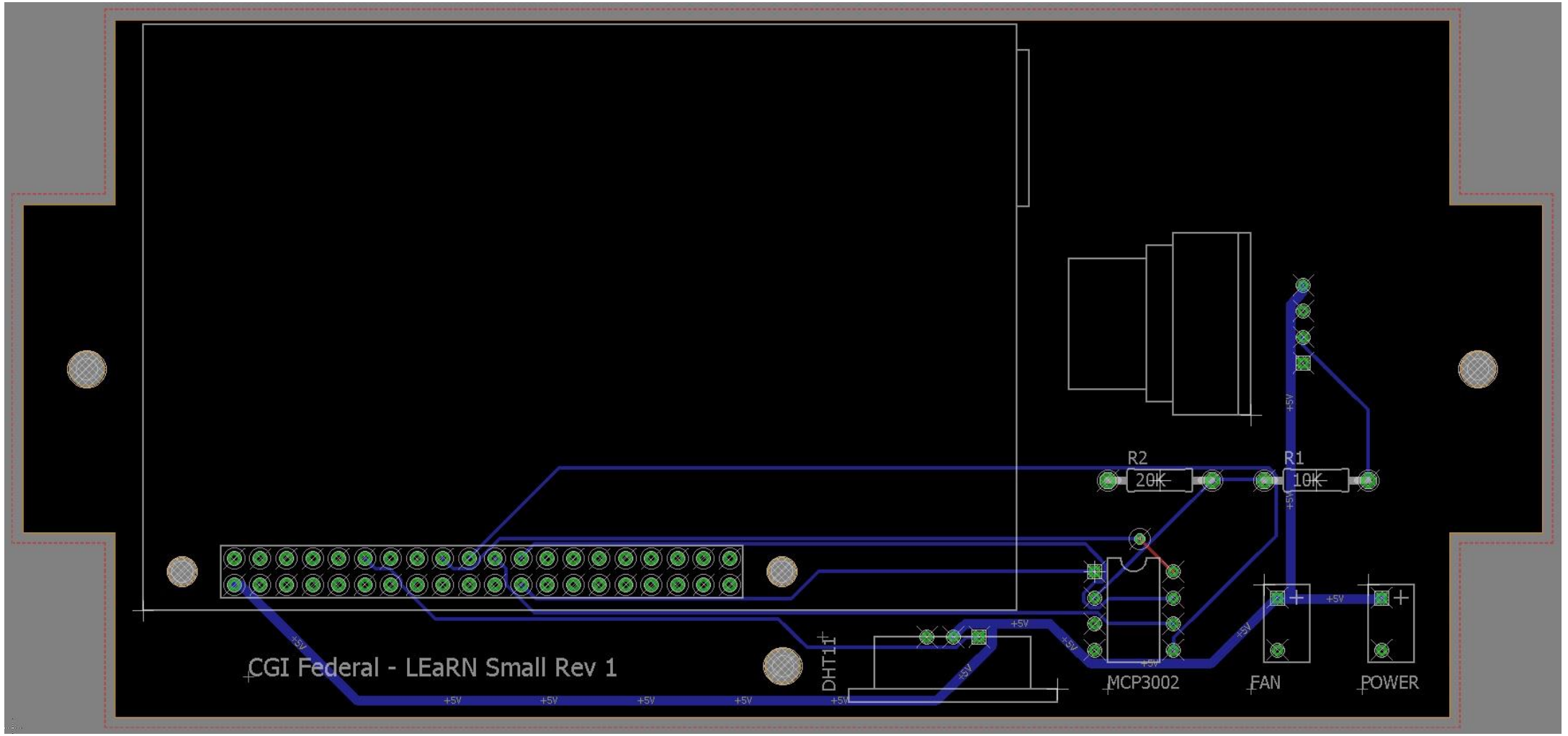
- **Formed in response to U.S. EPA Smart City Air Challenge:** Fall 2016
- **Two cities awarded $40,000:** Lafayette, Louisiana and Baltimore, Maryland
- **Deploy 250 to 500 air quality sensors in a community**
- **Community involvement in purchasing and using the sensors**: The community and its residents will provide funds for the sensors in order to ensure citizen engagement and better data quality.
- **Identification of partners and project sustainability**: EPA will provide prizes to the winning communities. The community and its residents will provide funds and establish partnerships to implement the strategy.
- **Be transparent in terms of making the data open and describing the data management plans**: The data from the sensors will be available for free and in machine-readable form. The data management plan describes how data will be managed in all parts of the information life cycle.


LEaRN
Sensor
Platform
CAUTION
BETA TOOL

LEaRN Sensor Platform

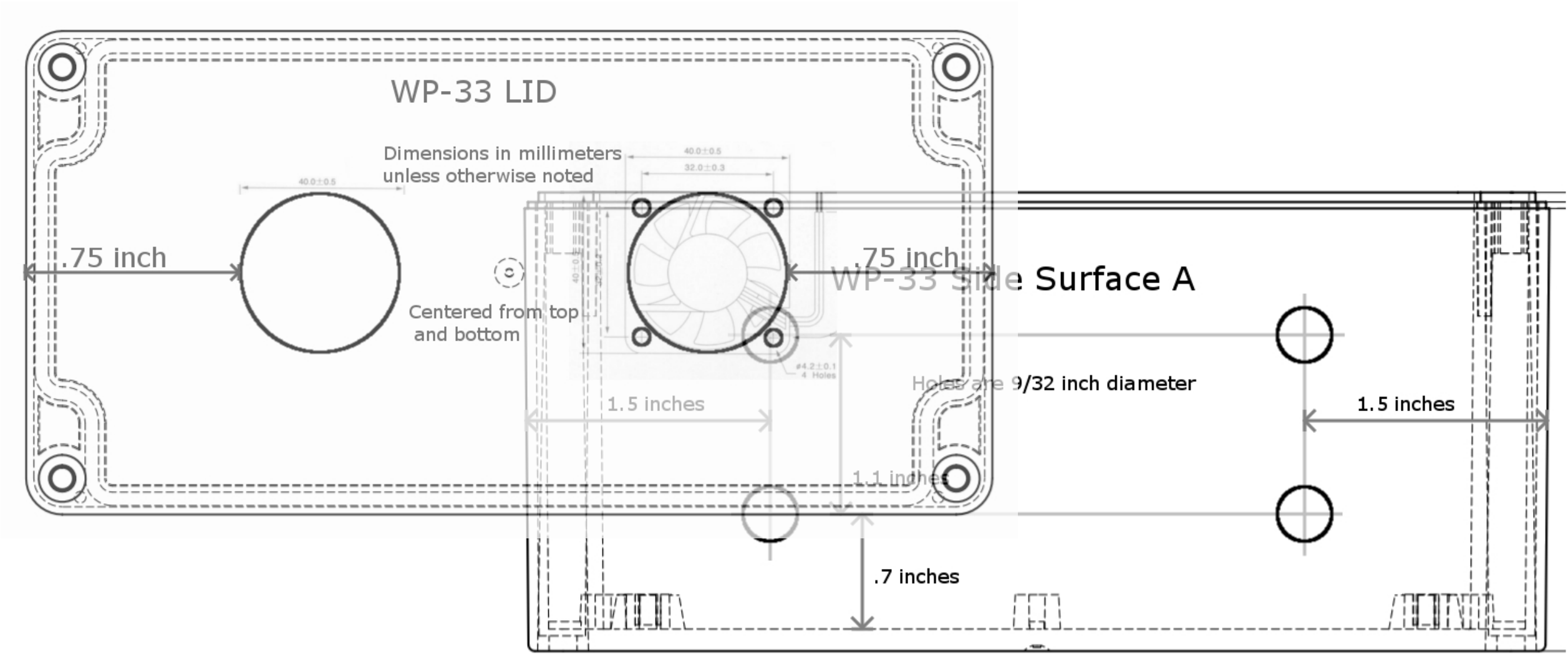
- O_3
  - Low-cost: Sainsmart MQ131 ($20)
    - Type: Metal oxide semiconductor (MOS)
  - Higher low-cost: Aeroqual SM50 ($255)
    - Type: MOS
- PM2.5
  - Low-cost: DF Robot SEN 0177 ($50)
    - Type: Light-scattering, particle counter
  - Higher low-cost: Alphasense OPC-N2 ($535)
    - Type: Light-scattering, particle counter
- Air temperature and relative humidity
  - DHT11 ($3.25)
    - Type: Thermistor (T), capacitive (RH)

Sensor Platform



Power Control Board (PCB) design

Sensor Platform



Small Enclosure machining drawings

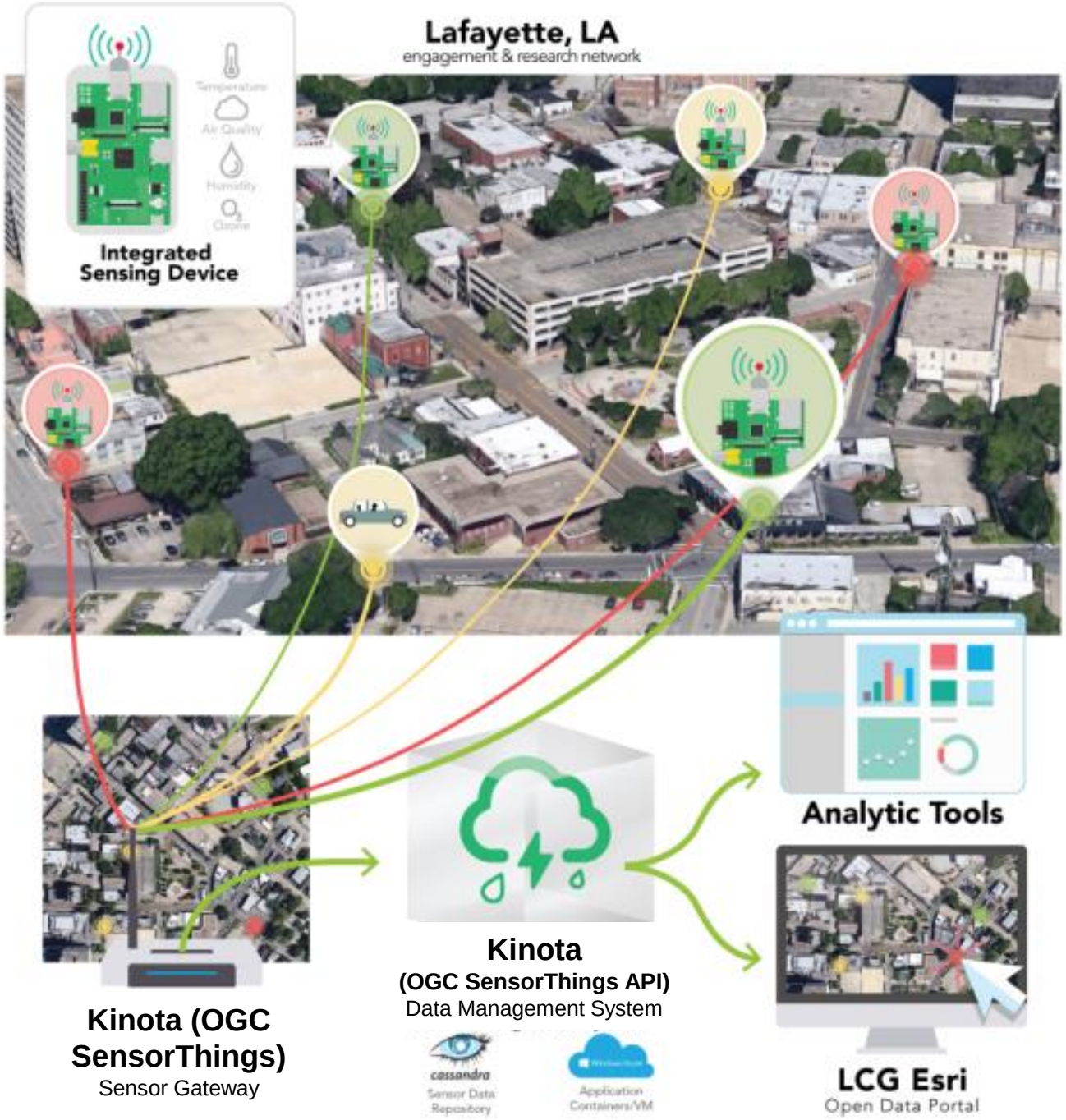
LEaRN Sensor Platform

- 250 total Things
  - 175 Things with cheap ozone only (small boxes)
  - 75 large enclosure Things
    - 50 cheap O_3, expensive O_3, cheap PM
    - 25 cheap O_3, expensive O_3, expensive PM
  - All Things will also have a temperature and humidity sensor

Sensor validation/calibration methodology

- Place all sensors at Louisiana Dept. of Environmental Quality (LDEQ) AQ station for 7-14 days
- Compare data during calibration period to reference sensors, building calibration curve
- Apply calibration curve to raw data to produce QA/QC'ed datastreams

Software architecture of the Kinota™ open source data management solution



What is Kinota?

- Kinota is an open source implementation of OGC SensorThings API Part 1: Sensing
  - LGPL v3 license
  - Written in Java 8
- Kinota prioritizes:
  - Standards compliance
  - Modularity
  - Security
- Kinota can be found here!
  - https://github.com/kinota/

What is SensorThings?

The OGC SensorThings API provides an ***open***, ***geospatial-enabled*** and unified ***way to interconnect the Internet of Things devices, data, and applications over the Web***. The OGC SensorThings API is an open standard, and that means ***it is non-proprietary, platform-independent, and perpetual royalty-free***. Although it is a new standard, it ***builds on a rich set of proven-working and widely-adopted open standards, such as the Web protocols and the OGC Sensor Web Enablement (SWE)*** standards, including the ISO/OGC Observation and Measurement data model [OGC 10-004r3 and ISO 19156:2011]. That also means the ***OGC SensorThings API is extensible and can be applied to not only simple but also complex use cases.***

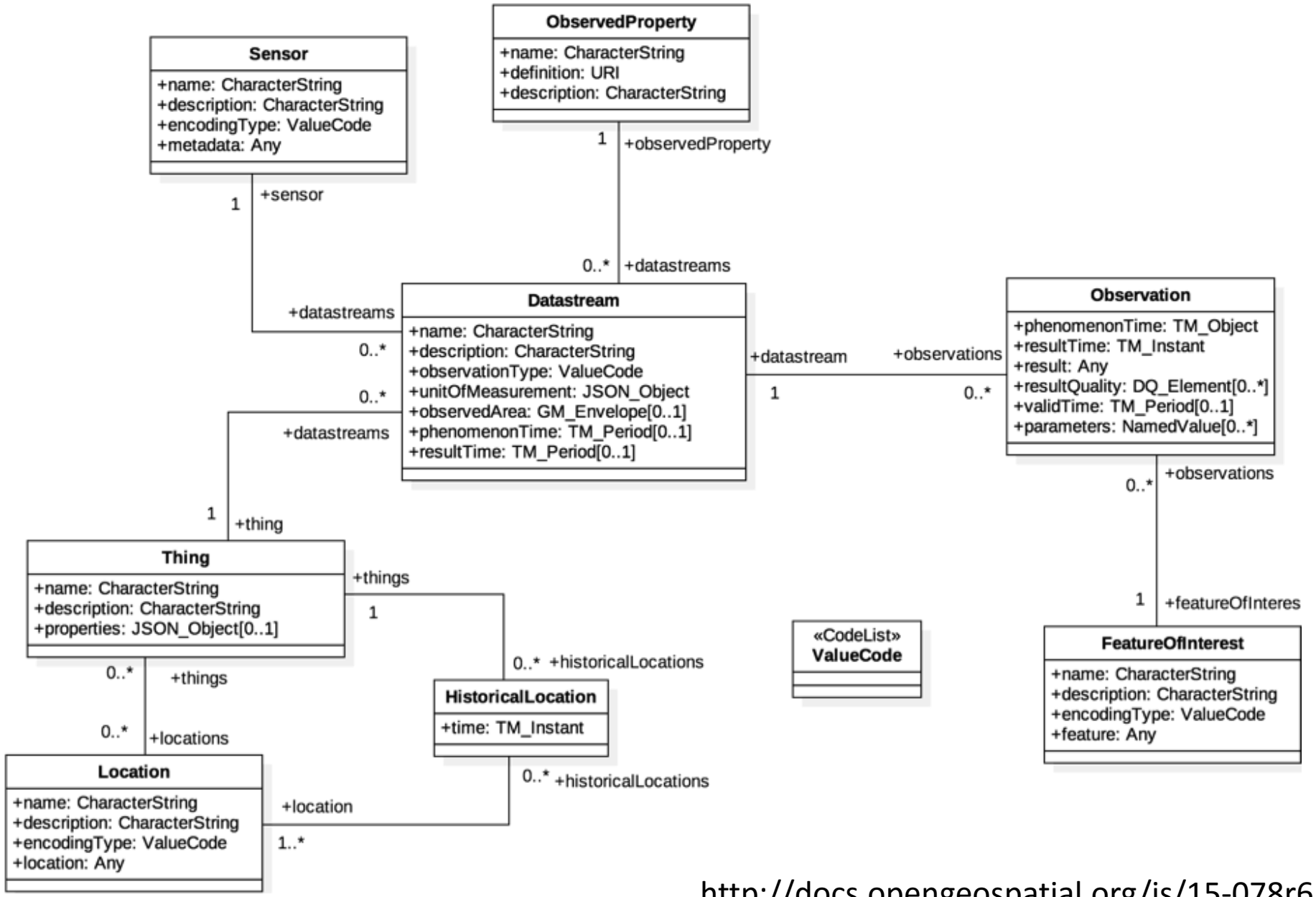
http://docs.opengeospatial.org/is/15-078r6/15-078r6.html

What is SensorThings?

- Components of the standard
  - SensorThings API Part 1: Sensing
    - Defines core data model and semantics for publishing, discovering, and downloading sensor data using HTTP REST or MQTT
    - Ratified 2016
  - SensorThing API Part 2: Tasking
    - Defines data model and semantics for parameterizing IoT devices
    - Two parts: Core, and Extended Tasking
    - Core tasking standard is being written and revised by the OGC SensorThings Standard Working Group now
      - ETA for ratified standard: Q2 2018

http://docs.opengeospatial.org/is/15-078r6/15-078r6.html

SensorThings API Part 1: Sensing – Data model



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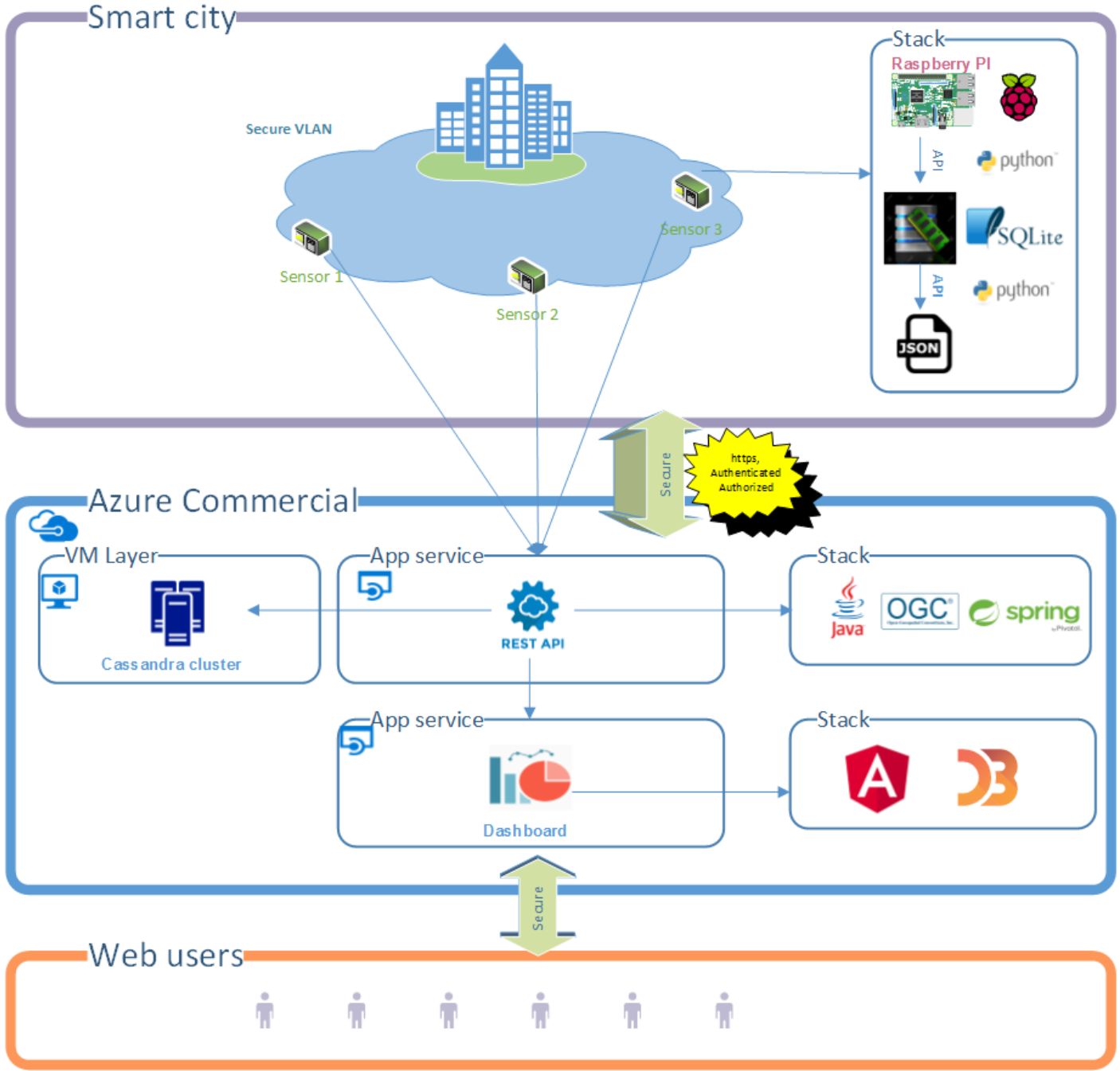
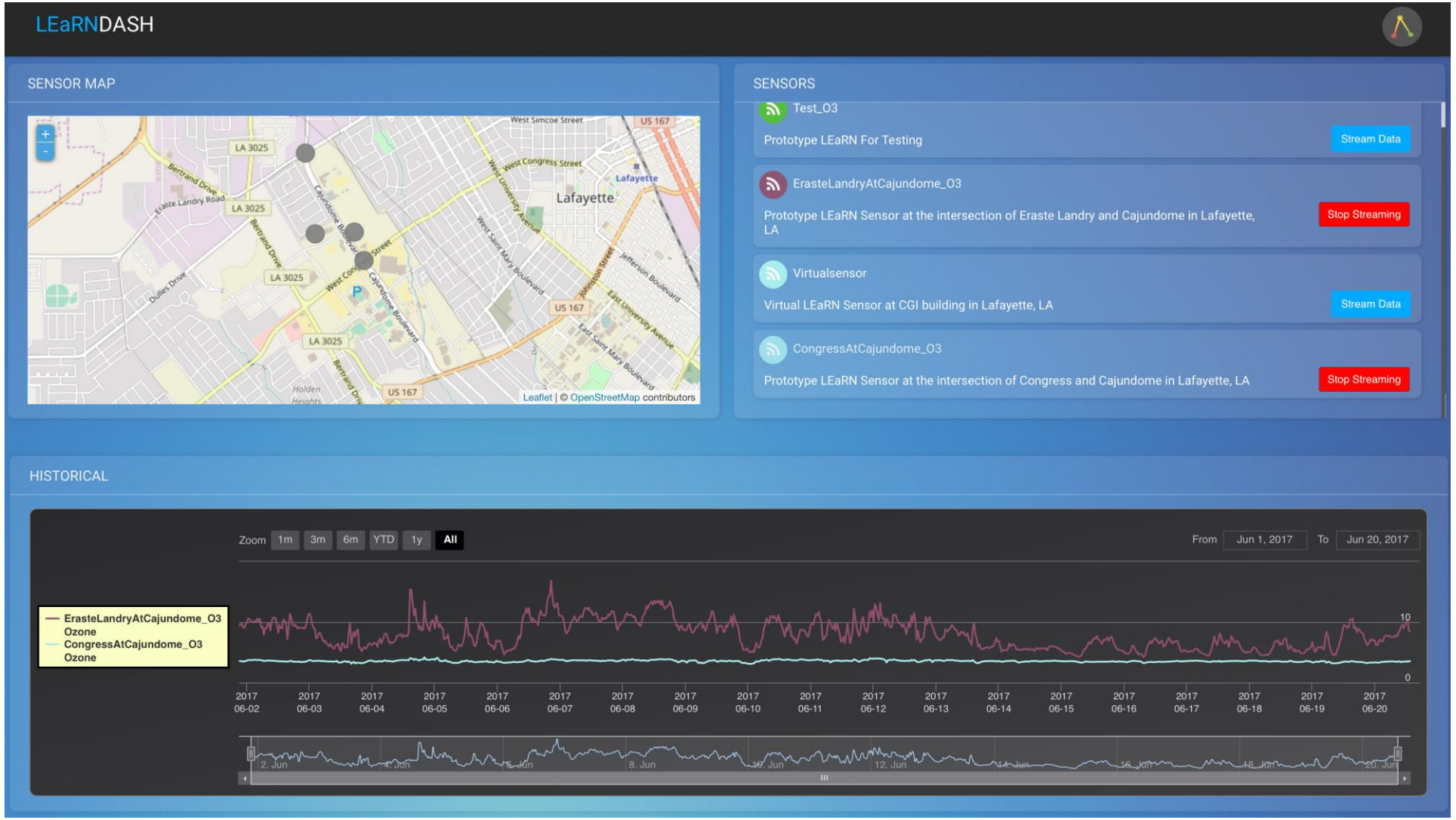
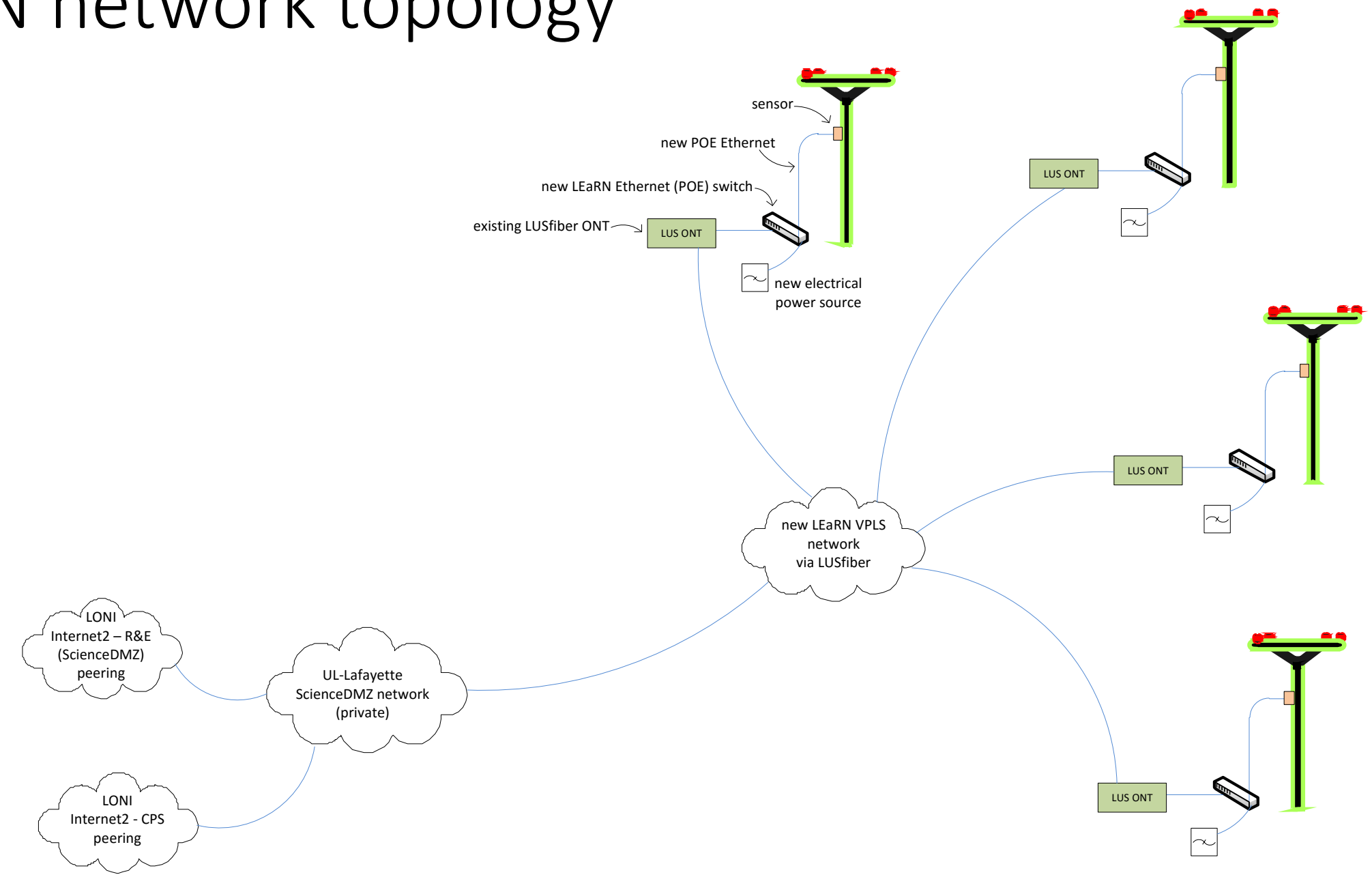
LEaRN – Data Architecture



Sample: Real-time Data Visualization in Browser

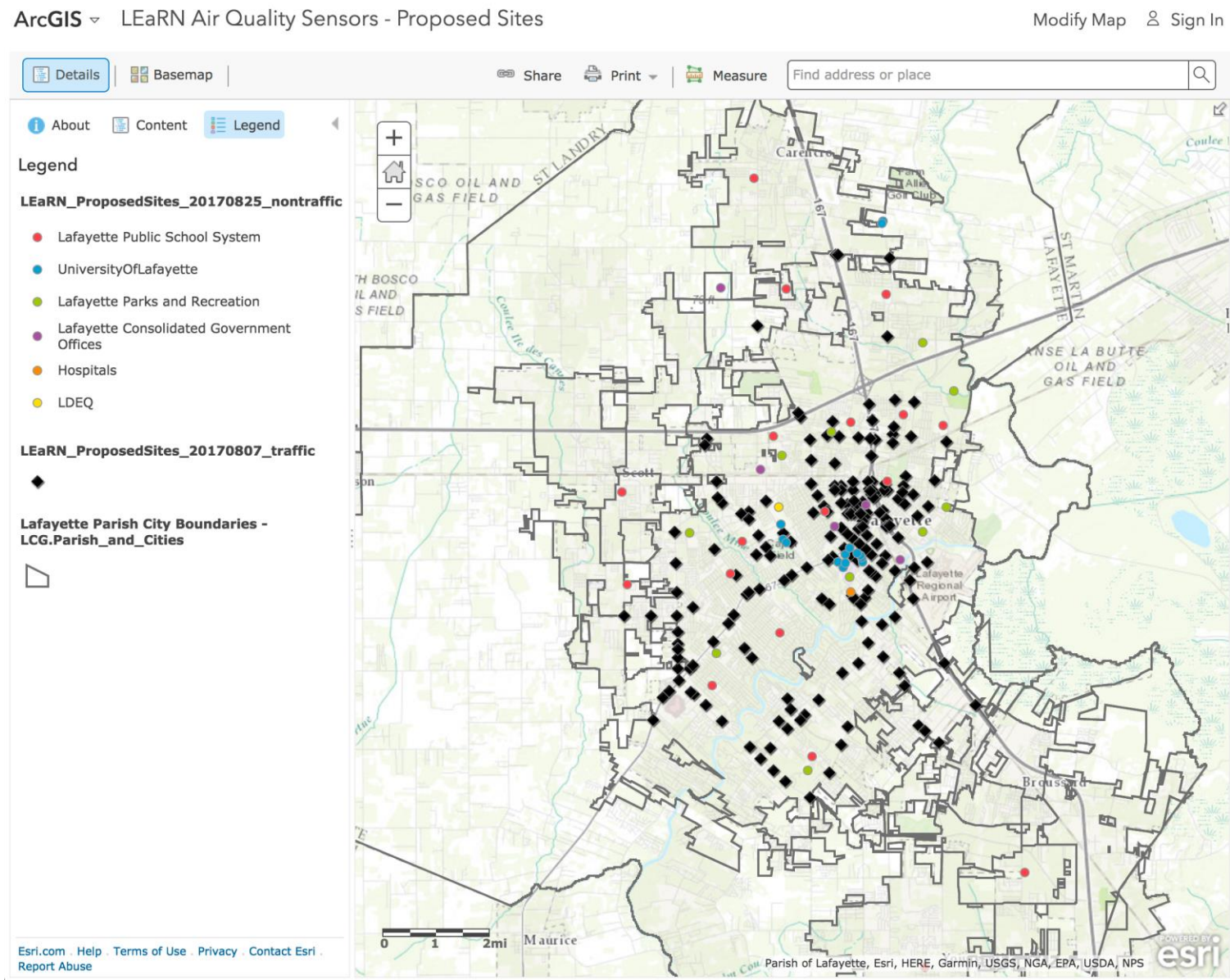


LEaRN network topology



Siting sensors in the community

- Place sensors at partner sites
- Place sensors such that there is uniform spatial distribution of sensors, to the extent possible
- Include a range of land uses covering: transportation infrastructure (roads, parking), residential, commercial, agricultural, forest
- Place sensors in locations with network and power available
- Place sensors in areas with known or suspected air pollution or near populations vulnerable to air pollution (e.g. near schools, parks, hospitals)

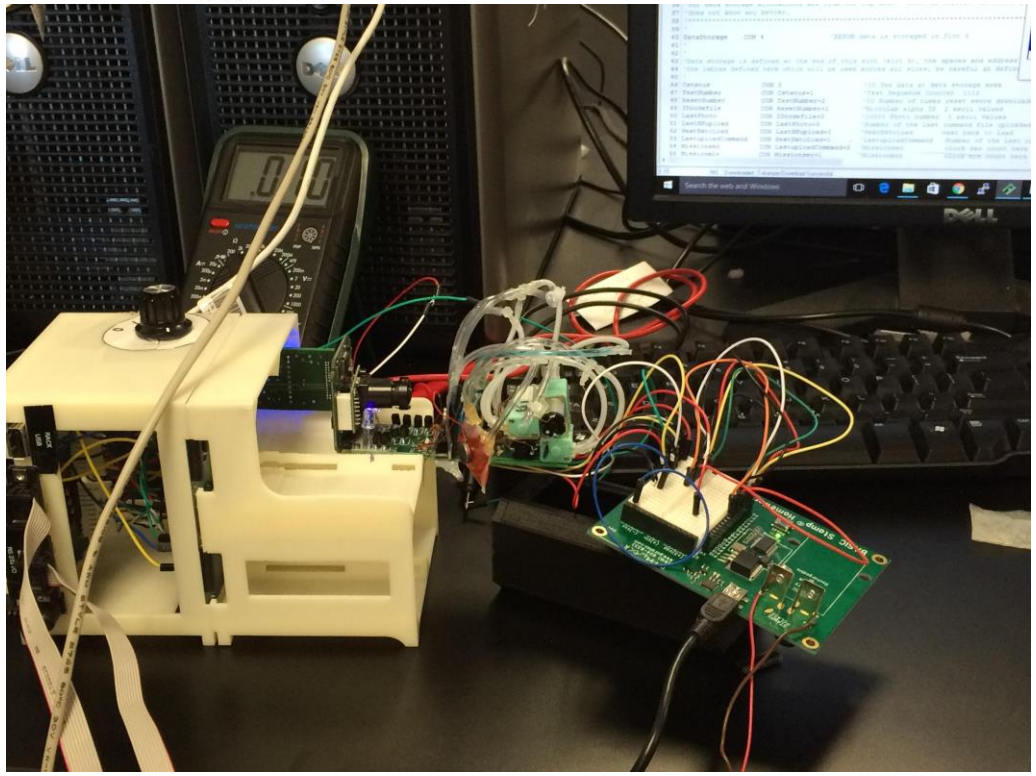


Sensor fabrication and STEM education

- LEaRN partner Lafayette Public School System will lead sensor fabrication
- Middle and High School students from David Thibodaux STEM Magnet Academy will be fabricating most of our sensors platforms
- Past students have participated in robotics competitions, and had an experiment flown on the International Space Station (ISS)
- Building LEaRN sensors will give a new class of students practical experience with electronics theory and skills (e.g. circuit design, soldering, etc.)

SCHOLARSHIP • INTEGRITY • PRIDE

DAVID THIBODAUX
STEM MAGNET ACADEMY



ISS Experiment: Full Interface Test 1 for NanoRacks-David Thibodaux STEM Magnet Academy-Antibiotic Effectiveness on Escherichia Coli in Microgravity (NanoRacks-DTSMA-Effectiveness of Antibiotics). Image courtesy of David Thibodaux STEM Magnet Academy.
https://www.nasa.gov/mission_pages/station/research/experiments/2388.html

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Questions?

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