



Location Powers; Our Urban Environment

Actionable Insights from Multi-sensor IoT Systems using the OGC SensorThings API

- sensors are always better when they are together! -

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About Steve



- Founder and CEO of SensorUp
- Associate Professor, Geomatics Engineering, Uni. Calgary
- Chair and Editor of OGC SensorThings API

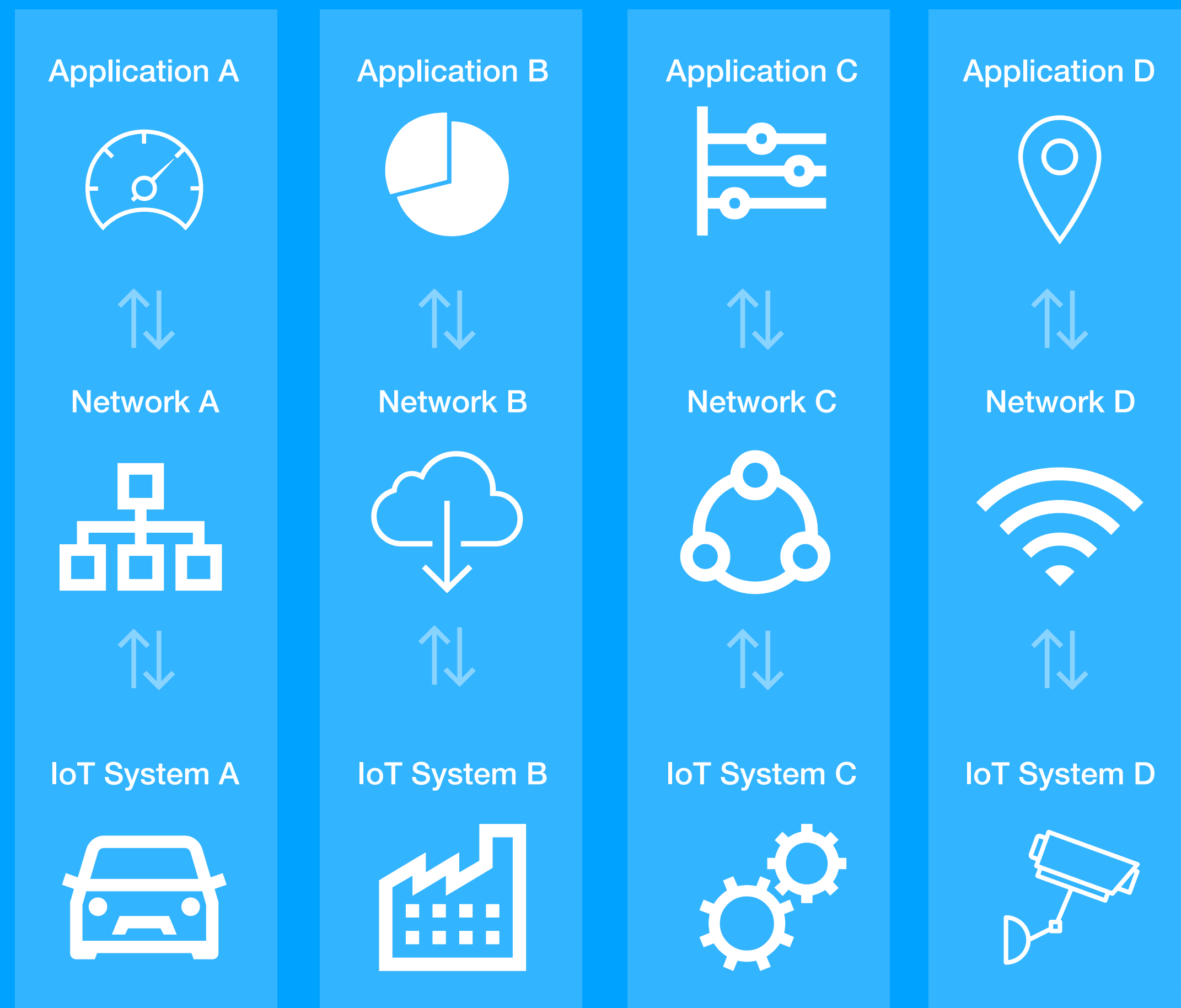
SensorUp is the leader in **Internet of Things cloud service platform** for customers who rely on **geospatial** in their IoT Implementations.

Our Cloud-based API allows our customers to rapidly **aggregate** and **coordinate multiple IoT systems**, and then **transform** them into **actionable insights**.



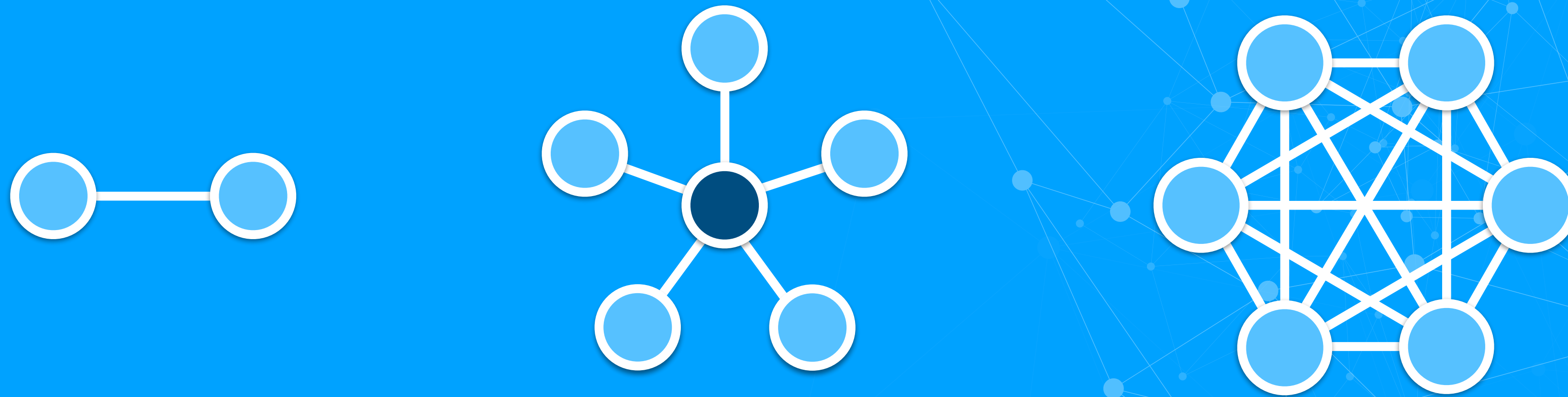
**NATO Defence Innovation Award Winner
on Secured Federation of IoT Devices**

Consolidating Different Sensor Networks with Open Geospatial Standards-based Software



“Today’s IoT Silos Severely Limit the Value of IoT”

Vision - System of Systems



OGC SensorThings API enables
network effects for IoT.



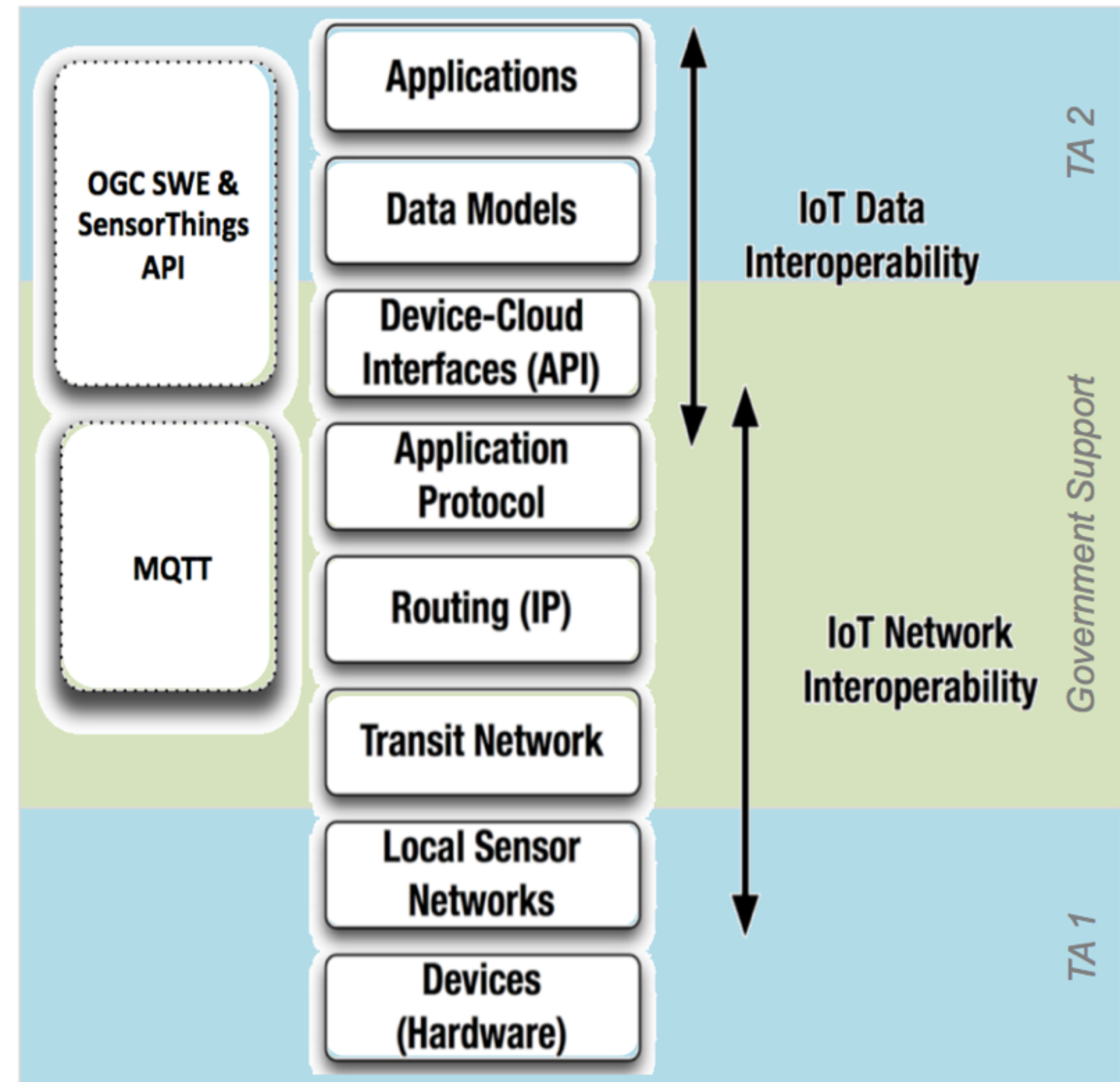
Government support: Ocean data testbed / infrastructure



System integration and logistics:

- Data platform construction
 - Cloud storage and processing
 - Availability to mission partners
- Data formatting and quality control
- Float deployment
- Communications with floats
 - Update float behaviors
 - Command effects
- Environmental compliance

SMEs across ocean sensing and signal processing domains

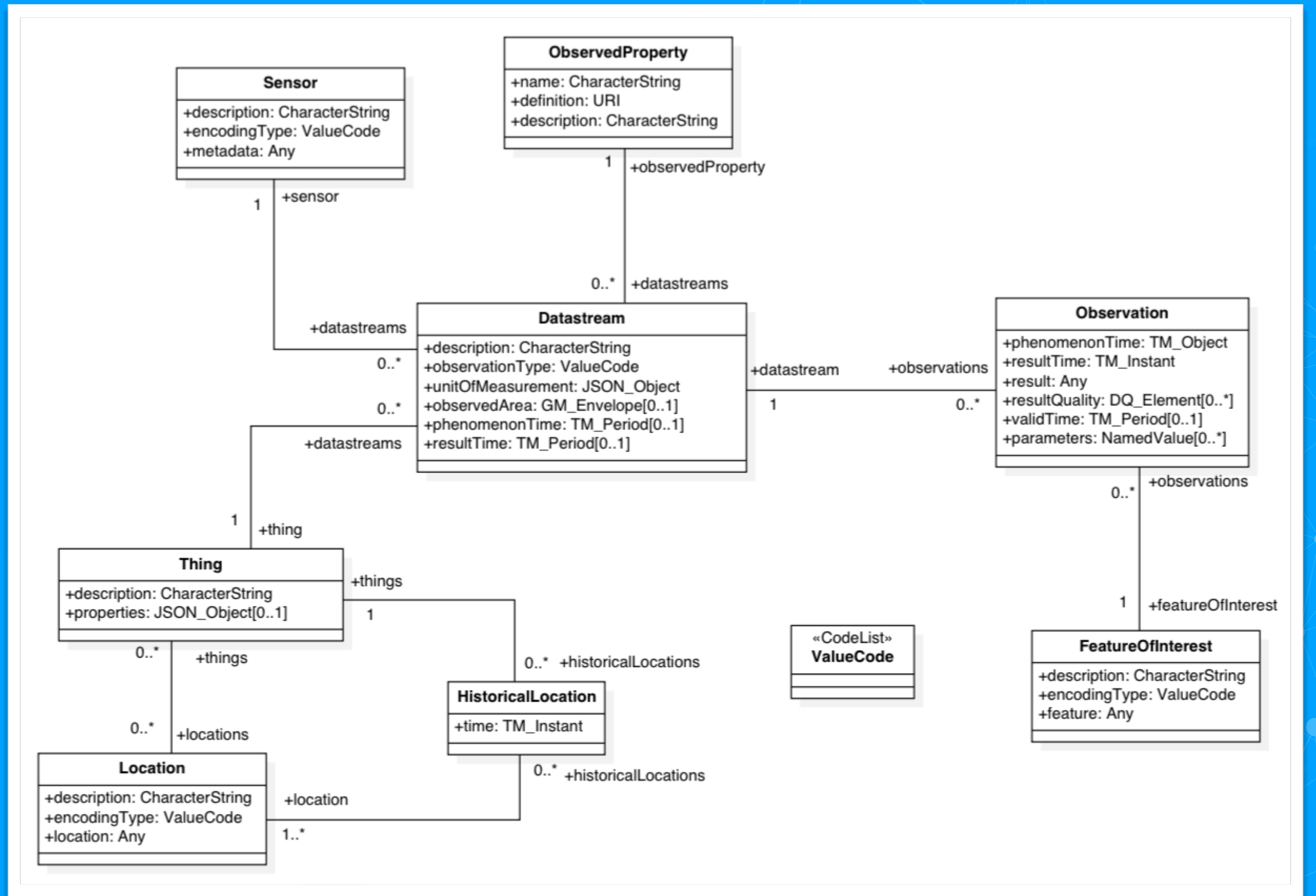


○ Commercial ○ Government

OGC SWE: Open Geospatial Consortium Sensor Web Enablement
 API: Application Program Interface
 IoT: Internet of Things
 IP: Internet Protocol
 MQTT: Message Queue Telemetry Transport

<https://www.darpa.mil/attachments/Ocean%20of%20Things%20Proposers%20Day.pdf>

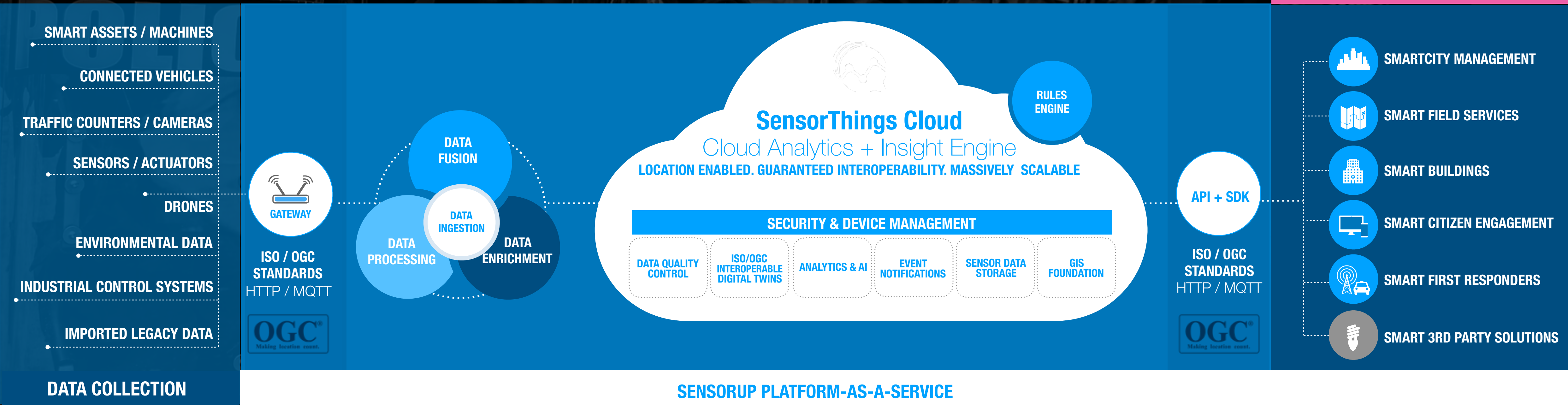
OGC Standard-based Data Model and RESTful API



SensorUp IoT Data & Analytics Platform

Aggregate data from disparate sensors and location data rapidly & transform them into actionable Insights

SENSORUP SOFTWARE-AS-A-SERVICE



SMART LOGISTICS & FIELD OPERATIONS
optimizing operations, unleash hidden value from IoT and tracking data, and uncover actionable insights



CRITICAL OPERATIONS
IOT - Enabled Situational Awareness will save 60 seconds of response time for every incident



ASSET PERFORMANCE MANAGEMENT
Improve operational efficiencies by offering a real-time and unified view of asset performance data

Some Numbers About SensorThings

Very Mature Ecosystem

2 years

since the
publication of the
standard

232 papers

found on Google
Scholar

9+ server

implementations
from different
vendors

82 repos

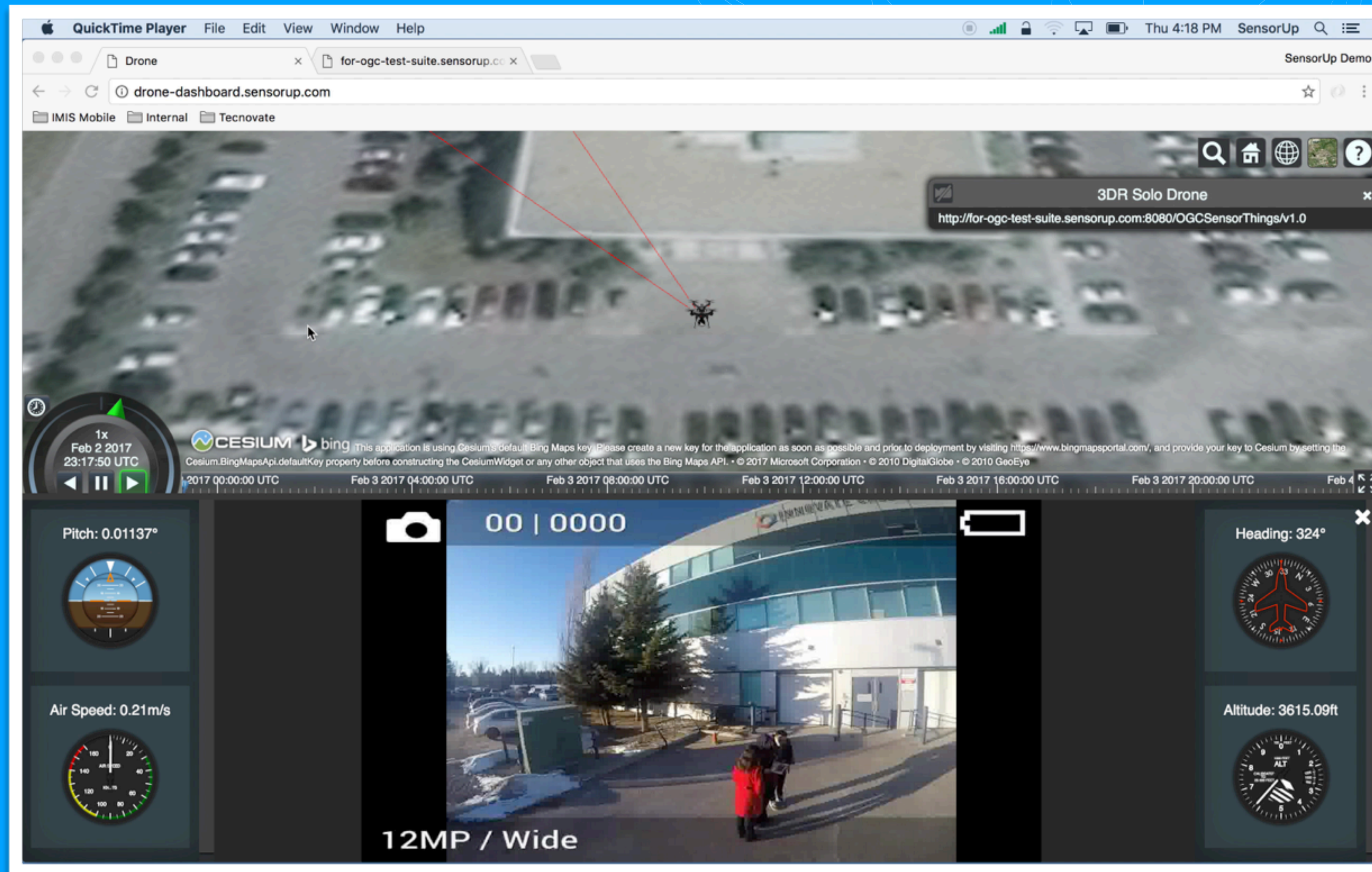
found on GitHub

SensorUp is a Reference Implementation of OGC
SensorThings API



Open Geospatial Consortium (OGC) is the most prominent
standard organization for geospatial web services and data.

Connected Drones

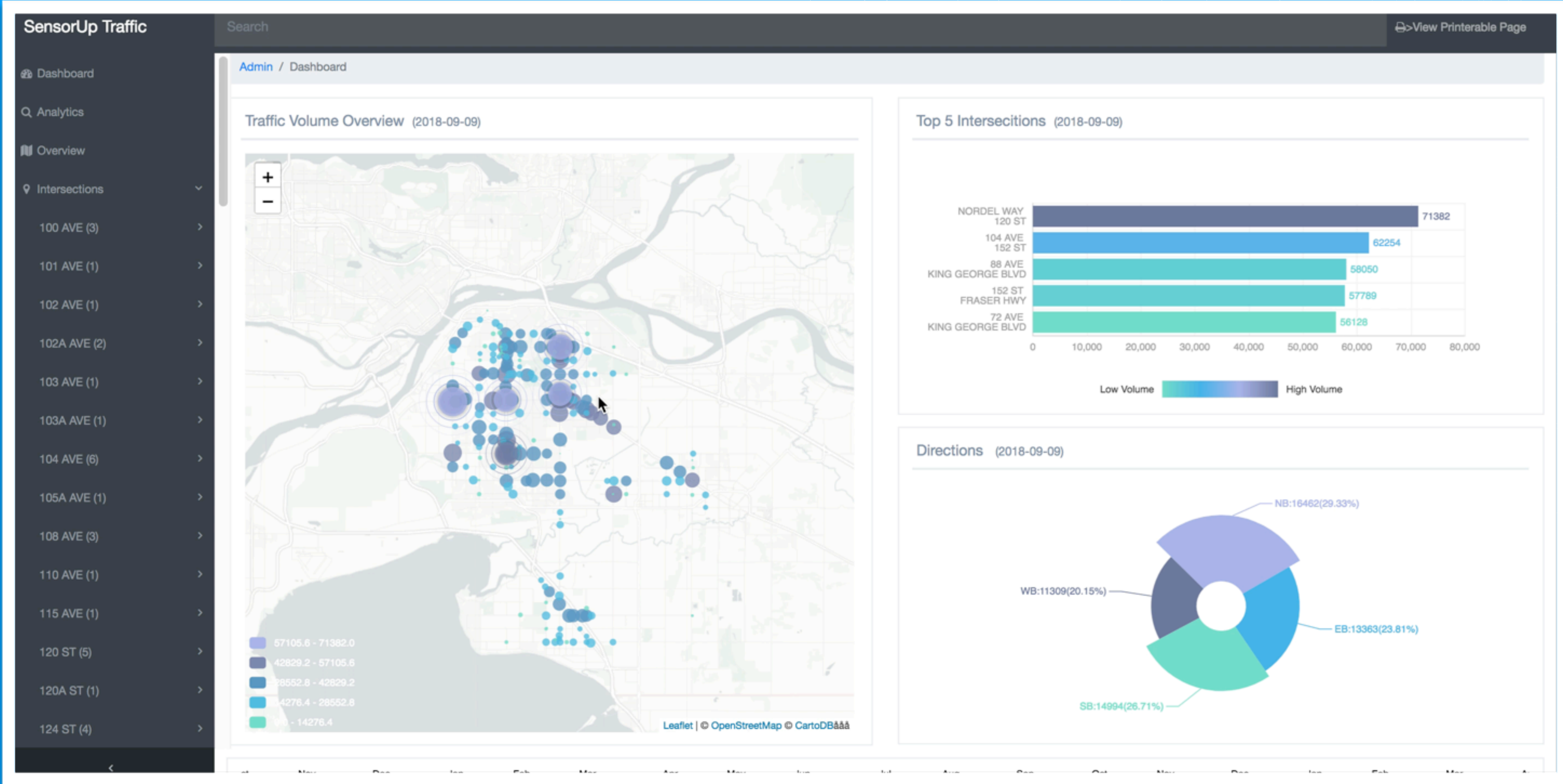


Connected Dashcams

The screenshot displays the SensorThings 1.0 dashboard interface. At the top left, the 'sensorup' logo and 'SensorThings 1.0' version are visible, along with the 'MITAC' logo. The top right corner features a 'Dashboards' dropdown menu. The main content area is divided into several sections:

- Top Left:** A video feed titled 'Car 1 with Dash-Cam in Taipei' showing a street view.
- Bottom Left:** A second video feed showing a different perspective of the road.
- Center:** A satellite map of Taipei, Taiwan, with a yellow highlighted route. The route is labeled 'Sec 1, Nei Hu Rd.' and 'Miramar'. A blue car icon indicates the current location. Map controls include zoom in (+), zoom out (-), and a full-screen button. A legend shows 'Sync Maps' (unchecked) and 'Toggle Labels' (checked). A 'CERTIFIED OGC COMPLIANT' logo is in the bottom right of the map area.
- Top Right:** A speed gauge titled 'Car 1 with Dash-Cam in Taipei - speed' showing a current speed of 21 km/h on a scale from 0 to 100.
- Bottom Right:** A street map view of the same area, showing the highlighted route and surrounding streets like 'Zhi Fu Rd.' and 'Jing Ye 4th Rd.'.

Connected Intersections



LoRAWAN and SensorThings API

The screenshot displays the 'City Asset Tracking Admin' interface, powered by sensorup. The interface includes a sidebar with three sensor configurations and a main map area. The sidebar configurations are:

- LT100-3565**: CLASS_A, Last Location (checked), Tracks (checked), Config button.
- LT100-53550**: CLASS_A, Last Location (checked), Tracks (checked), Config button.
- LT100-B3550**: CLASS_A, Last Location (checked), Tracks (checked), Config button.

The main map area shows a green dashed line representing the movement tracks of the sensors. The map includes labels for 'Quarry Trail', 'Bow River Pk.', and 'Hemlock Crest SW'. The interface also features a 'Select Date Range' calendar, a 'Show All' toggle, and zoom controls (+/-). The bottom right corner of the map area contains the text 'Leaflet | © OpenStreetMap © CartoDB'.

LoRAWAN Buttons as Sensors



Calgary HD Button

Secure https://city-help-desk-button.sensorup.com/buttons/2

Help Desk Admin

Dashboard / LoRa Button #2

Calgary

Summary

- LoRa Button 9D7B
- LoRa Button 9D7C

General Config

Recipients

Historical Message

LoRa Button 9D7C: General

- Status: online
- Supplier: test supplier
- Model: test device model
- Battery Model: 3.0V Alkaline Battery

Location: Andrew Davison Building (51.047194,-114.071111)

Battery

Battery Level: 100%

Type	Status	Template	Recipients
email	press	Hello, a customer is here pressing Button {ID} at {Location} on {Time}	Rob
sms	press	Hello, a customer	Rob

Messages

- Tuesday, July 31, 2018 10:36 AM
Hello, a customer is here pressing 2 at Andrew Davison Building on Tue, Jul 31, 2018 10:36:09 AM
- Tuesday, July 31, 2018 10:36 AM
Hello, a customer is here pressing Button 2 at Andrew Davison Building on Tue, Jul 31, 2018 10:36:09 AM
- Tuesday, July 31, 2018 10:15 AM
Hello, a customer is here pressing 2 at Andrew Davison Building on Tue, Jul 31, 2018 10:15:23 AM

Weekly Counts (2018-07-25 to 2018-07-31)

Date	Count
2018-07-25	2
2018-07-26	6
2018-07-27	0
2018-07-28	0
2018-07-29	0
2018-07-30	0
2018-07-31	6

Hourly Counts (Last Update: 2018-07-31 11:21 AM)

Hour	Count
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	3
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	0
19	0
20	0
21	0
22	0

Locations

- 7061:Bloor St / Brunswick Ave**
The geographic location with coordinates for the Toronto bike share station Bloor St / Brunswick Ave
- 7216:Wellington Dog Park**
The geographic location with coordinates for the Toronto bike share station Wellington Dog Park
- 7211:Fort York/Garrison**
The geographic location with coordinates for the Toronto bike share station Fort York/Garrison
- 7210:Mary McCormick Rec Centre**
The geographic location with coordinates for the Toronto bike share station Mary McCormick Rec Centre

Things

- 7061:Bloor St / Brunswick Ave**
Bloor St / Brunswick Ave Toronto bike share station with data of available bikes and available docks
- 7216:Wellington Dog Park**
Wellington Dog Park Toronto bike share station with data of available bikes and available docks
- 7211:Fort York/Garrison**
Fort York/Garrison Toronto bike share station with data of available bikes and available docks
- 7210:Mary McCormick Rec Centre**
Mary McCormick Rec Centre Toronto bike share station with data of available bikes and available docks

Datastreams

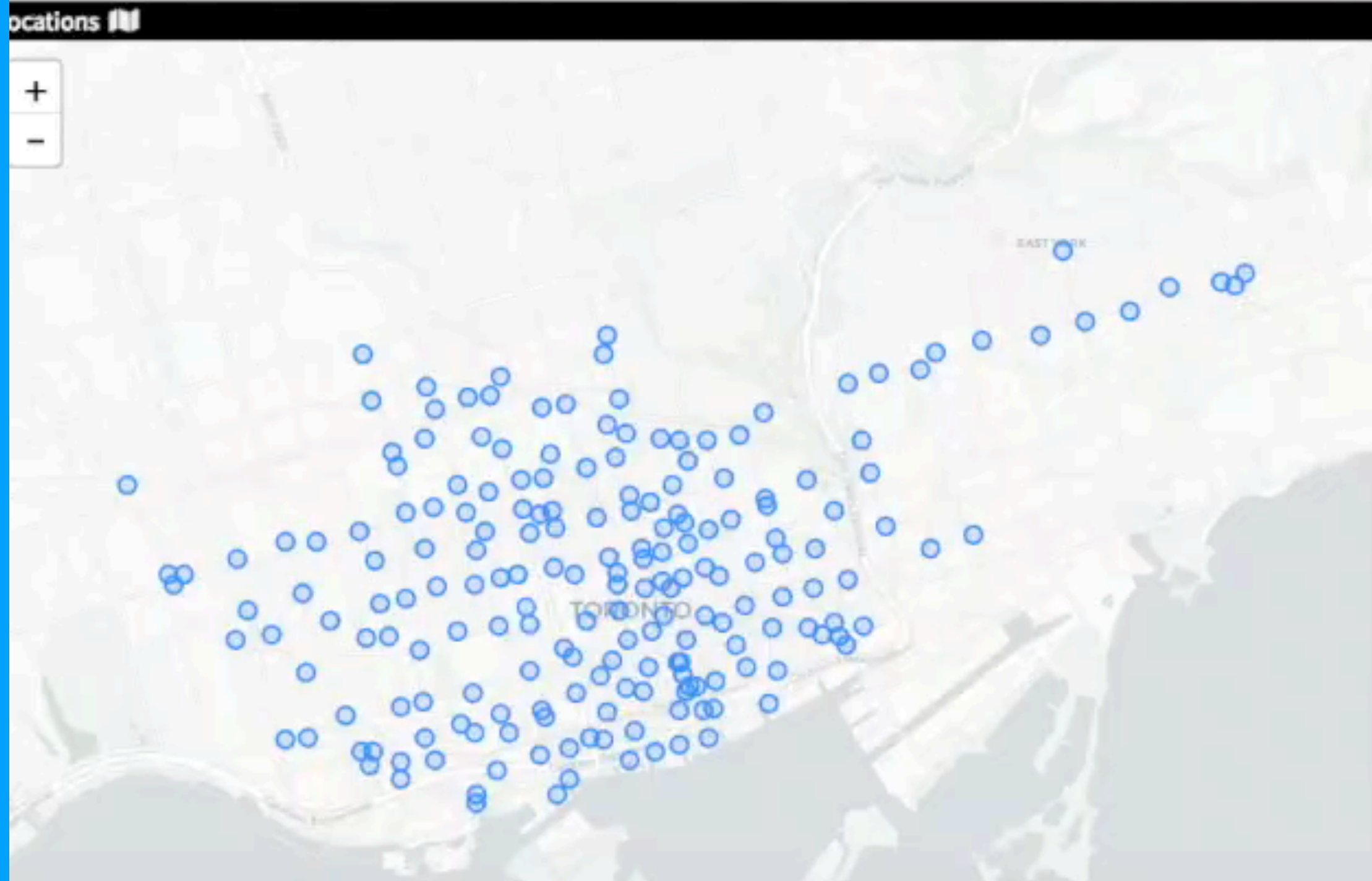
- 7061:Bloor St / Brunswick Ave:available_docks**
The datastream of available docks count for the Toronto bike share station Bloor St / Brunswick Ave
- 7061:Bloor St / Brunswick Ave:available_bikes**
The datastream of available bikes count for the Toronto bike share station Bloor St / Brunswick Ave
- 7216:Wellington Dog Park:available_docks**
The datastream of available docks count for the Toronto bike share station Wellington Dog Park

Observed Properties

- available_docks**
The total number count of available docks in a bike station
- available_bikes**
The total number count of available bikes in a bike station

Sensors

- available_docks**
A sensor for tracking how many docks are available in a bike station.
- available_bikes**
A sensor for tracking how many bikes are available in a bike station.



Datastream Chart



Entity

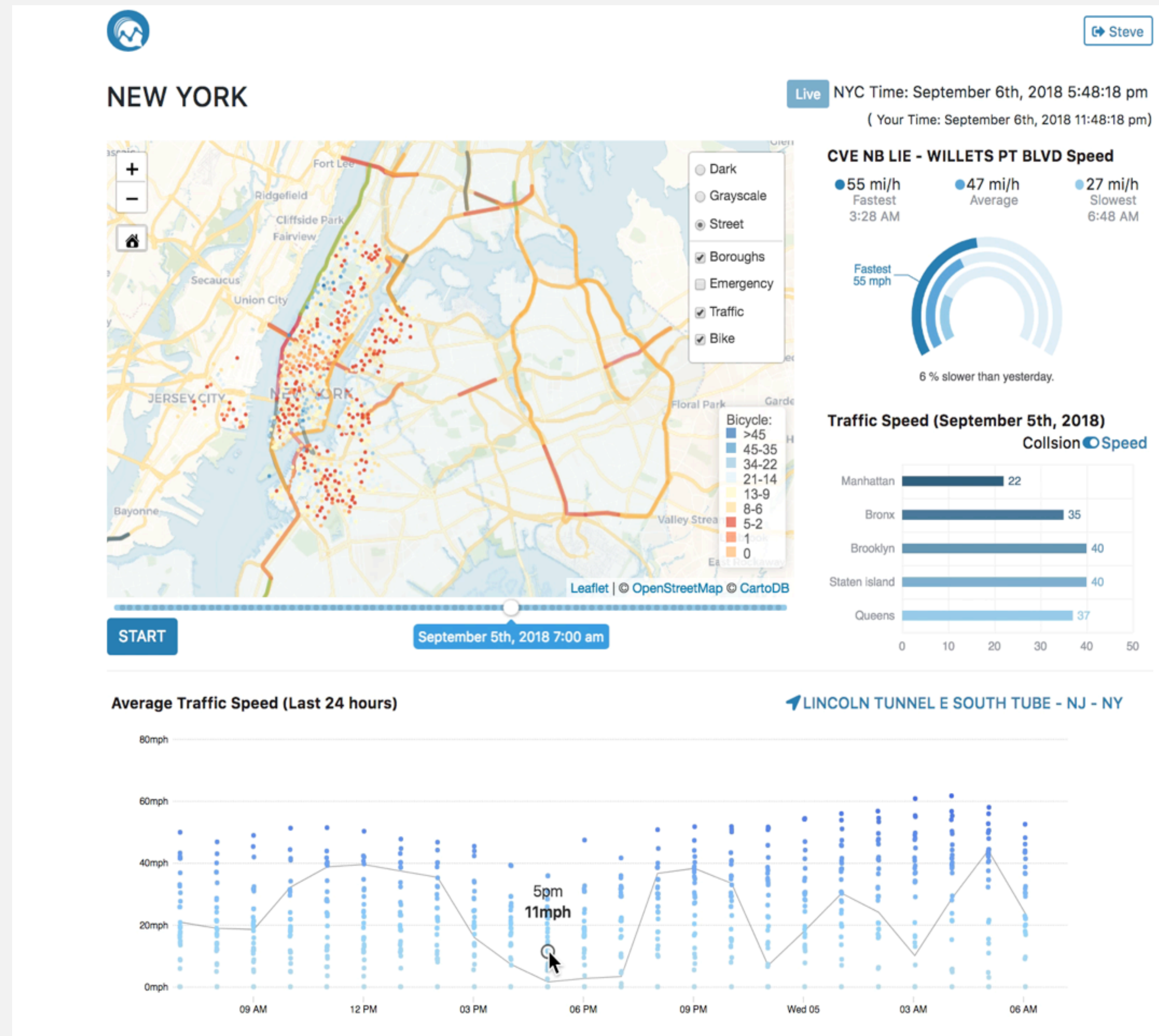



Asset Performance Management

- Real-time / History
- Traffic
- Inventory (Bikes)
- Incidents

Start to Finish

- 2 weeks



 Chart

SensorThings Chart Settings

Preview

Endpoints Chart Gallery

Map

Chart

Data Exporter

Assets Manager

Settings

Line
A Multi-Series
Line Chart
(Multiple Datastreams) [Create](#)

Line Stack
A Multi-Series
Stacked Line
Chart
(Multiple Datastreams) [Create](#)

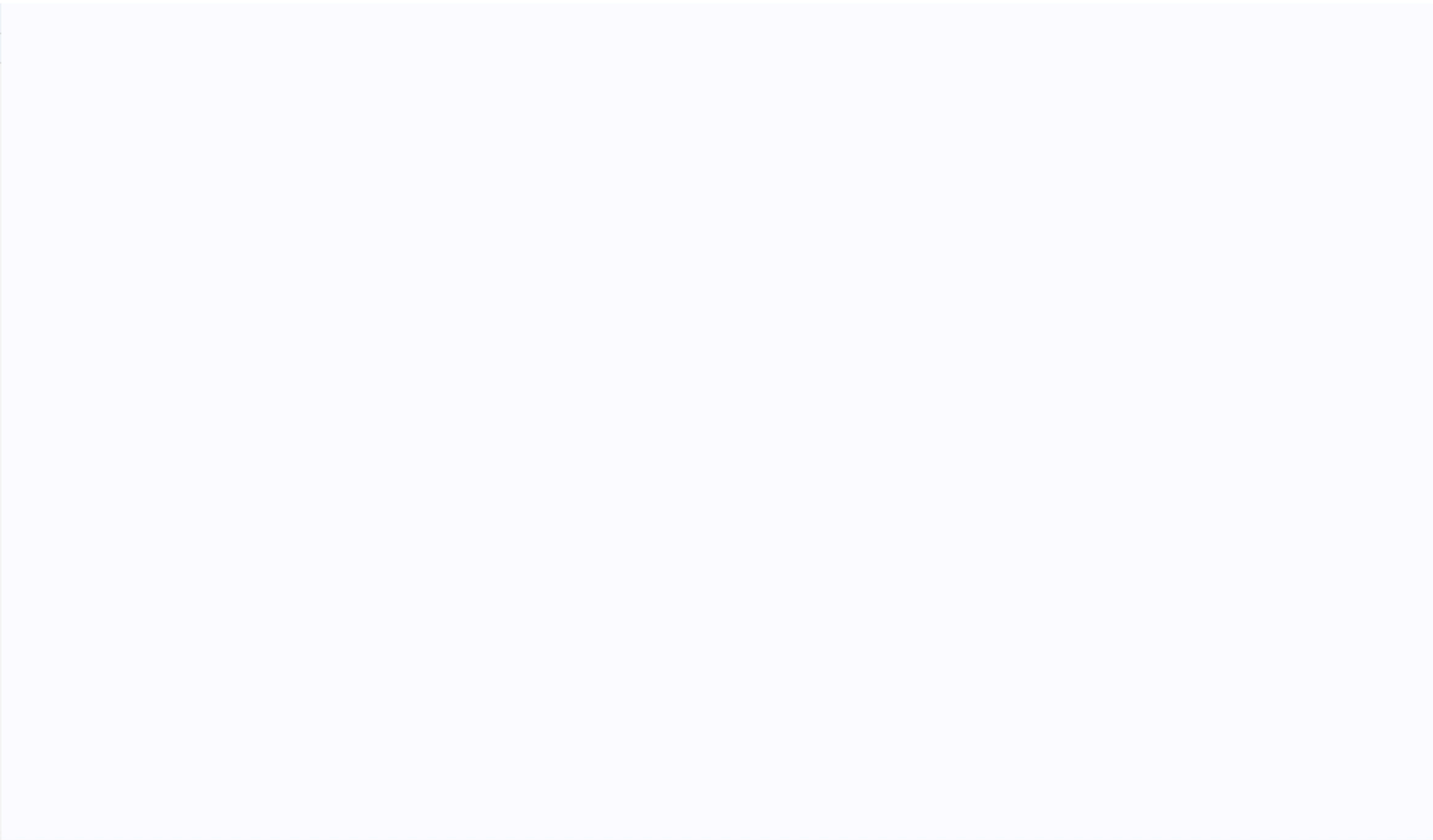
Bar
A Multi-Series
Bar Chart
(Multiple Datastreams) [Create](#)

Bar Stack
A Multi-Series
Stacked Bar
Chart
(Multiple Datastreams) [Create](#)

Horizontal Bar
A Multi-Series
Horizontal Bar
Chart
(Multiple Datastreams) [Create](#)

Horizontal Stack Bar
A Multi-Series
Stacked
Horizontal Bar
Chart
(Multiple Datastreams) [Create](#)

Pie
A Range
Aggregation
Pie Chart
(One Datastream) [Create](#)



When lives are on the line, every second counts

IoT-enabled Common Operating Picture for Situational Awareness



Jet Propulsion Laboratory
California Institute of Technology

An aerial view of a multi-story building on fire, with thick black smoke rising from the roof. A red triangle is overlaid on the image, pointing to the fire. The building is surrounded by a parking lot and some greenery.

FIRST RESPONDERS
on site

00:12:35:665
862.2
16/07/2018

47% 53% 68% 15%

24 KM/H
DRONE SPEED

18 KM/H
WIND SPEED

FIRST RESPONDERS / on site

Walter Pierce

Alexander Simpson

12:22

Rob Jacoby
STATION #44 - NEW YORK

CHECK-INS
72

VITALS HEALTH RECORDS

HEART RATE 84
BMP

BODY TEMPERATURE 37°

AMBIENT TEMPERATURE 40°

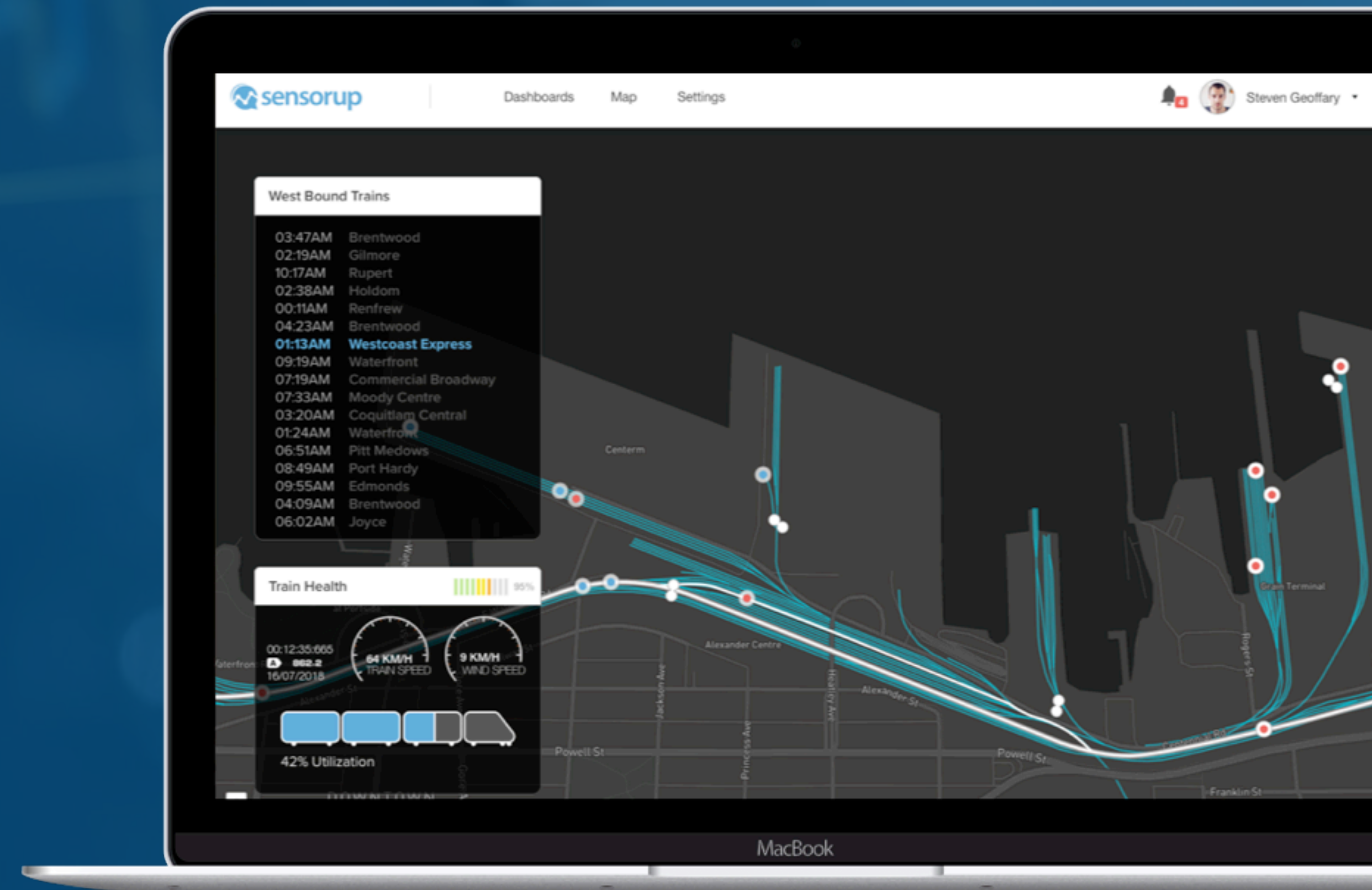
OXYGEN LEVELS 90
mm Hg

CO2 LEVELS 408.34

Monetize IoT Data while Optimizing Operational Efficiencies and Safety

Transforming business model by service-enabling physical assets (things)

A major North America logistics company using SensorUp to transform their business model by service-enable the locations, trajectories, and statuses of their mobile and stationary assets.

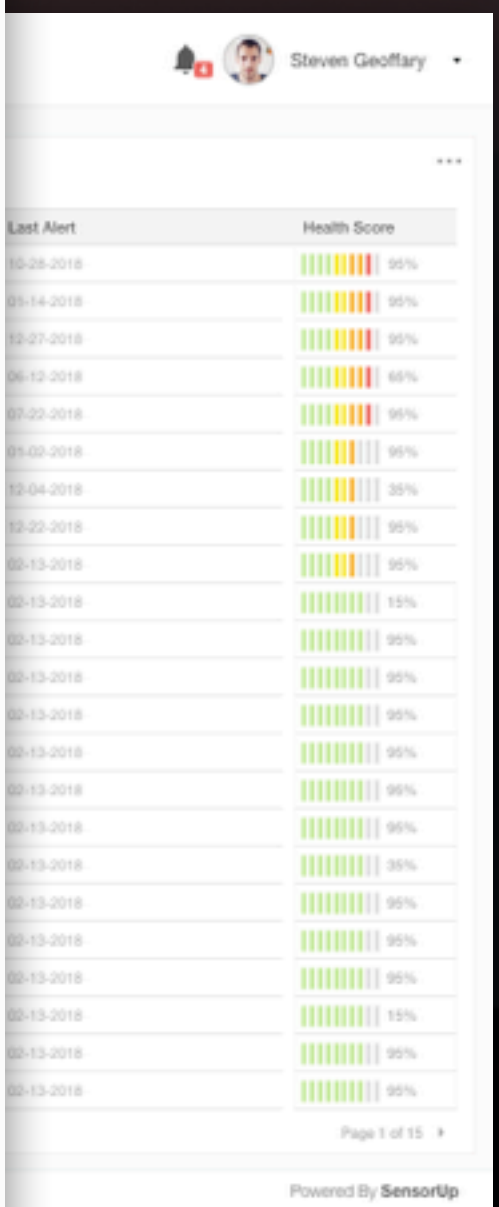
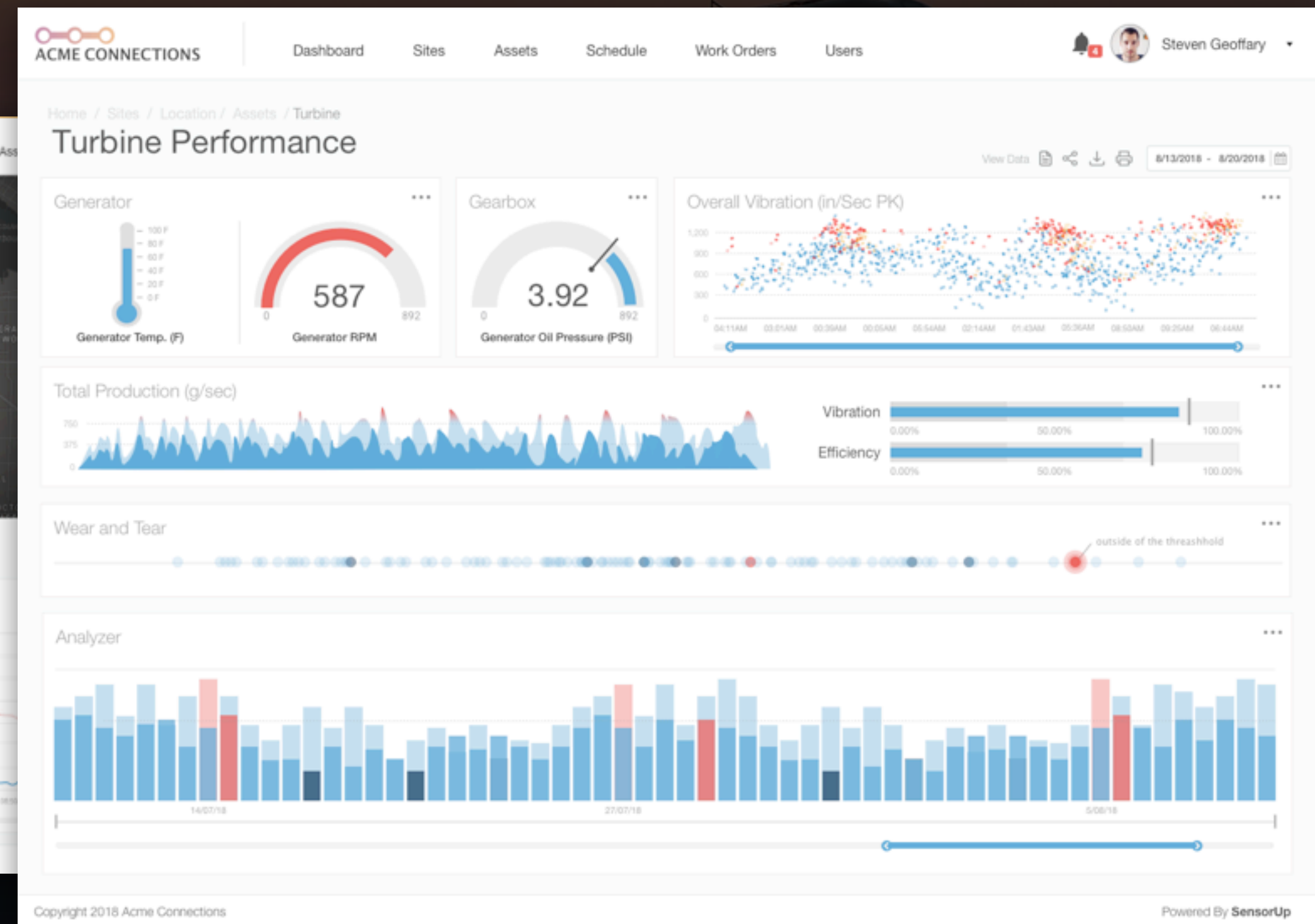
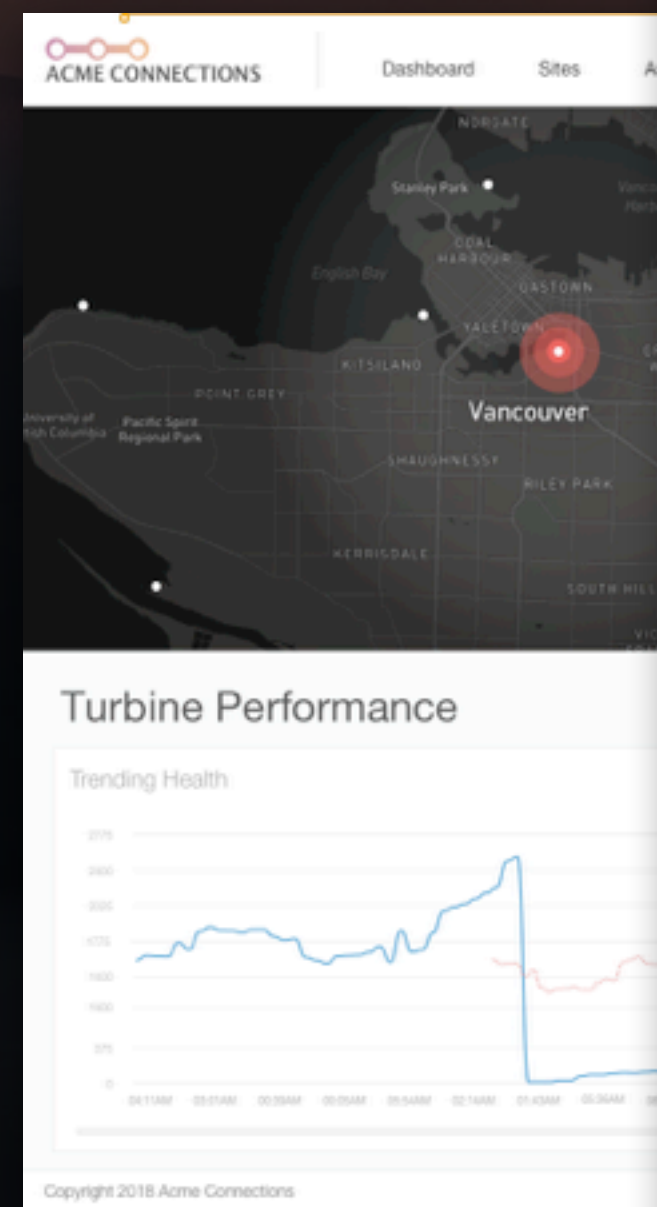


Reduce Unnecessary Site Visits

SensorUp Asset Performance Management IoT can reduce at least 20% unnecessary site visits

20%

Reduction in Unnecessary Site Visits



SensorThings Summit 2019

Part of OGC Technical Committee Fall 2019

September 2019
Banff, Canada

pending on OGC approval





Questions for the Audience

- How do we communicate the complicated value proposition of (geospatial) IoT interoperability to the rest of the world who only have 30 seconds attention span?
- What are the value propositions that can ONLY be delivered by interoperable IoT systems?

Grid Connected
.....
.....
.....
.....



Put Your IoT Data on the Map