

DB₄IoT

Making Traffic Data Accessible

Millions of moving objects

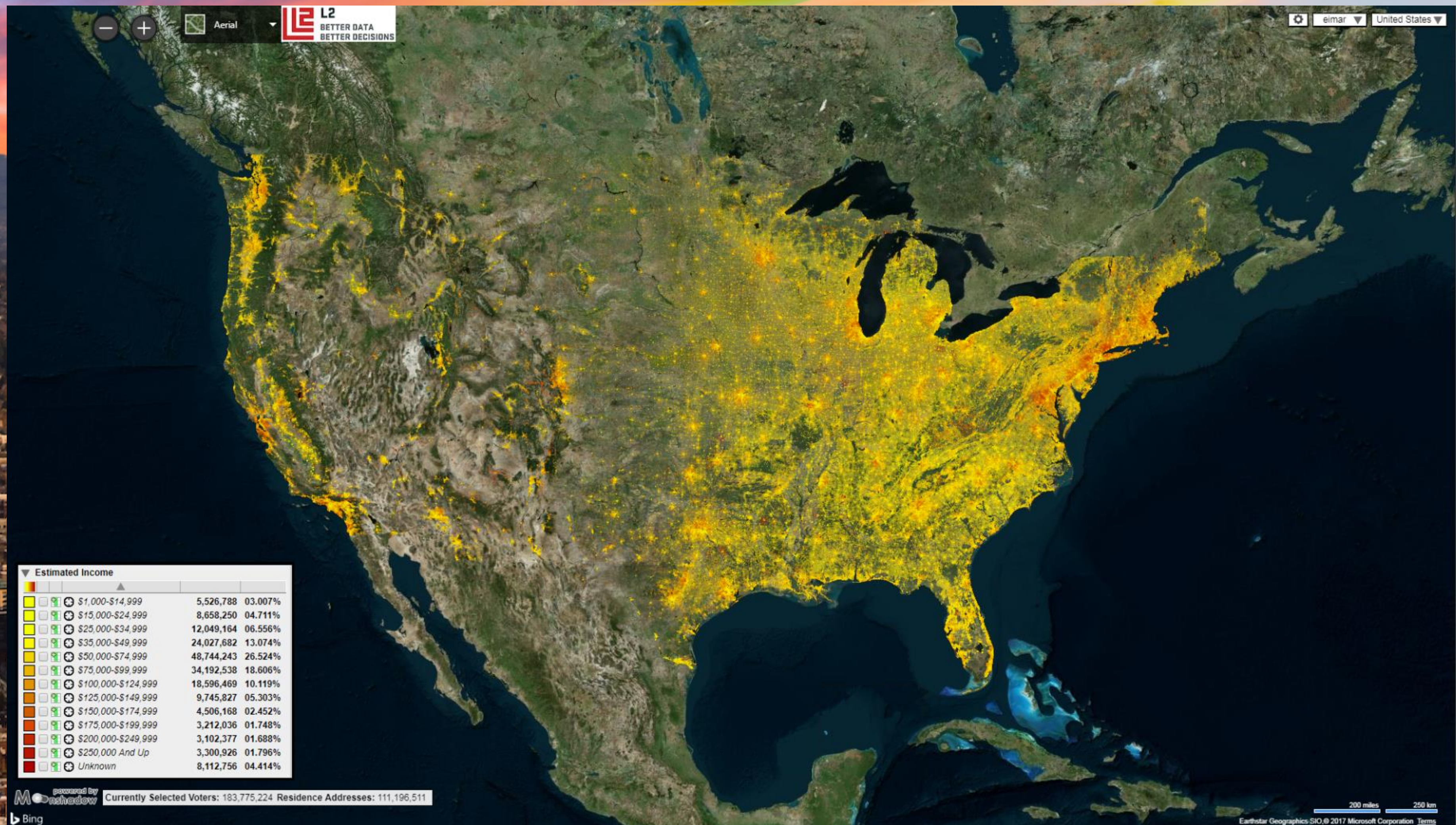
**Hundreds of millions of measurements
*per second***

Eimar Boesjes, CEO, Moonshadow Mobile, Inc.

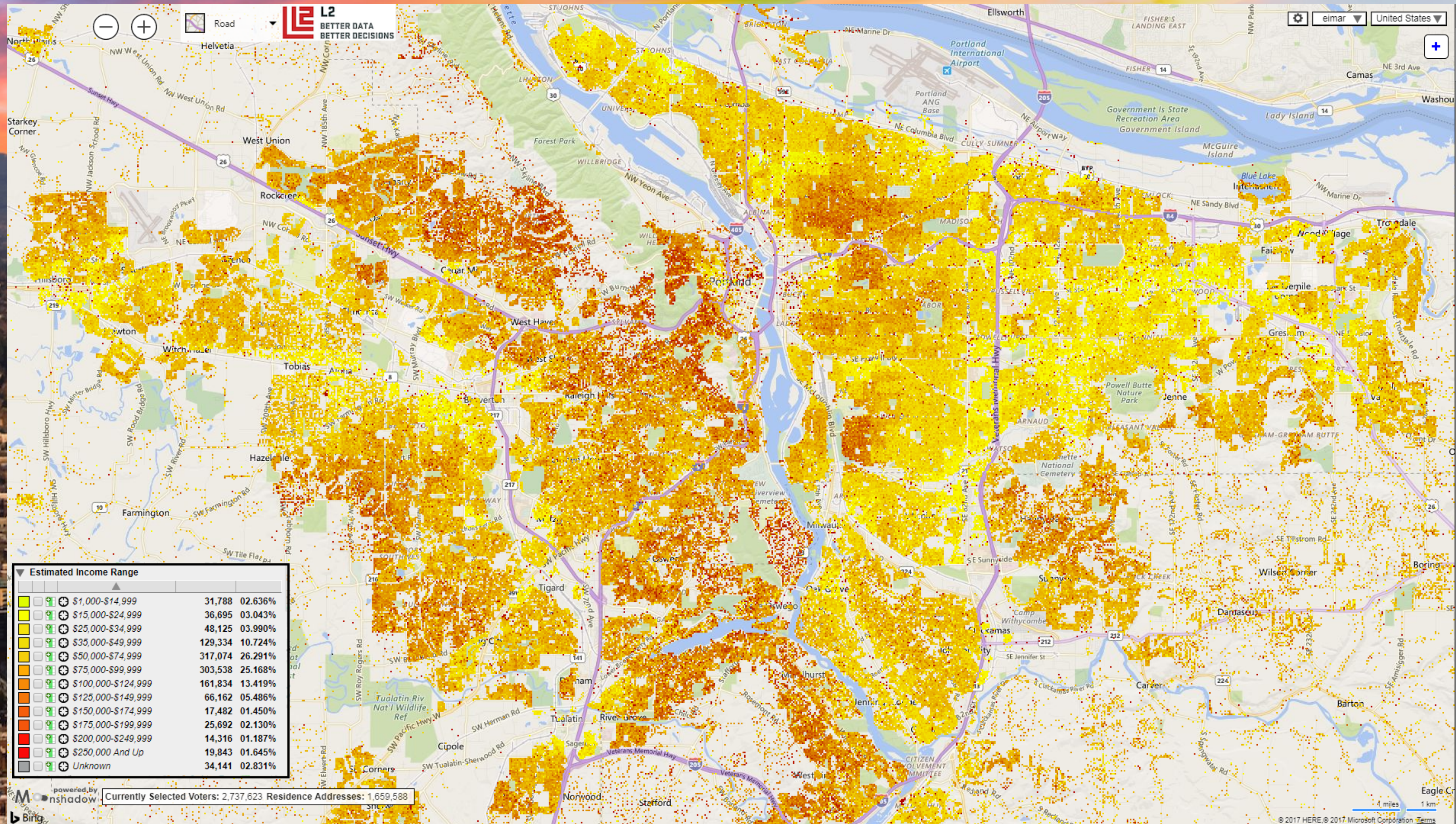
db4iot.com

moonshadow.com

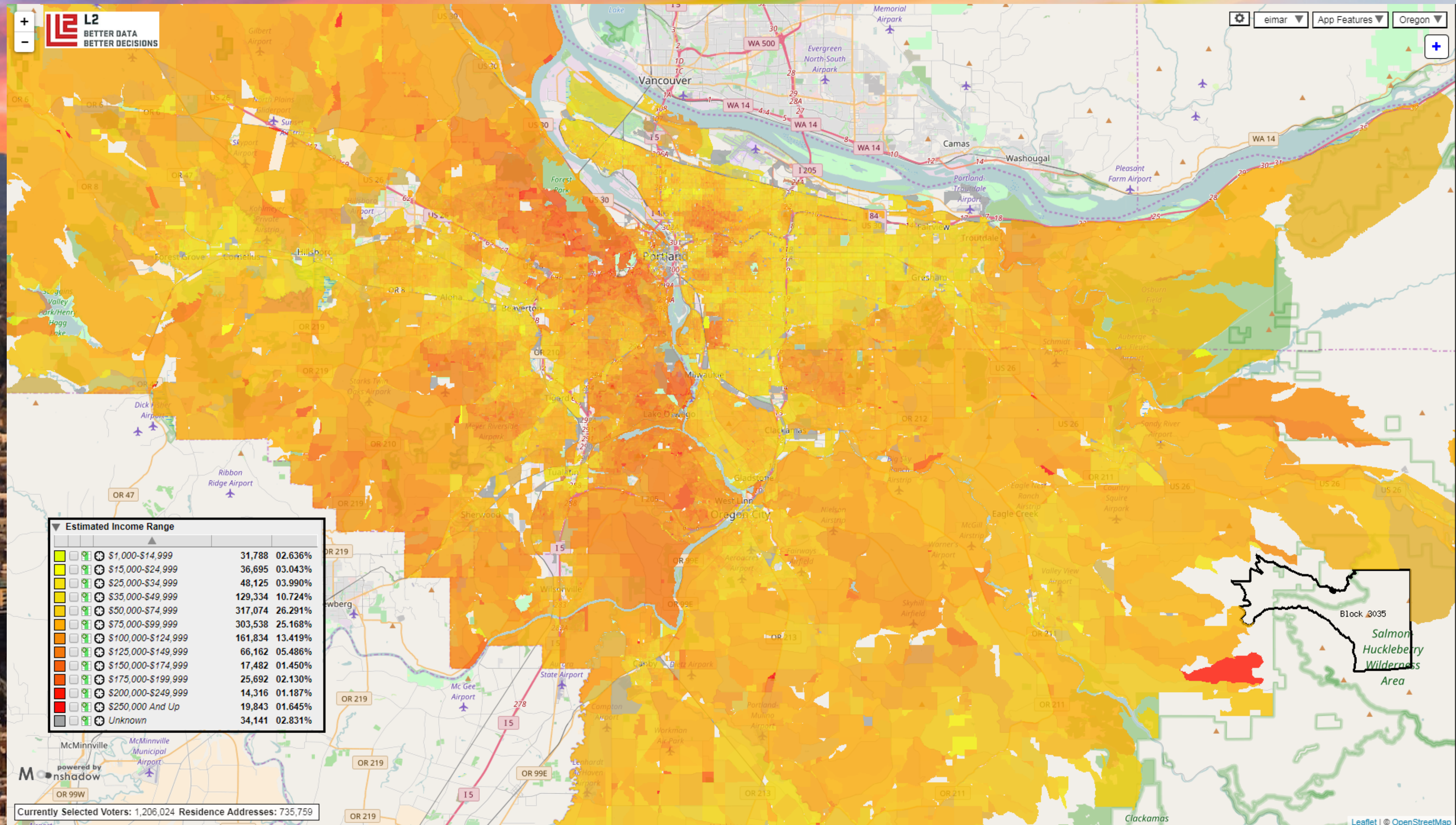
Moonshadow History: Map & Visualize US Population



Tri County Income Levels per Household

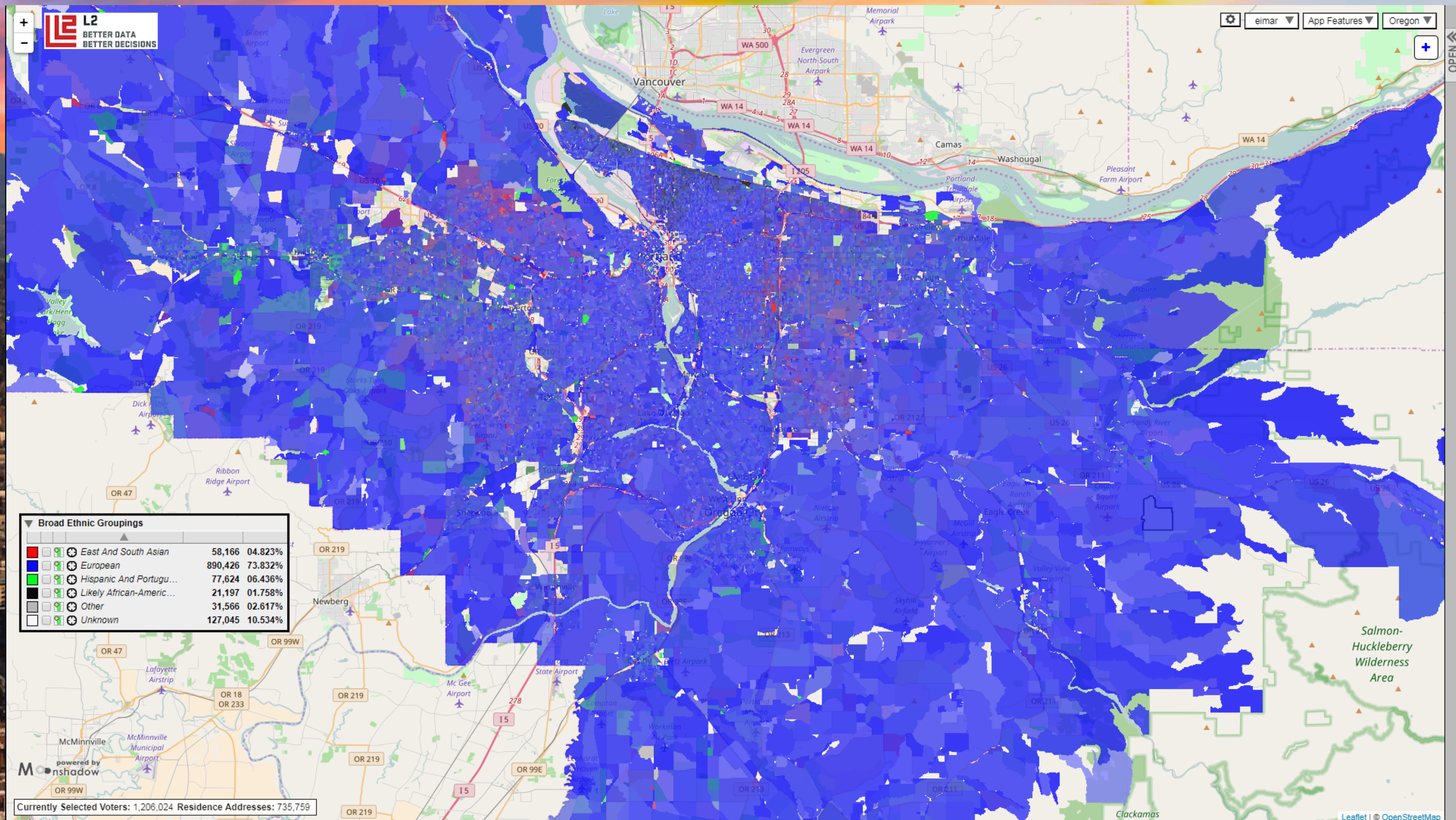



Tri County Income Levels per Census Block



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Tri County Ethnicity per Census Block



The background of the slide is a scenic photograph of a city, likely Portland, Oregon, taken from a high vantage point. In the foreground, there are dark, silhouetted trees. The middle ground shows a dense urban area with various buildings, including several tall skyscrapers. In the background, a large, snow-capped mountain (Mount Hood) rises against a dramatic sky with streaks of orange, pink, and blue from the setting or rising sun.

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Making Traffic Data Accessible

Millions of moving objects

Hundreds of millions of measurements
per second

Problem: The data is too big to work with
DB4IoT solves this problem

IoMT Data Isn't Big Data, It's Bigger Data

TriMet Example

- One month, 662 buses, 5-second interval
- 30,000 bus log files, 250 million records
- 20+GB in PostgreSQL
- 4GB in DB4IoT
- 20-80 millisecond seek times
- Visualize on Maps 5x per second



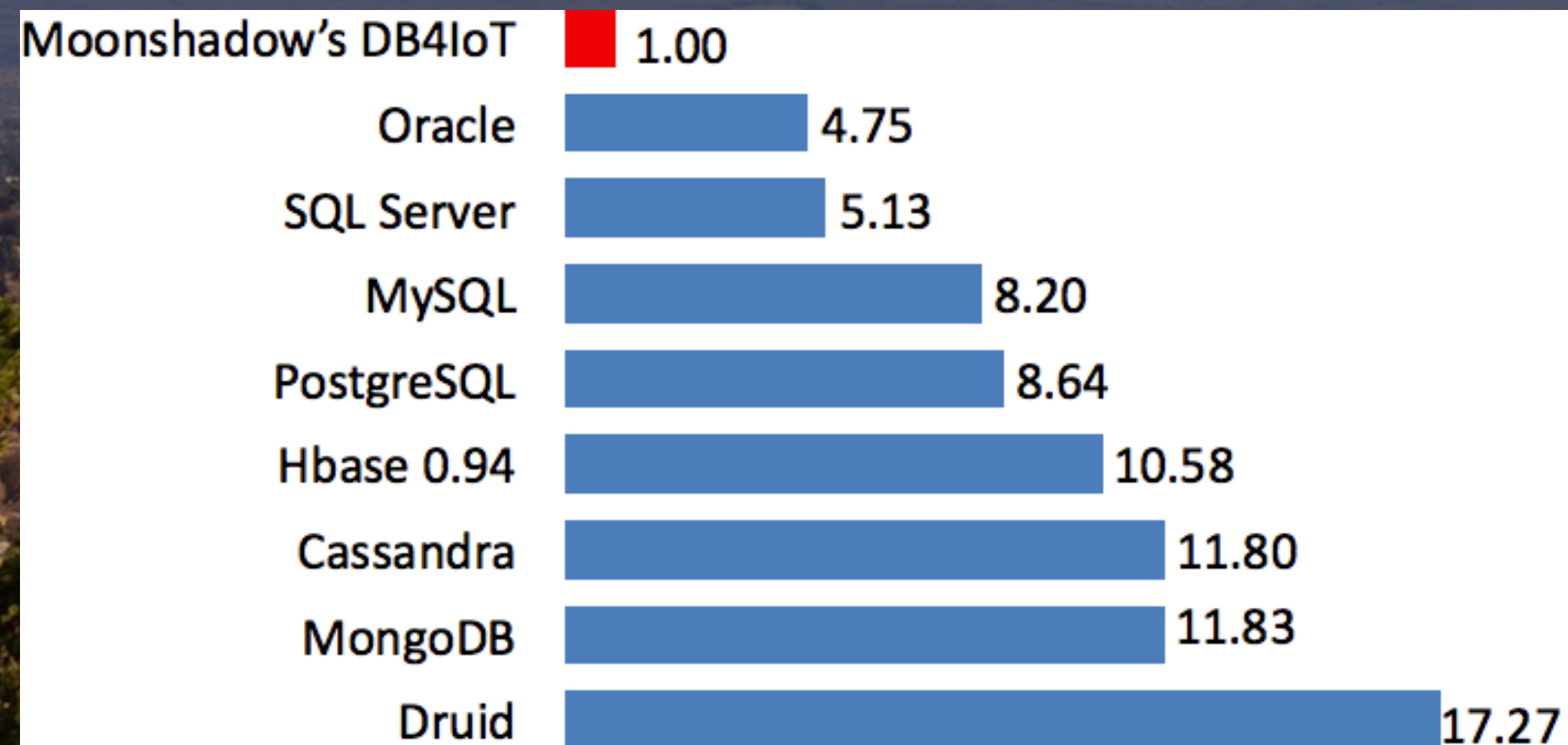
IoMT Data Isn't Big Data, It's Bigger Data

Vehicle Movement

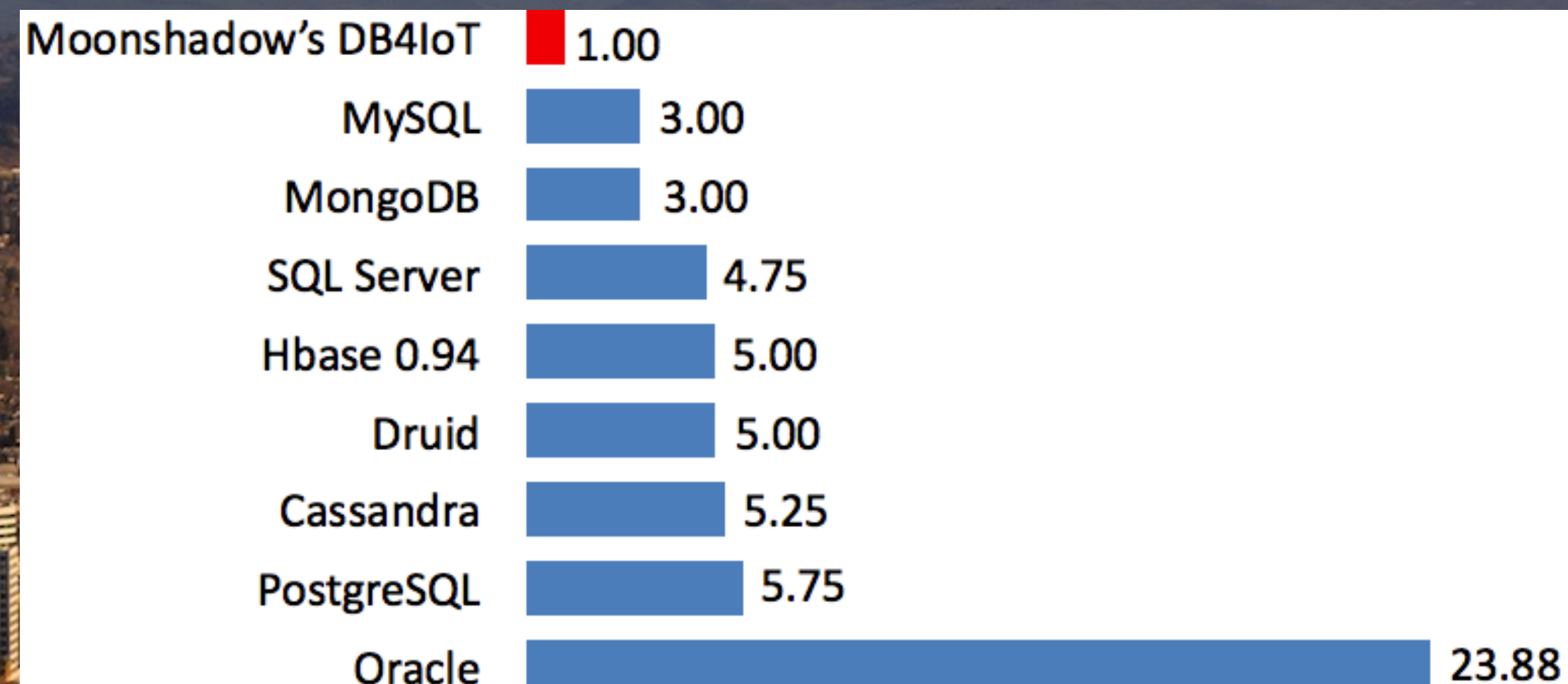
- 60 MPH = 1 mile/minute = 27 meters/second
- For <1 meter movement resolution, you need 50 measurements/second
- Now TriMet's one-month bus movement database is 60 Billion Records
- 1 Month of TriMet Bus Data = 1TB in DB4IoT
- That is for only 662 Buses

Solution: Make Big Data Small

Data Footprint Size

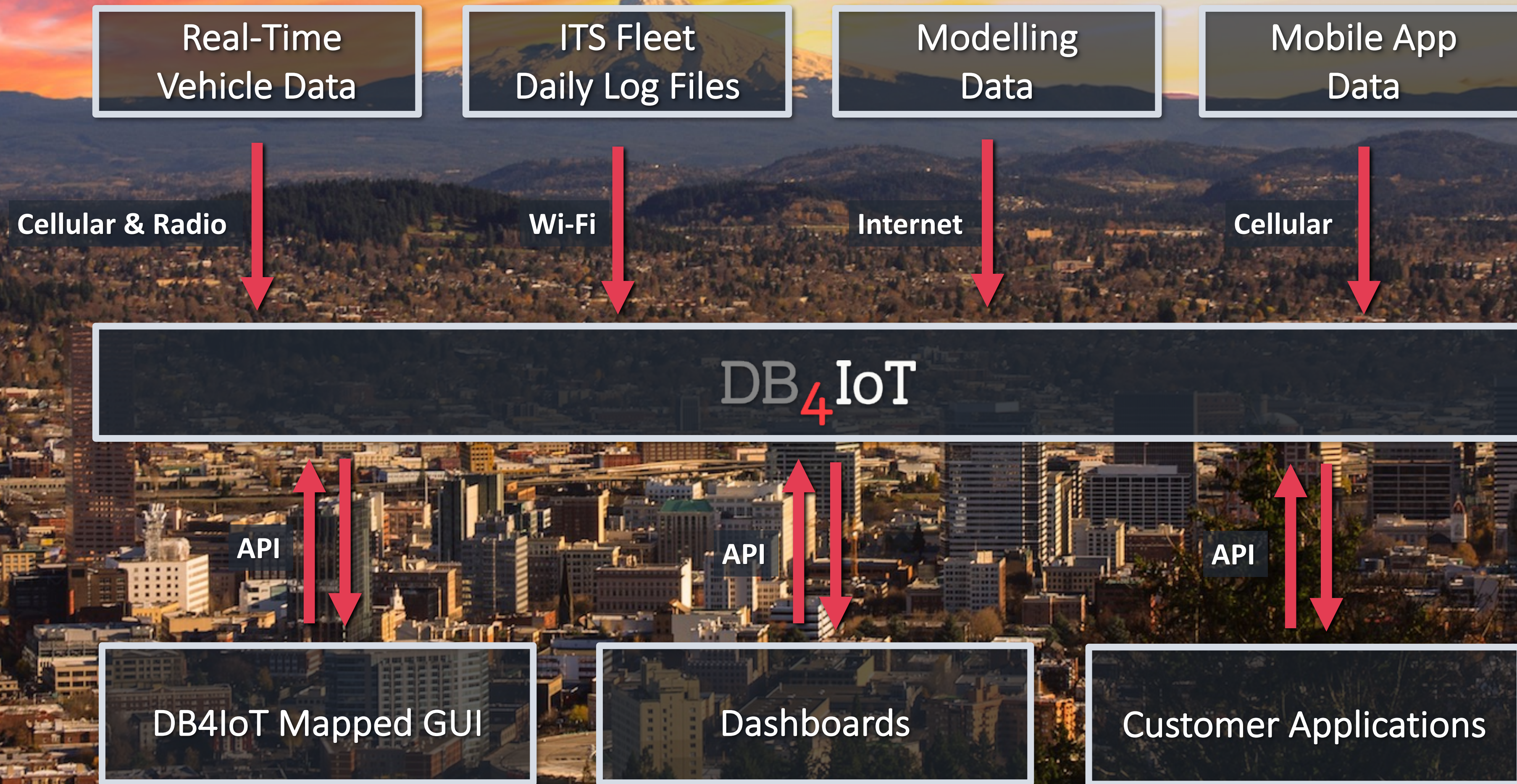


Data Row Overhead Size



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Storing & Retrieving Data



How TriMet Collects Data

Sensors

- Time, Location, Delay
- Acceleration, Speed
- Breaking, Lane Changes
- Passenger Counts
- Engine Diagnostics

Gateway

- Some data is transmitted from the buses in real time via a radio or cellular connection

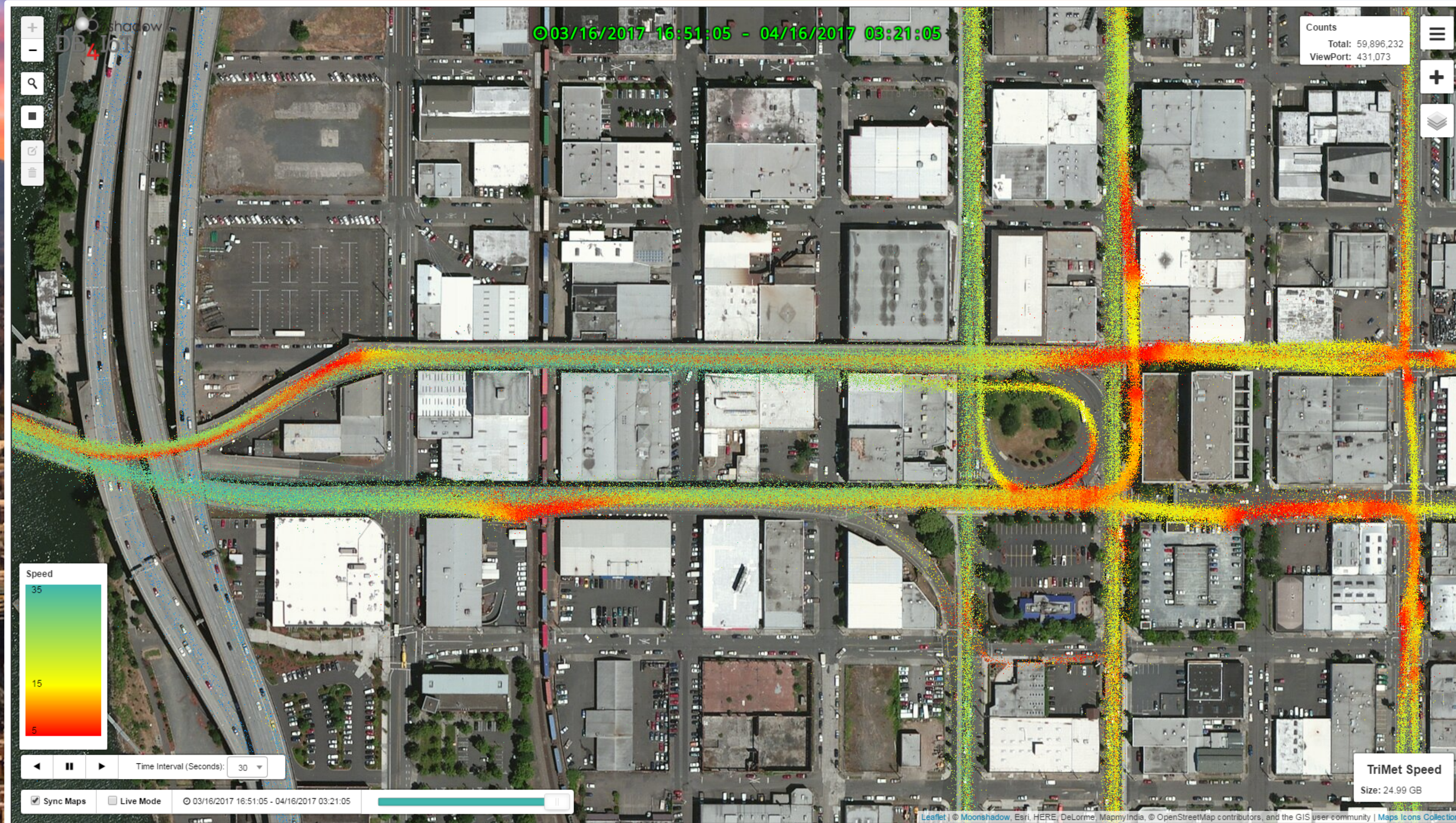
Computer

- Most of the data is stored on a computer located in the bus and uploaded once per day



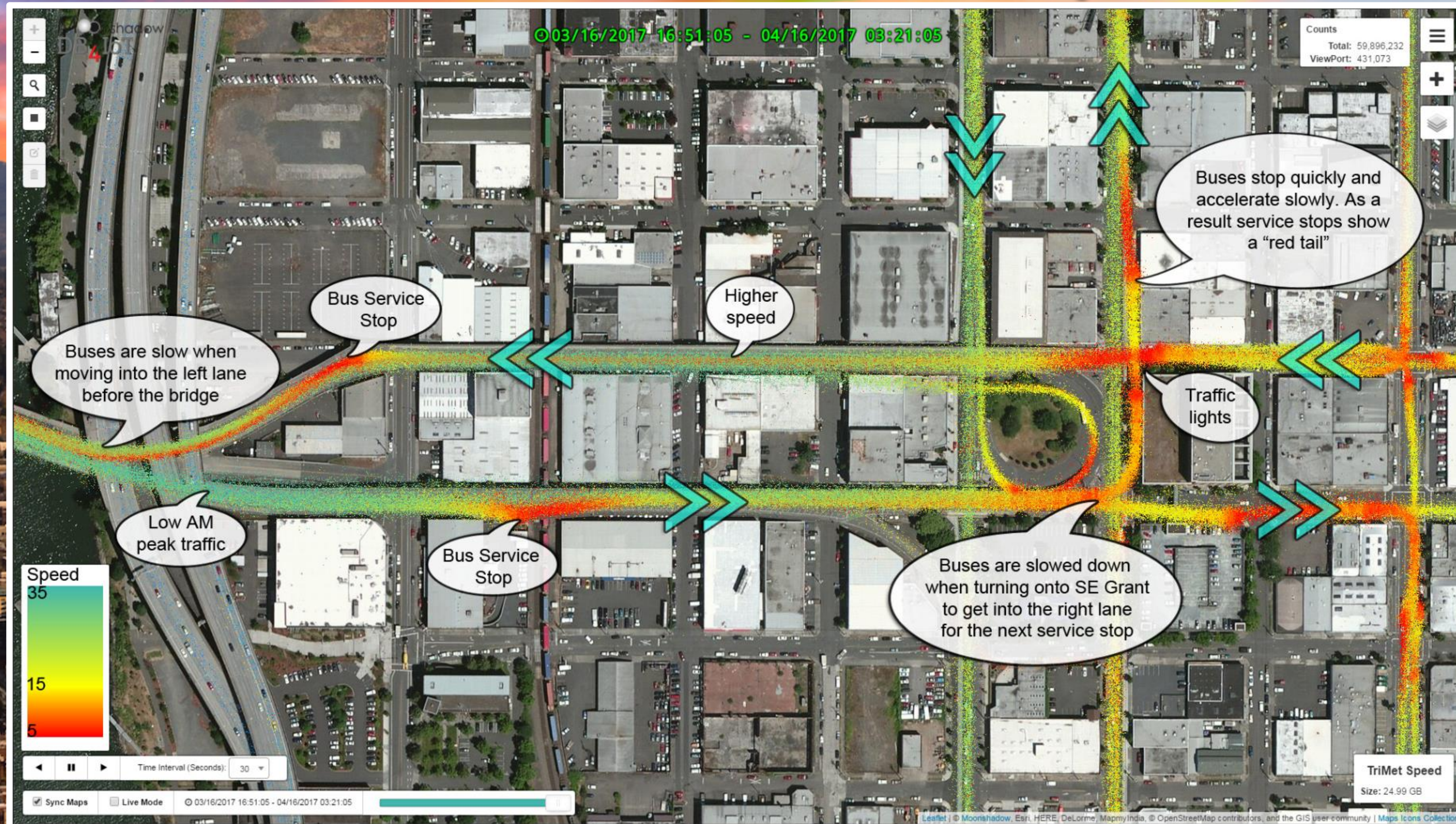
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Vehicle Speed Recordings



Data Source: TriMet

Conclusions from the Vehicle Speed Data



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One Week of Bus Movement Data



Data Source: TriMet

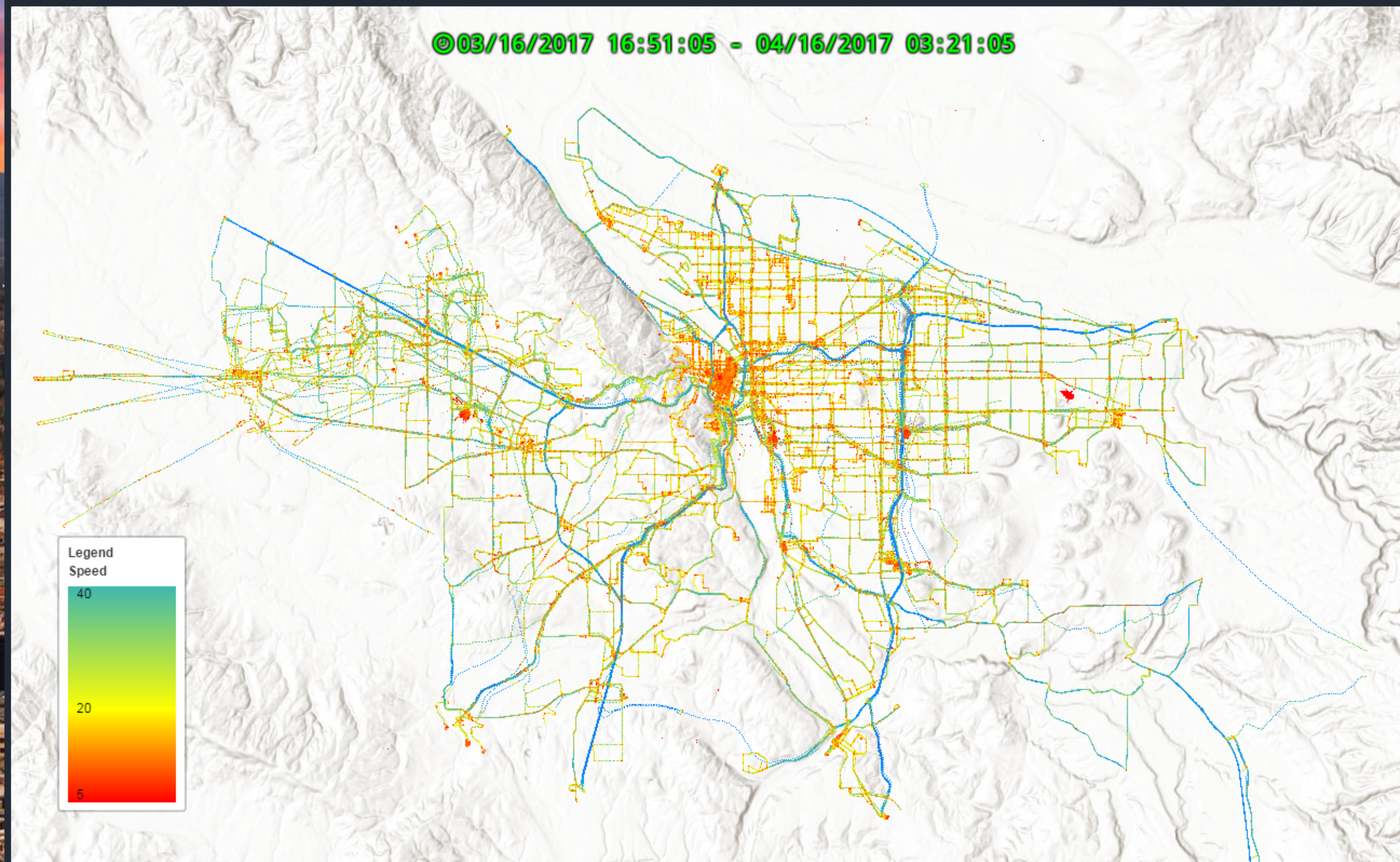
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Comparing Time Periods



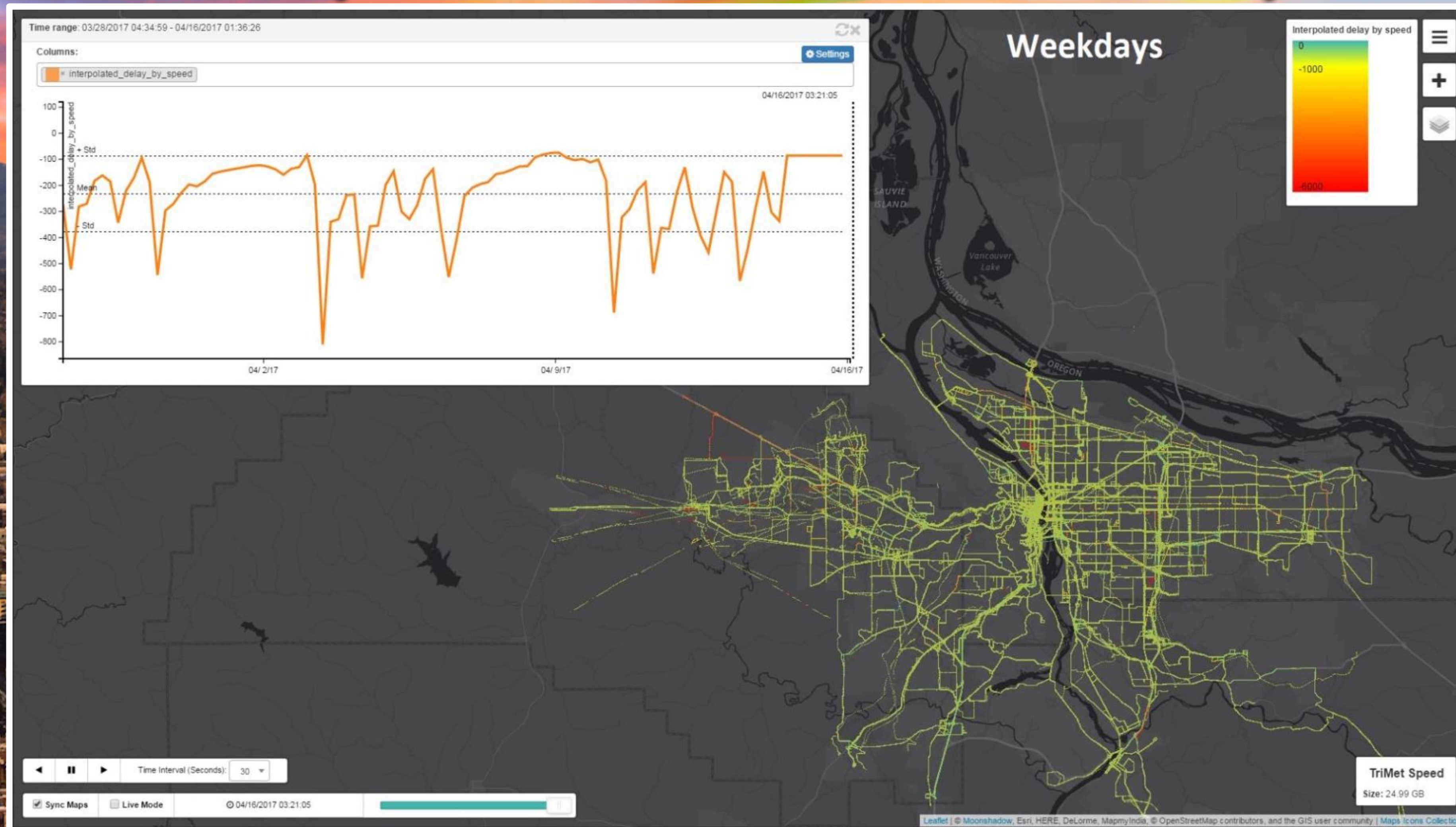
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Speed of Entire TriMet Area for One Month

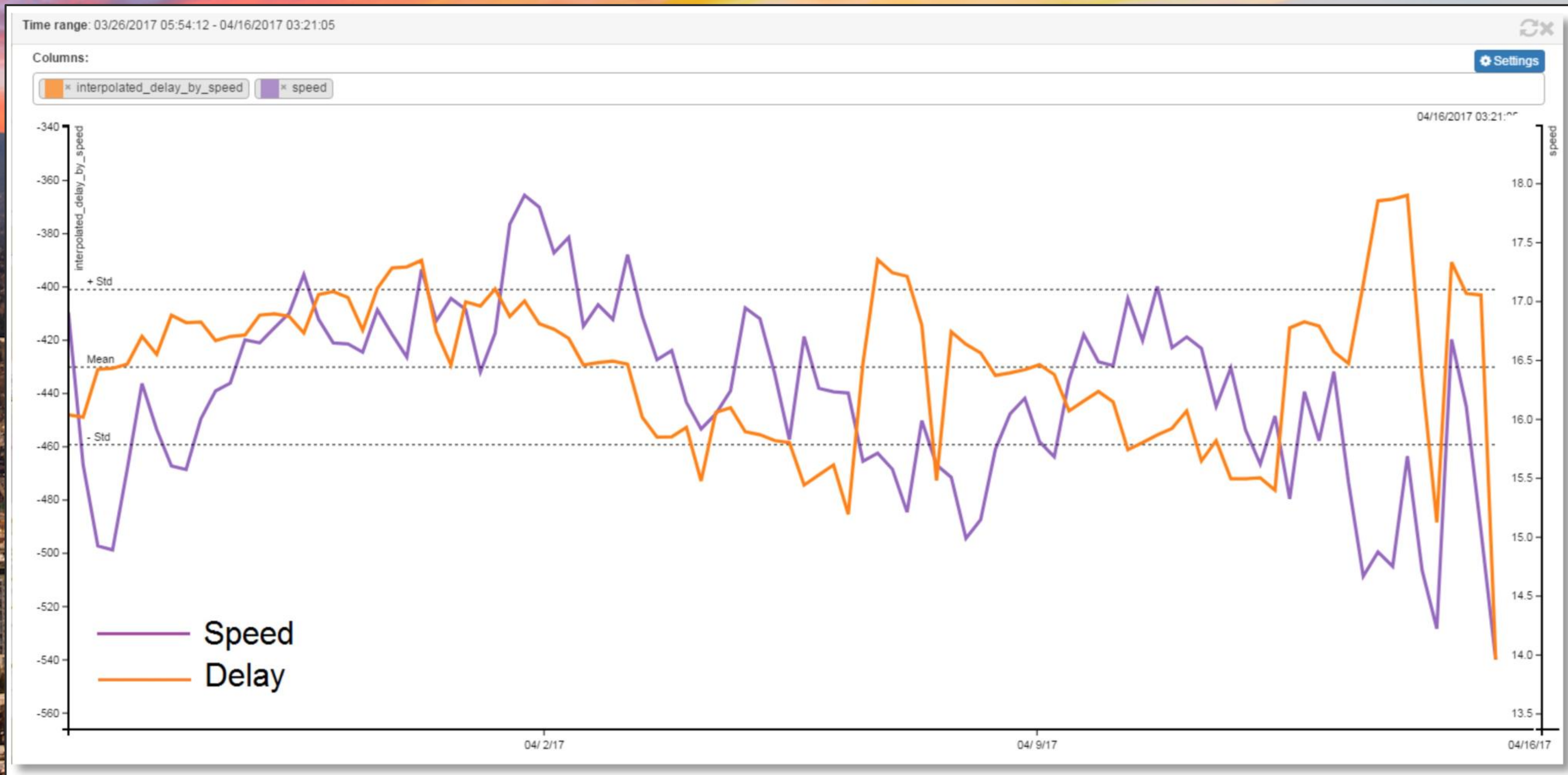


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Delays for One Month on Weekdays

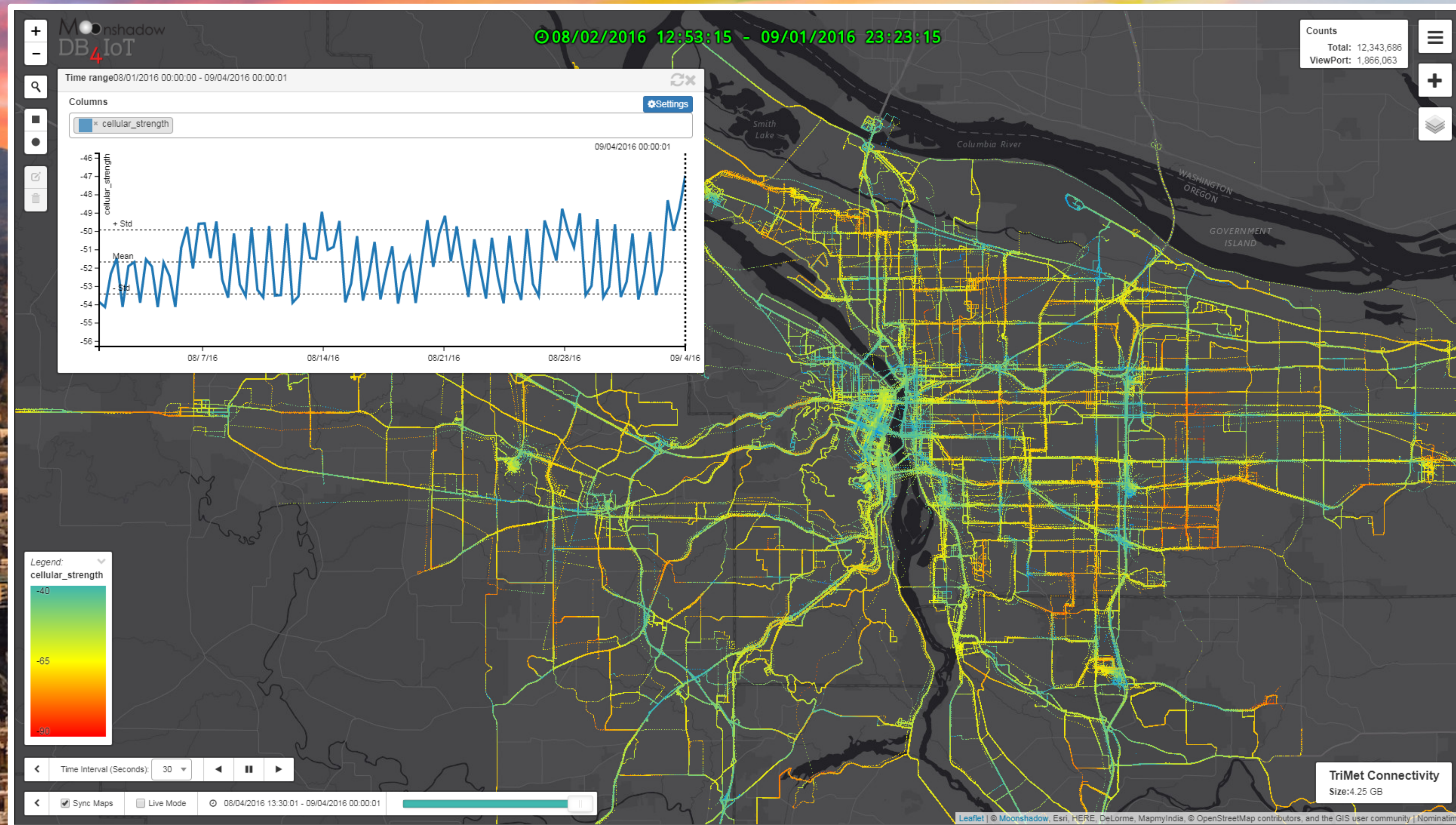


Comparing Speed and Delay over Time



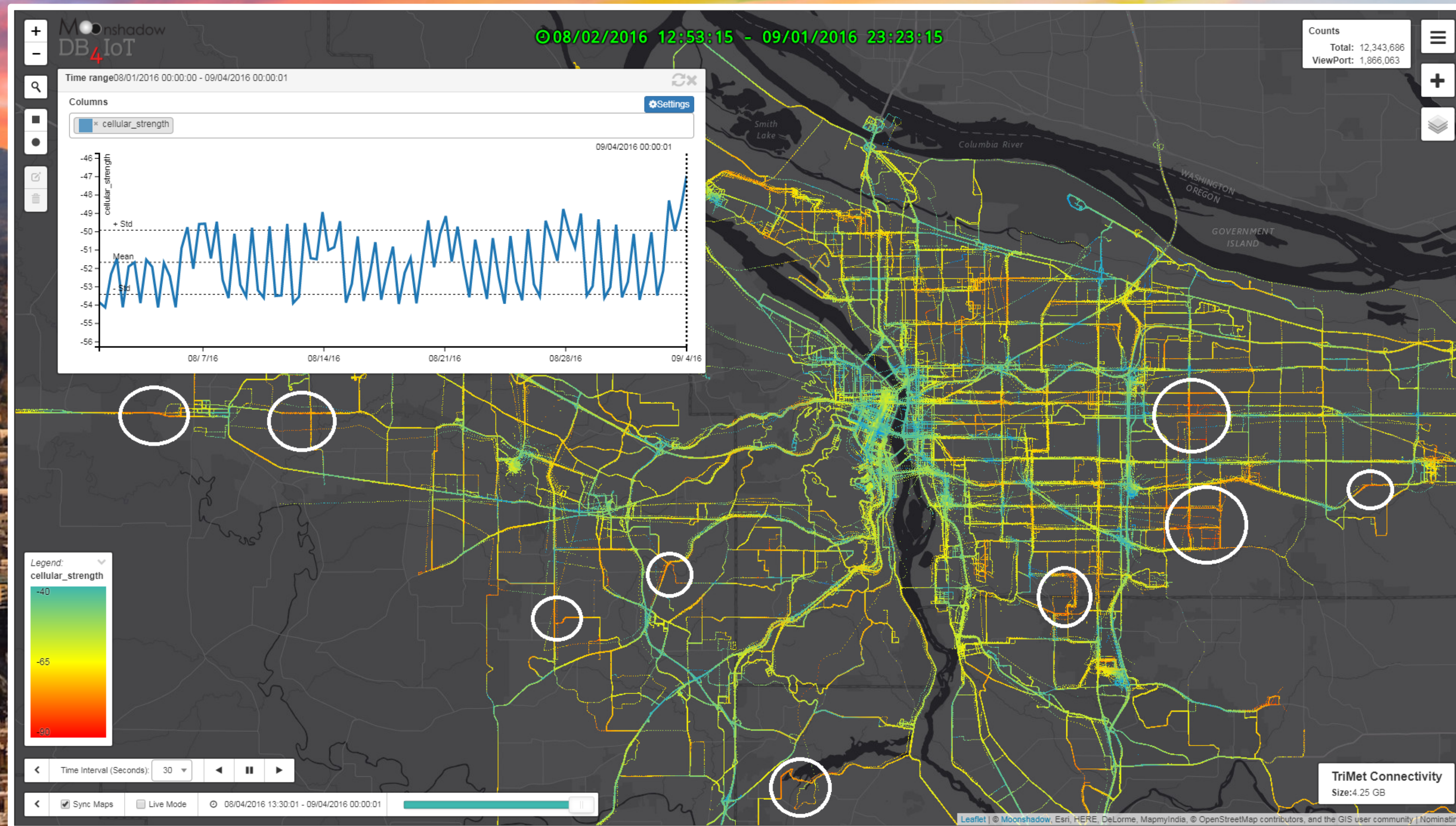
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Cellular Connectivity over One Month



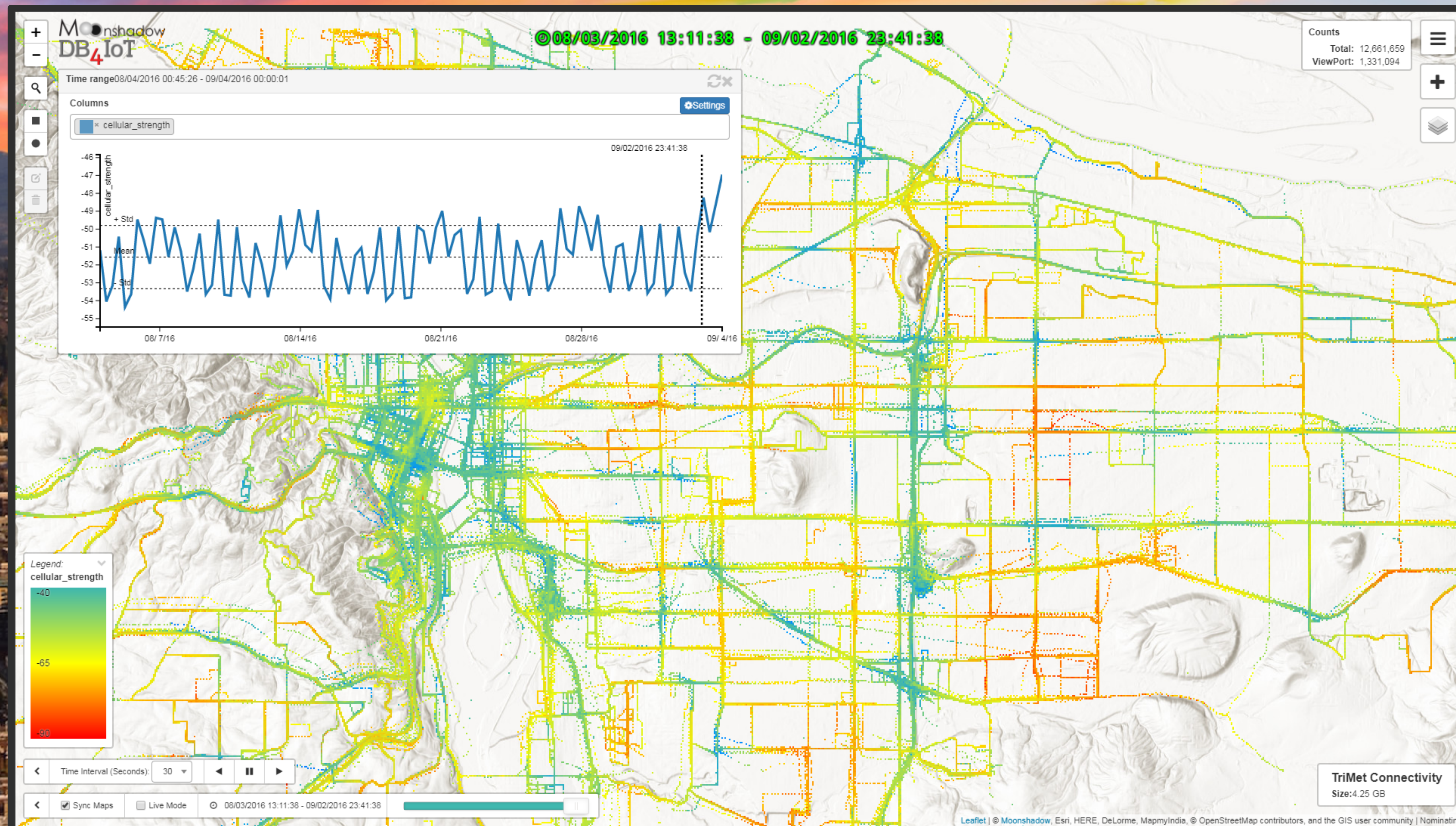
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Cellular Connectivity: Bad Areas



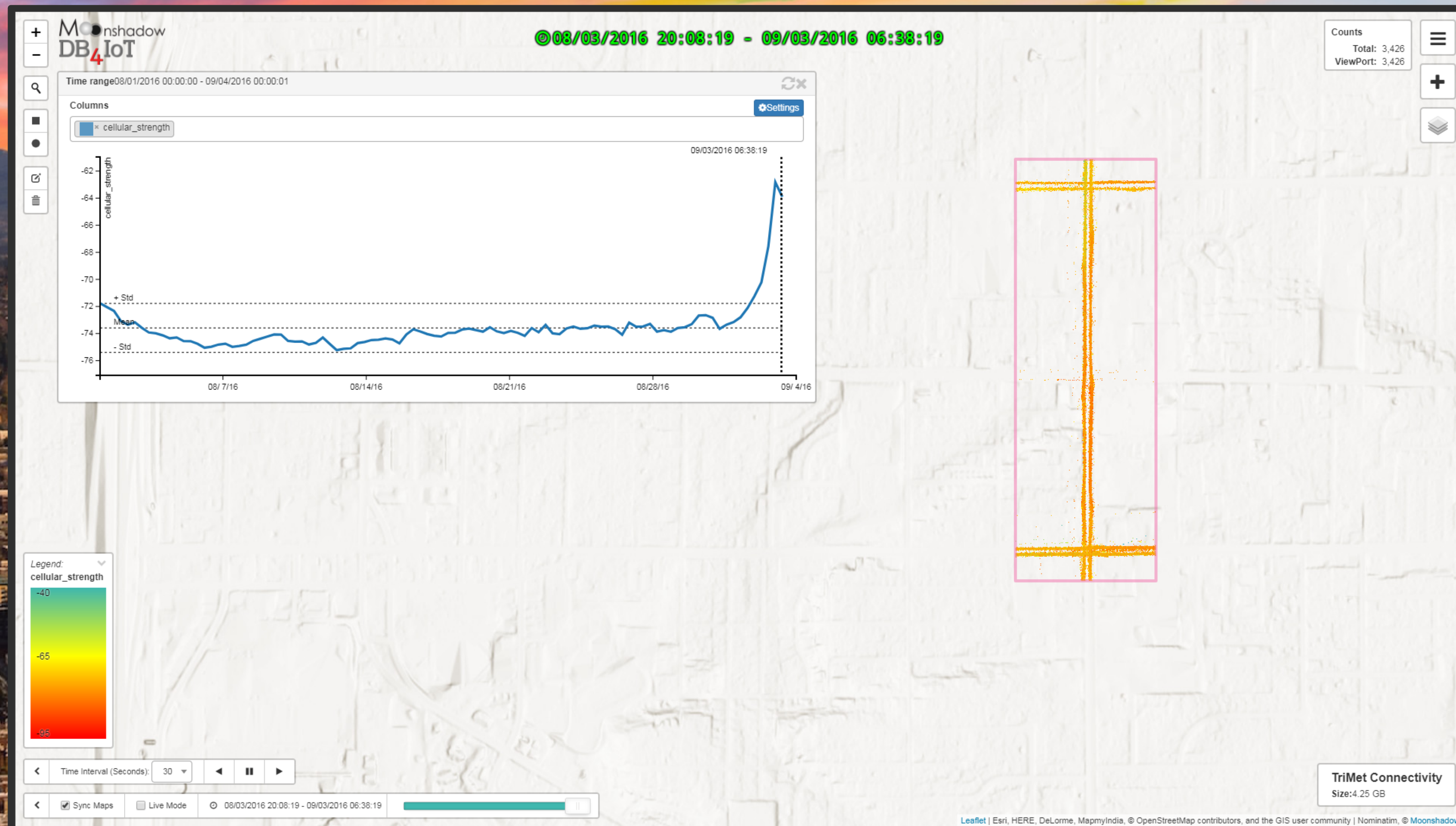
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Comparing Connectivity with Geography



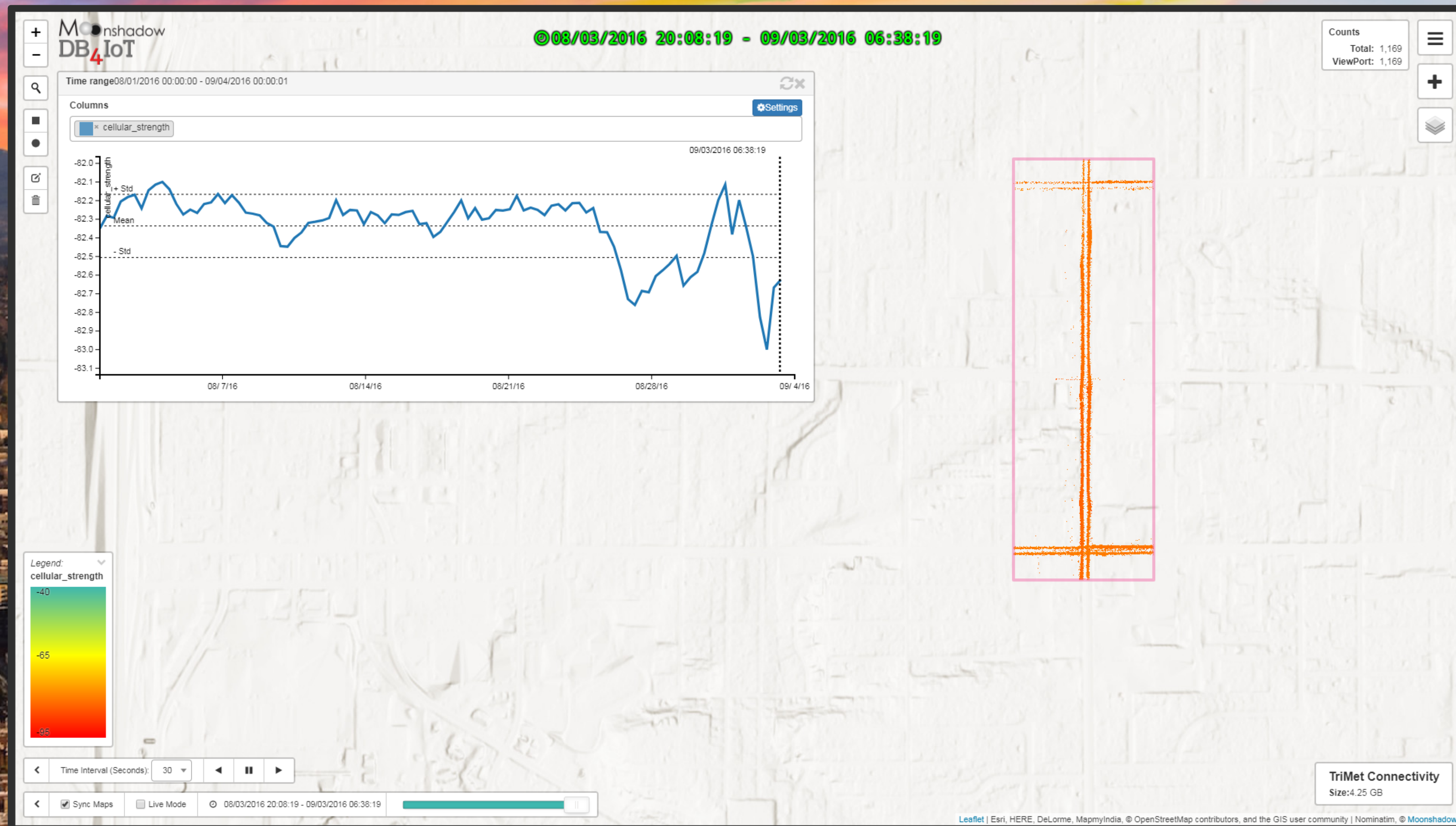
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Cellular Connectivity: Bad Area



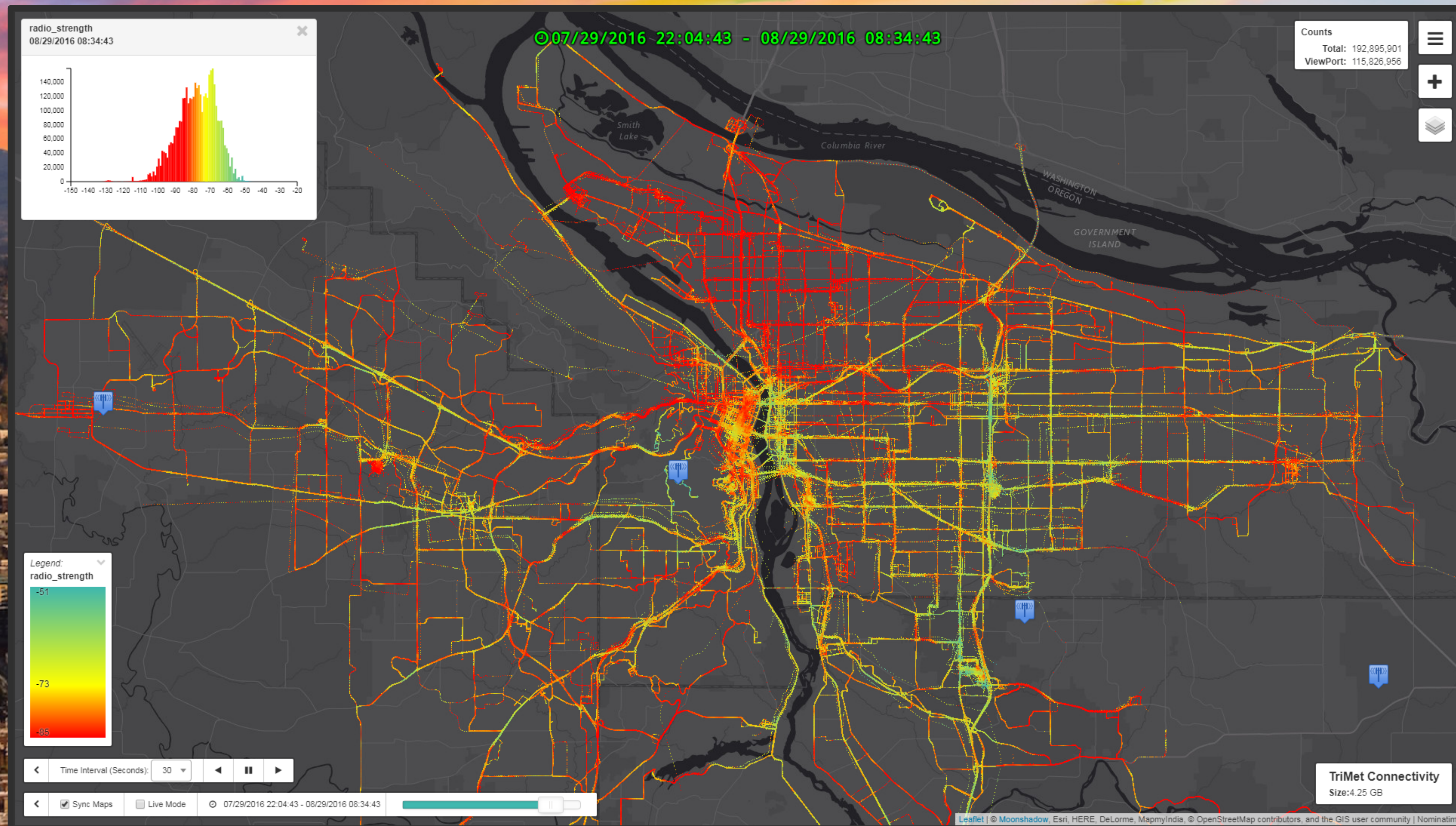
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Cellular Connectivity <-80: 33% Bad Connectivity



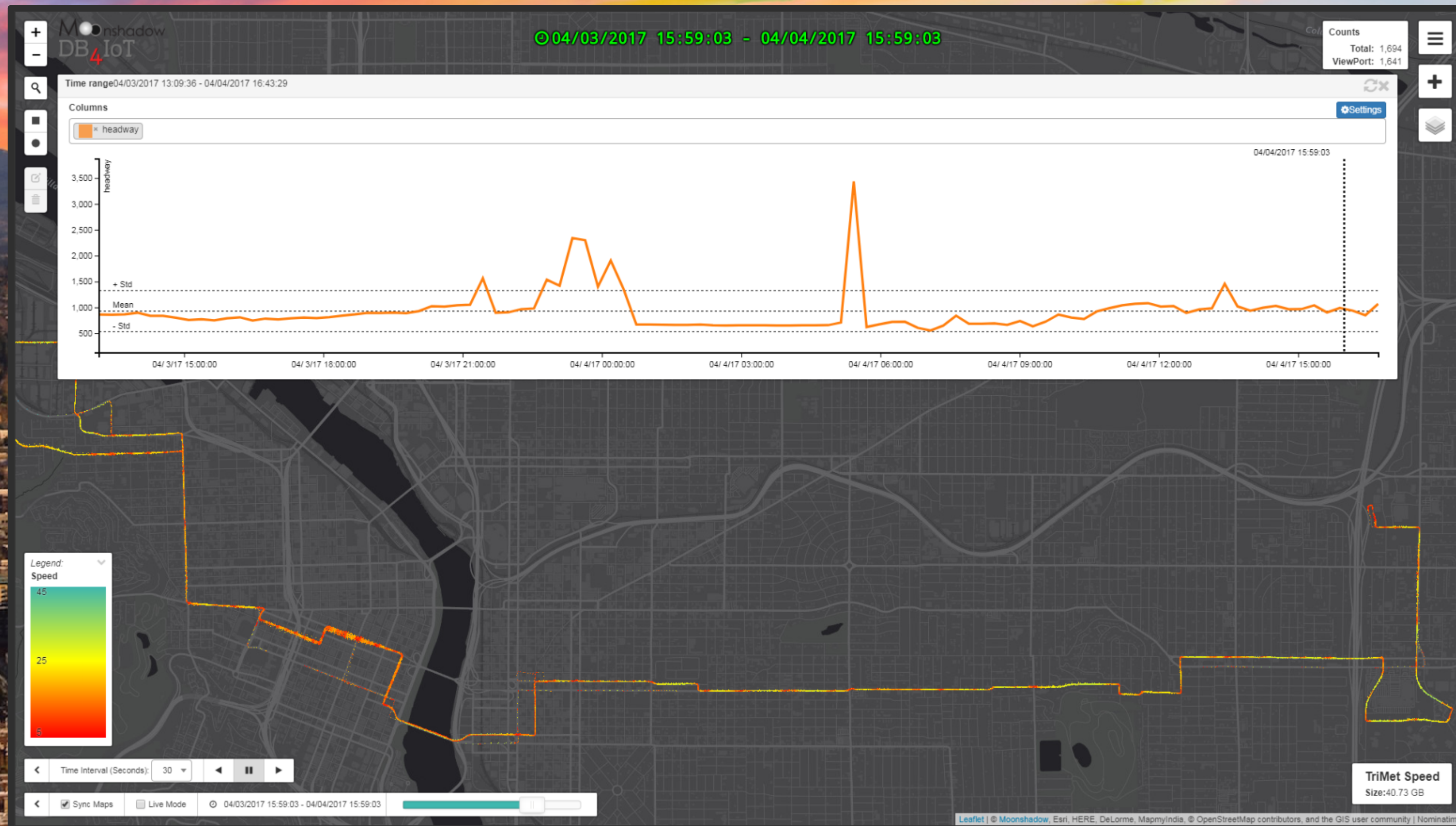
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Radio Strength for One Month



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Route #15 Headway and Speed for One Day

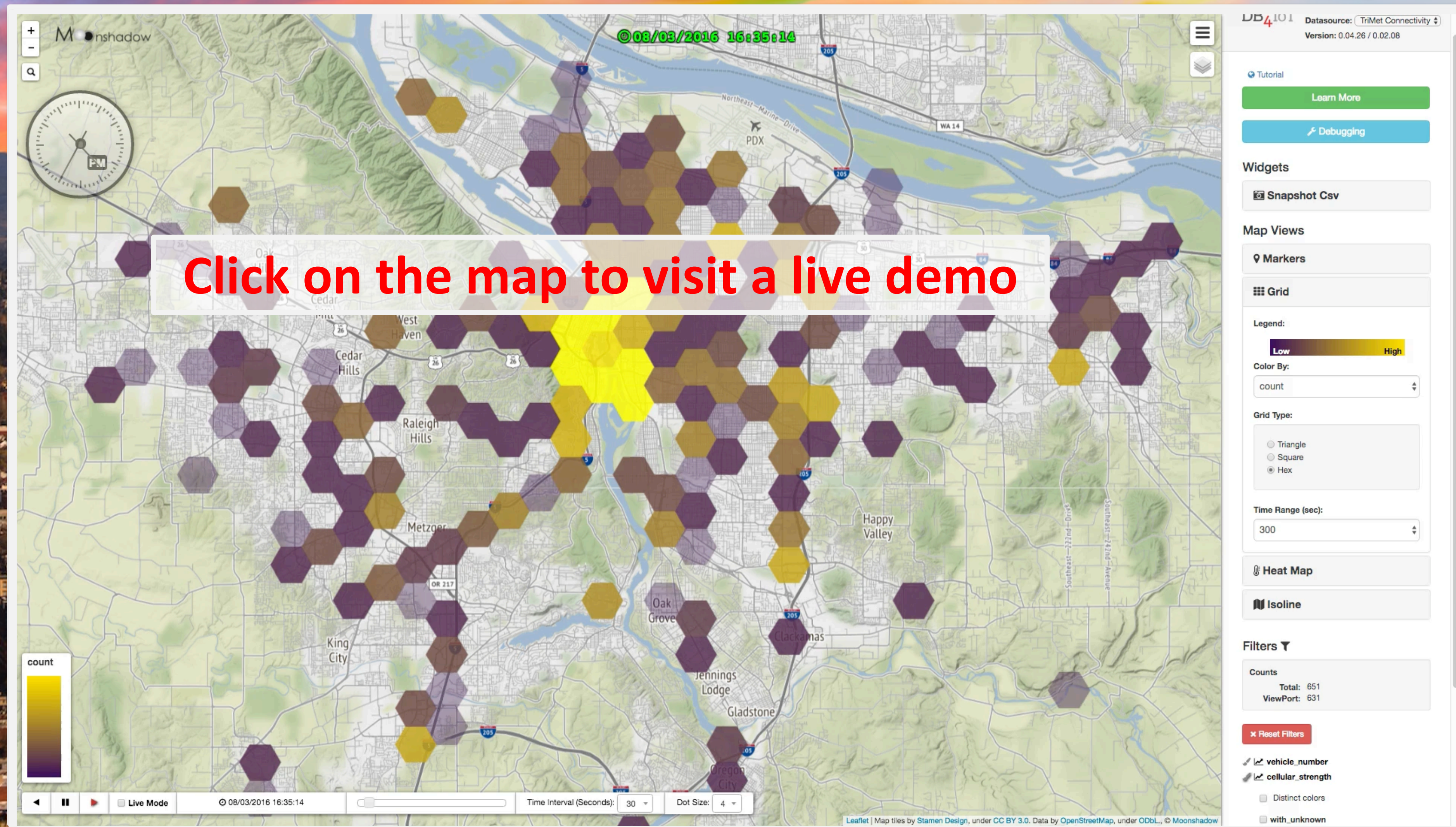


Output Spreadsheets: Routes Sorted by Speed

route_number	speed:time_weighted_count	speed:time_weighted_mean	speed:time_weighted_sdev
37	10,198	15.1	12.1
36	16,077	14.6	10.8
65	4,306	13.0	8.3
29	30,313	12.8	10.5
67	77,764	12.1	11.3
152	22,055	12.1	9.9
30	127,407	12.0	14.3
38	47,520	11.8	10.7
87	111,014	11.5	10.7
8	204,427	11.3	6.9
156	25,842	11.1	10.7
43	93,421	11.0	9.5
92	11,696	10.9	8.1
34	131,766	10.7	10.3
155	81,440	10.7	10.8
72	926,702	10.7	9.5
23	24,781	10.4	9.1
55	4,870	10.4	9.3

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Instant Visualizations Over Interactive Maps



Click on the map to watch the video

A Day In The Life Of TriMet

24 Hours:

09/07/2016 03:30 am

09/08/2016 03:30 am



Leaflet | Tiles courtesy of OpenStreetMap Sweden — Map data © OpenStreetMap, © Moonshadow

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Making Traffic Data Accessible Thank You!

Technology

Moonshadow

Data

TRI MET

Consultant

DKS

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