



DB₄IoT

Analyzing Public Transit Data

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IoT: The Internet of Things
IoMT: The Internet of Moving Things

Examples:

Buses

Trains

Light Rail

Driver Mobile Apps

Passenger Mobile Apps

How TriMet Collects Data: Real-Time and Daily

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



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

TriMet Example

- 700 buses
- 145 light rail
- 300,000 weekday trips
- 100 million trips/year
- 400,000 daily stops

One Month of Data

- 200 values per bus
- Measured every five seconds
- Stored in 30,000 daily log files
- Comprising 250 million records
- Containing 50 billion values

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

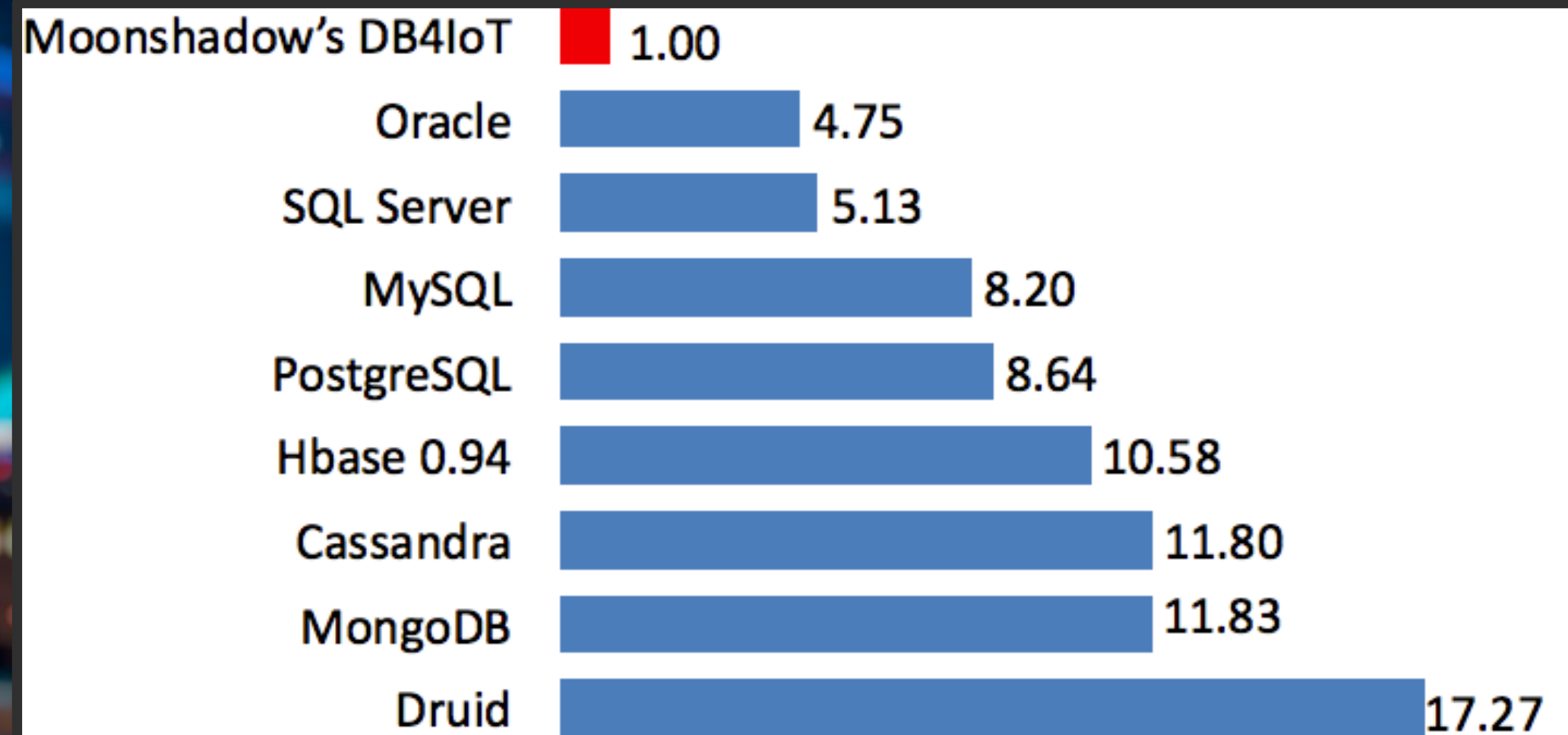
Vehicle Movement Data

- 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 845 vehicles

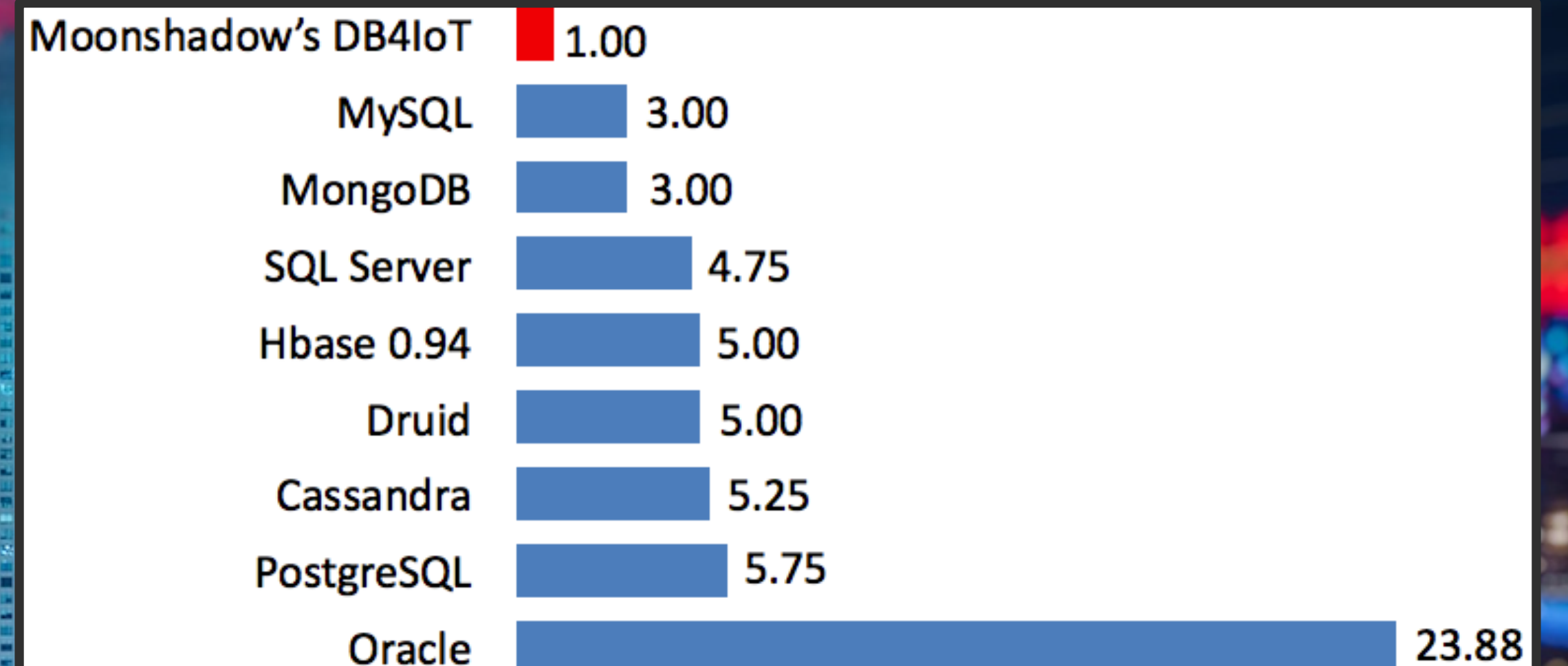
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The Solution: Make Big Data Small

Data Footprint Size



Data Row Overhead Size



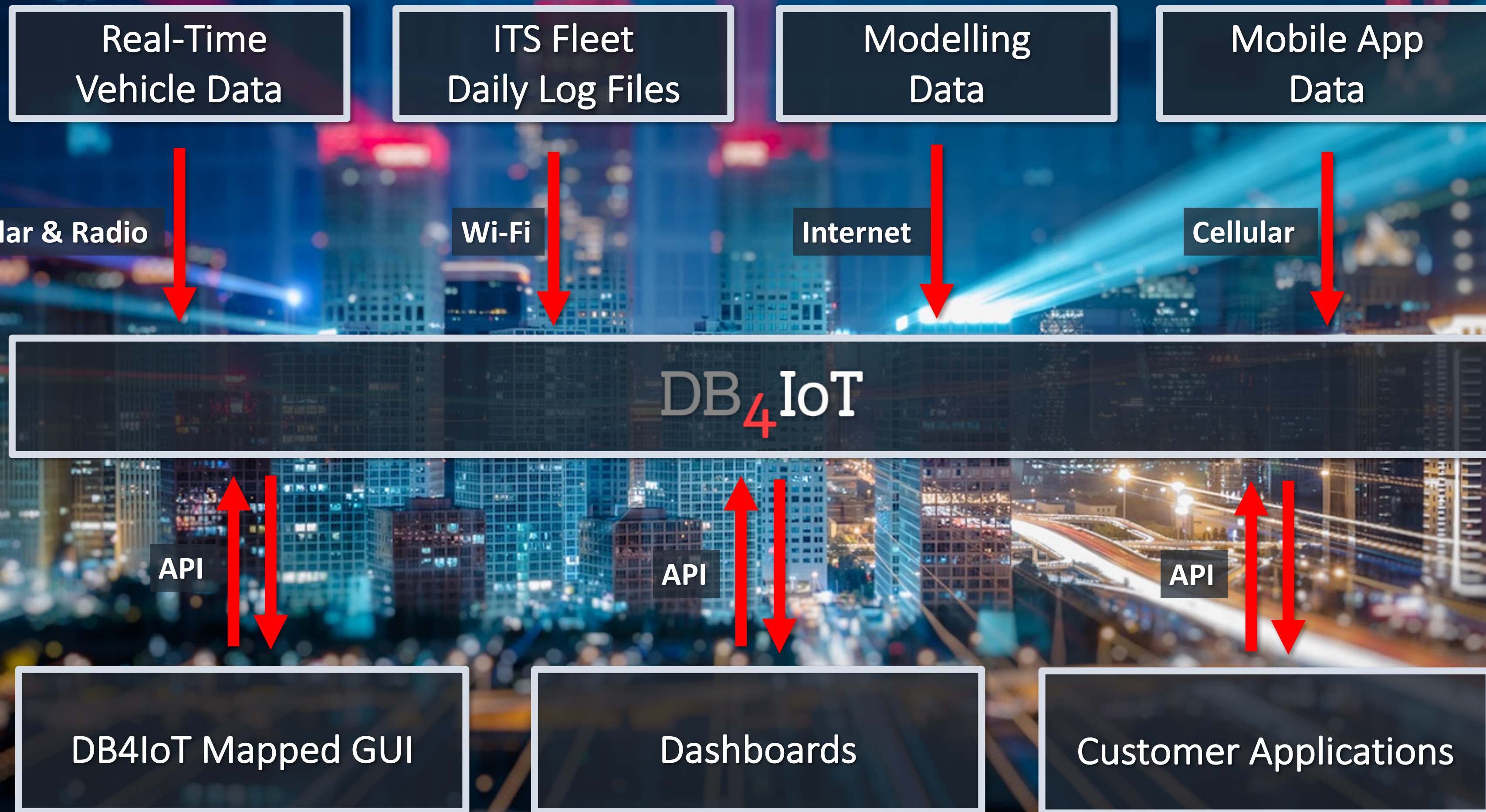
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The Solution: Make Big Data Fast & Easy

High data ingestion rate	100k updates/second/server
Super efficient data storage	<1 byte/value
High speed searches	200M records/cpu/second
Software as a Service	Requires no Hardware Purchases
Software as a Service	Requires no Technical Staff
Instant maps	Map 200M records 10x per second
Easy Integration	Does not replace existing systems

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Storing, Retrieving and Analyzing Data



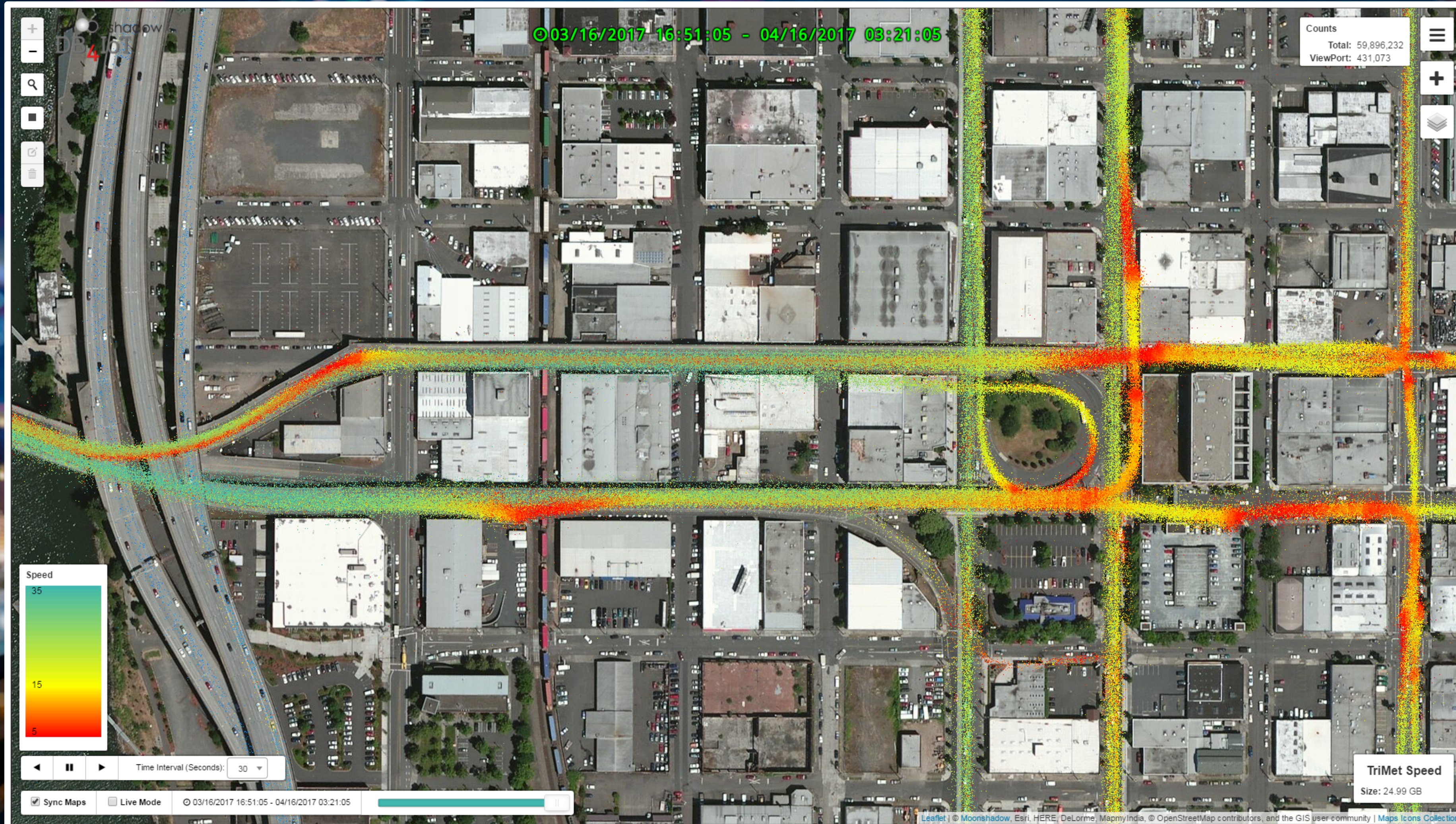


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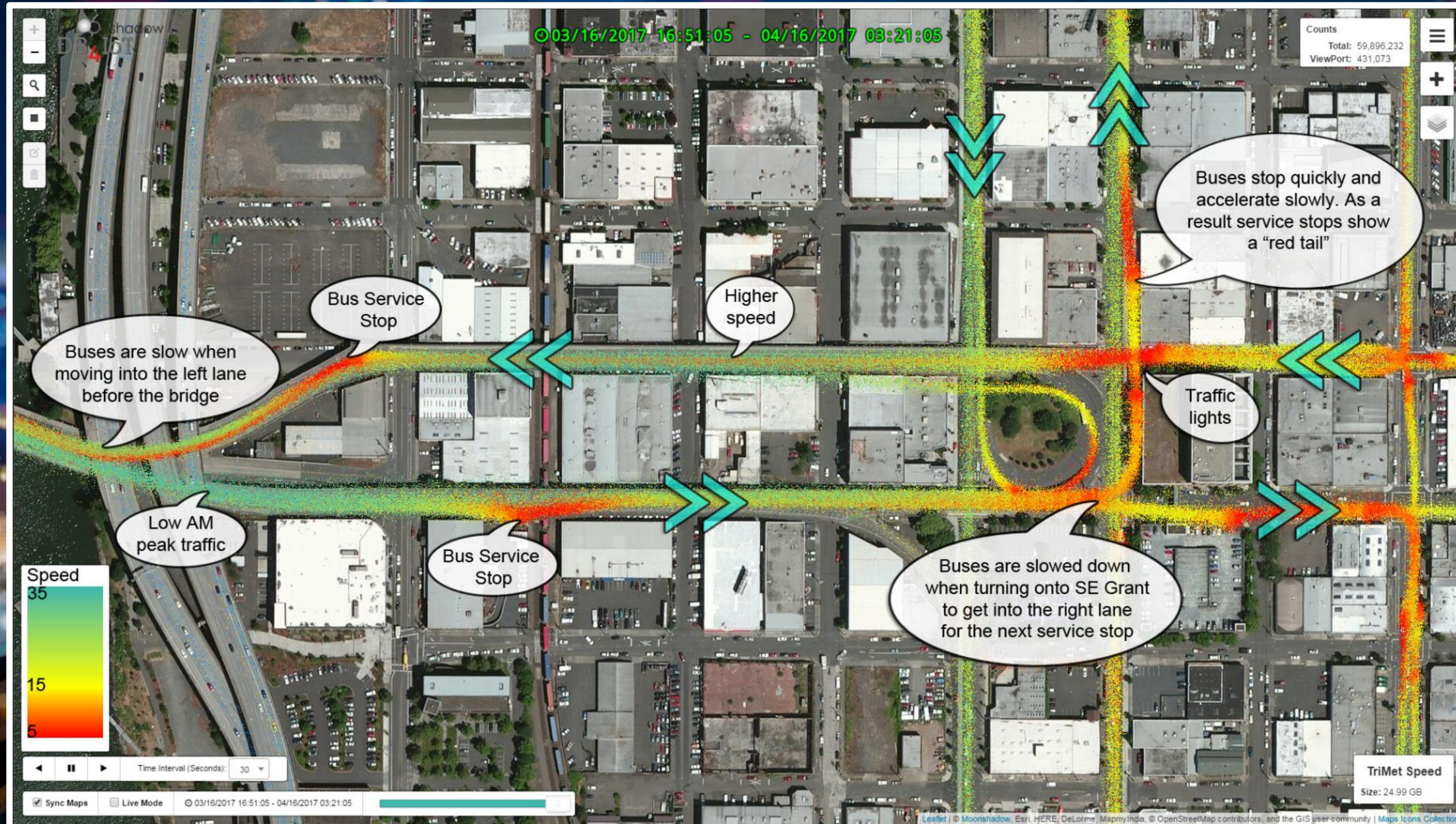
Examples:

**How Internet of Moving Things
Data Analytics and Visualization
Delivers Important Benefits**

Vehicle Speed Data: Every Dot is a Bus Recording



Conclusions from the Vehicle Speed Data

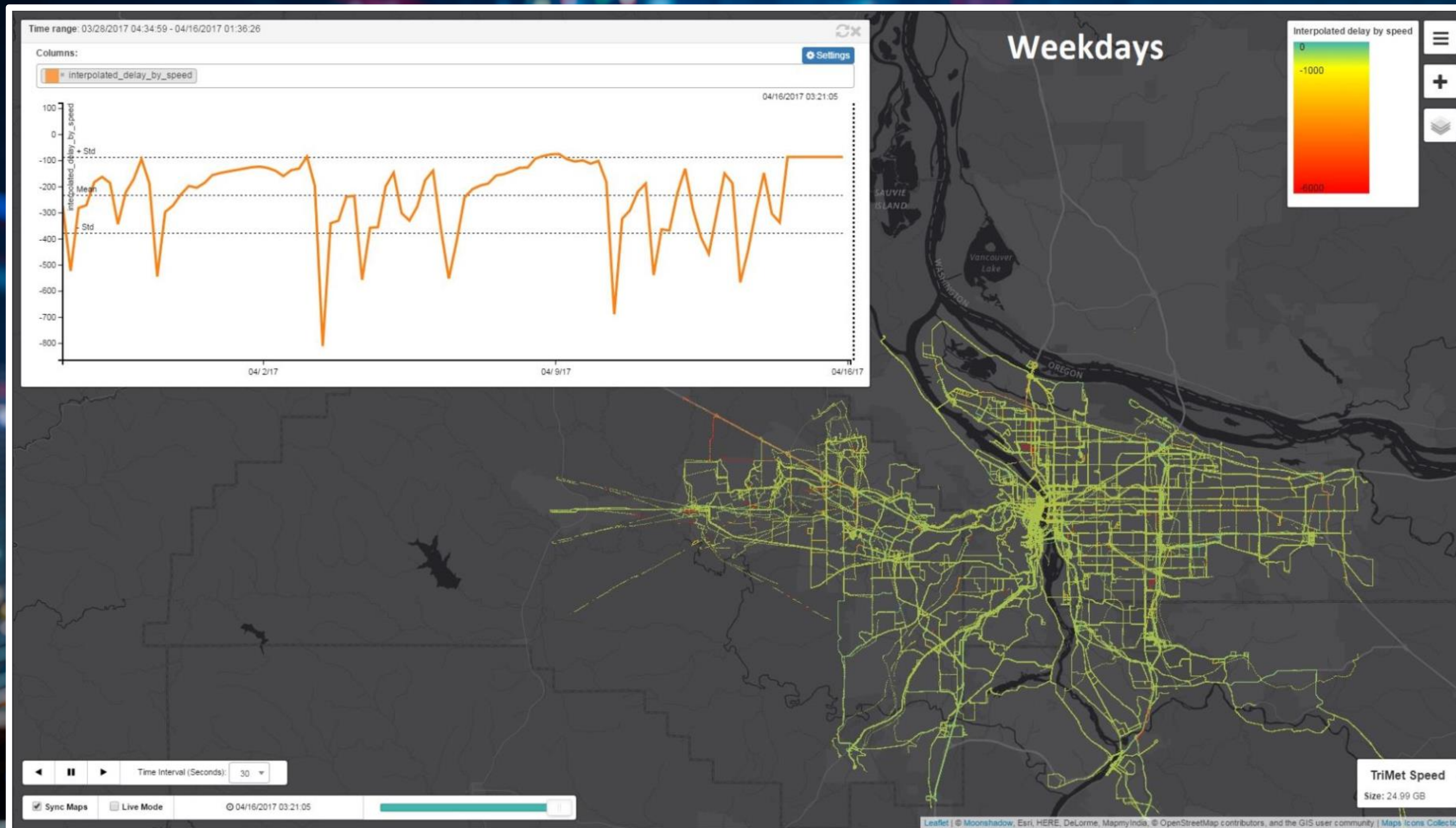


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Comparing Time Periods



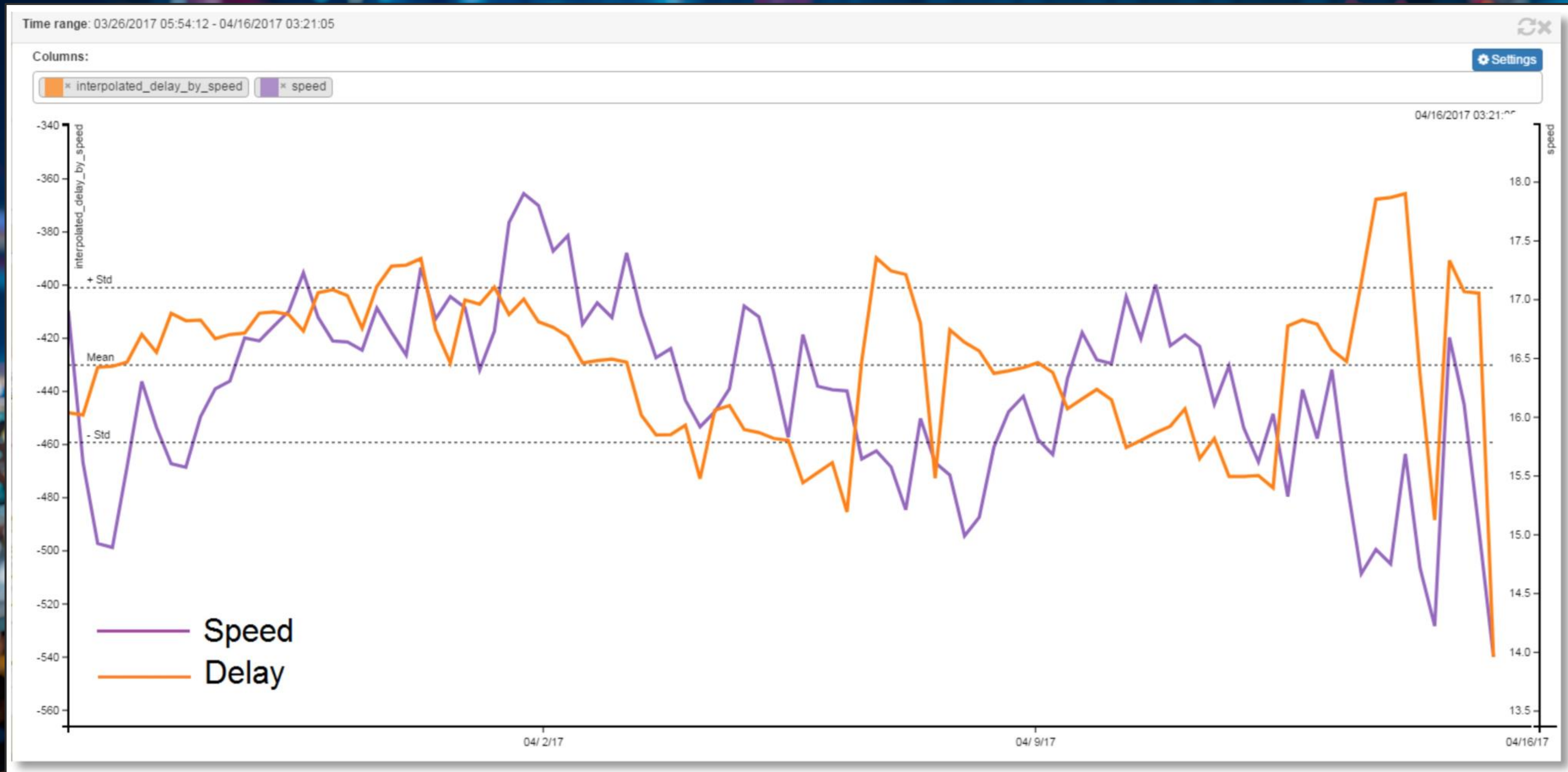
Delays for One Month on Weekdays



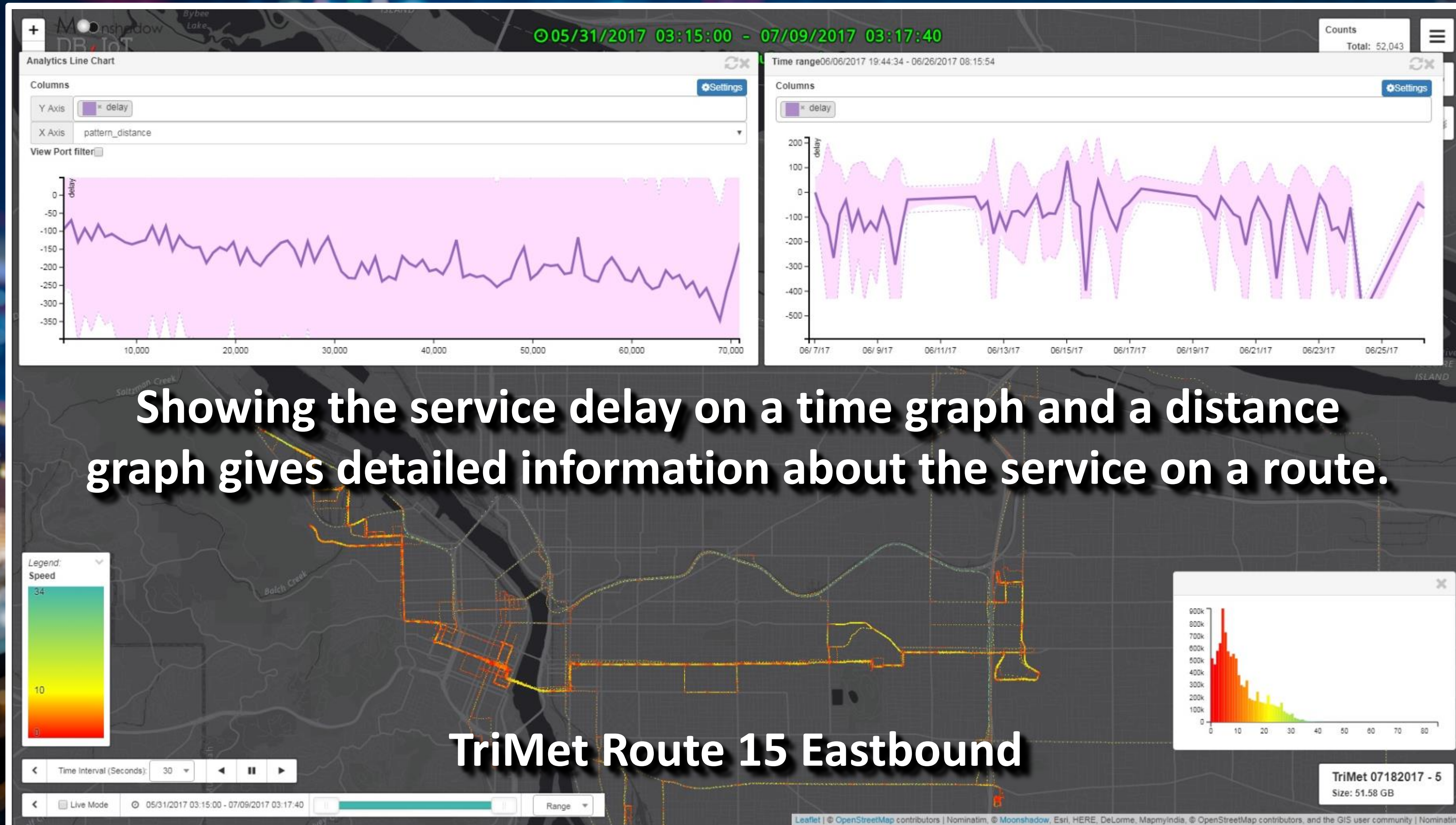
The Graph shows delays over time.

The Map shows delays over space.

Comparing Speed and Delay over Time



Route Delay by Route Distance

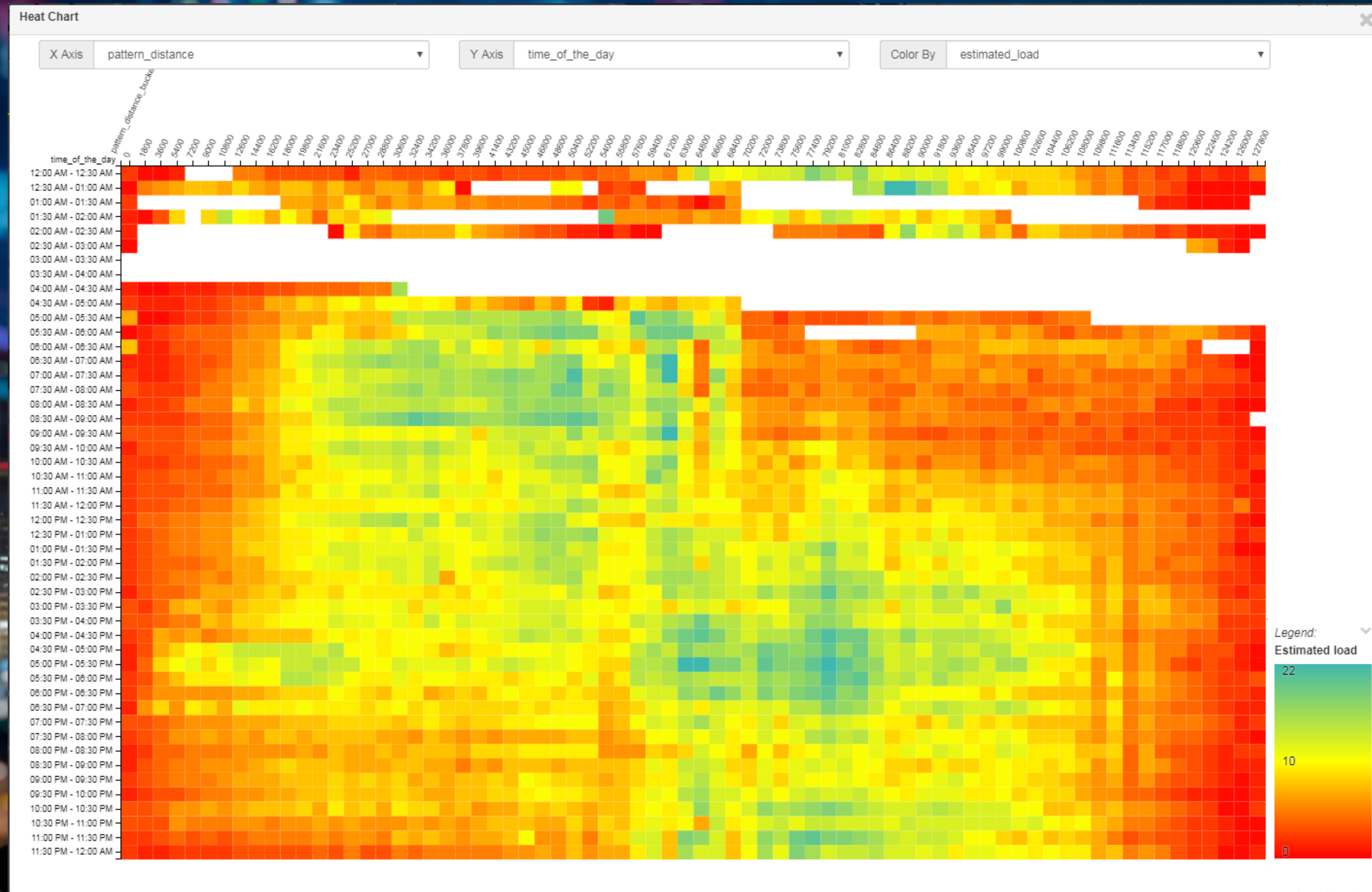


Showing the service delay on a time graph and a distance graph gives detailed information about the service on a route.

TriMet Route 15 Eastbound

Passenger Count by Time of Day and Route Distance

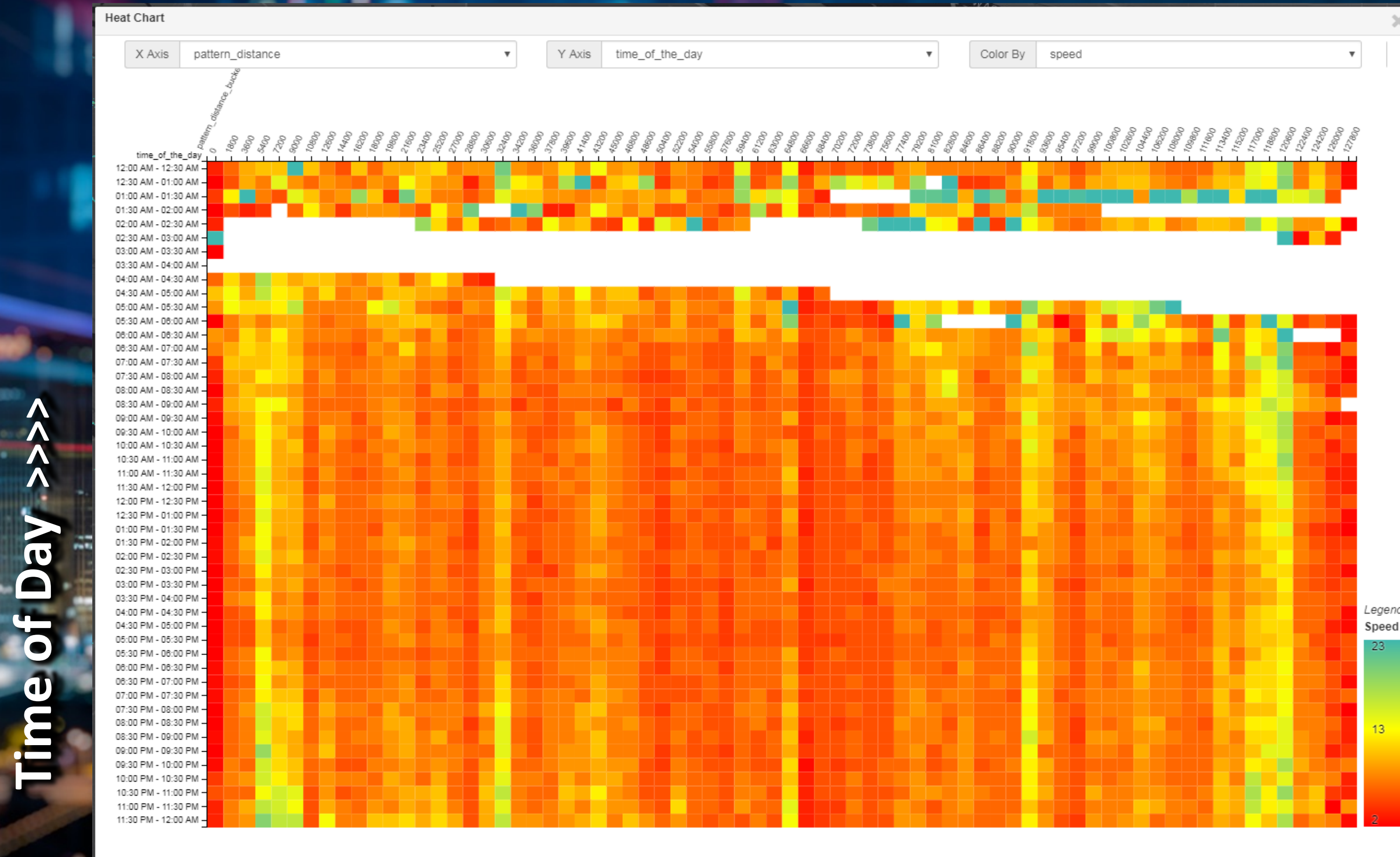
Time of Day >>>>



TriMet
Route 4
Eastbound
Weekdays

Distance along route >>>>

Speed by Time of Day and Route Distance

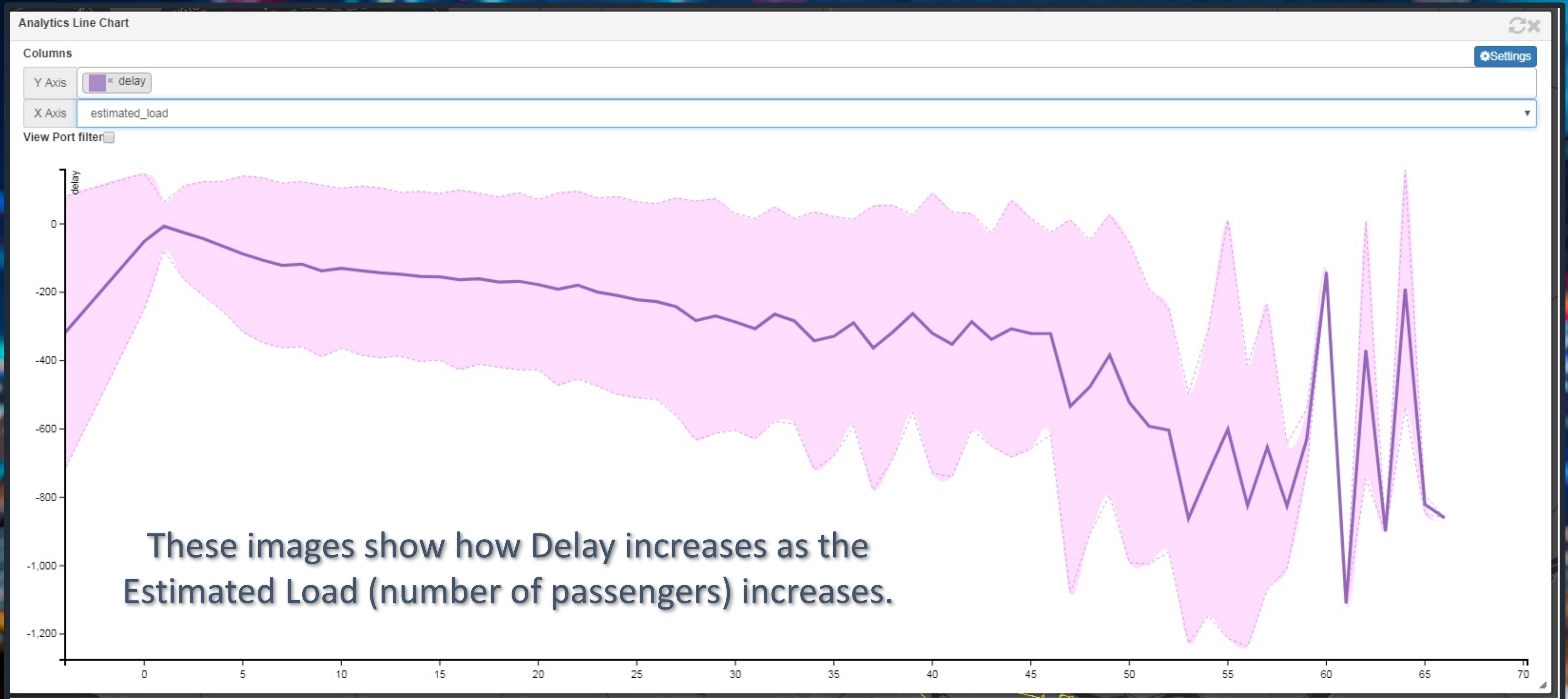


Time of Day >>>>

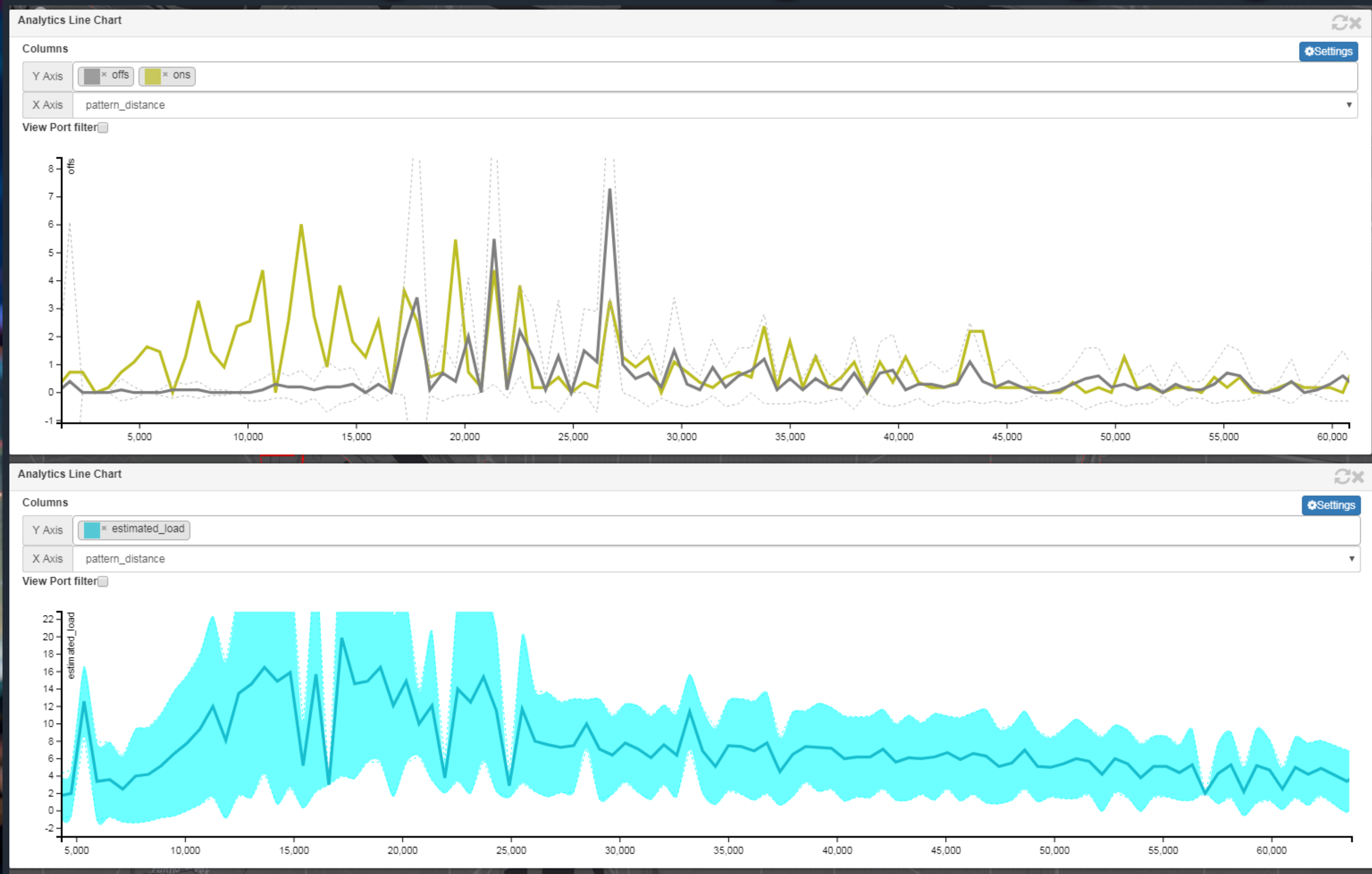
Distance along route >>>>

TriMet
Route 4
Eastbound
Weekdays

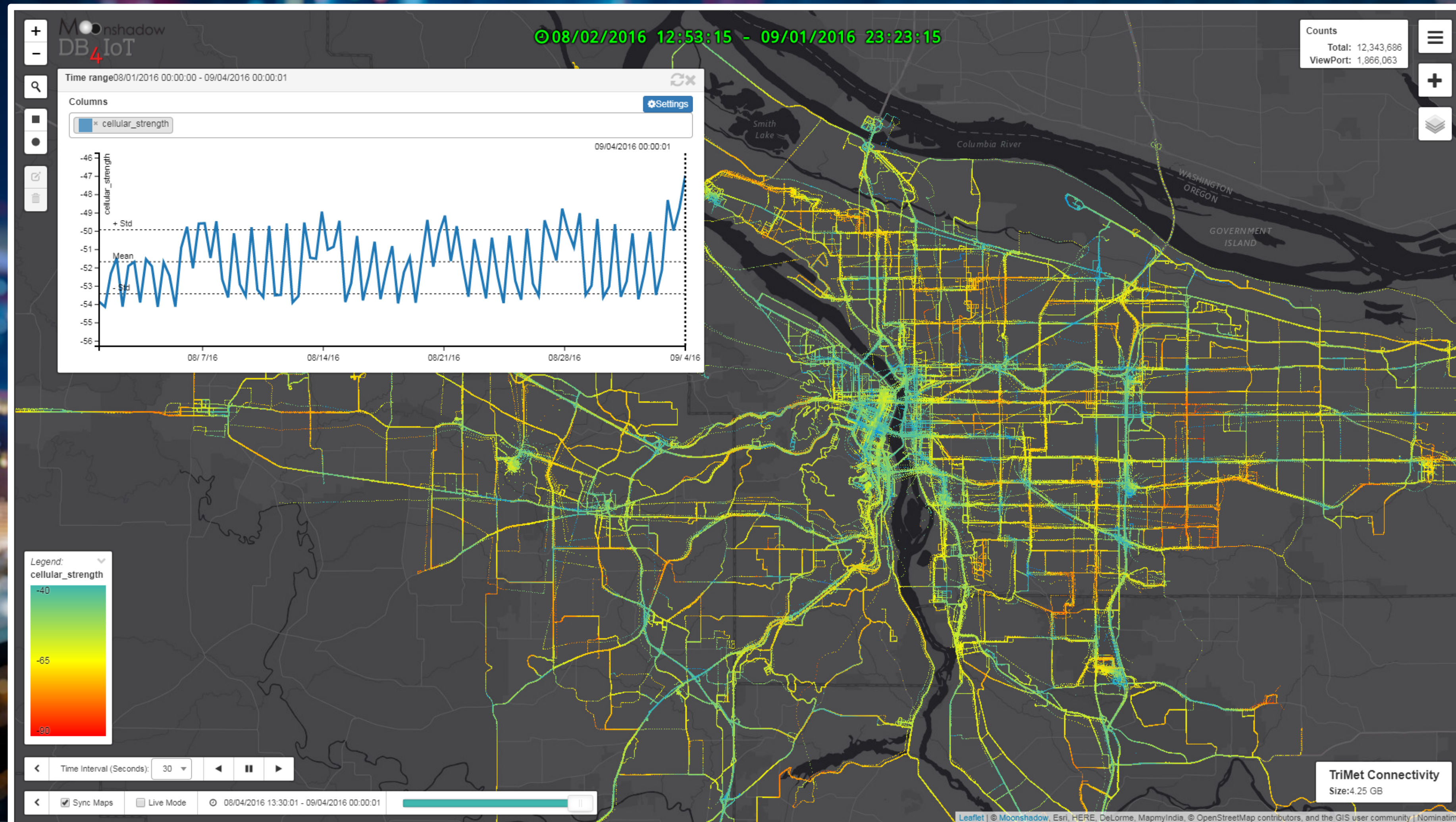
Bus Delay Versus Passenger Count



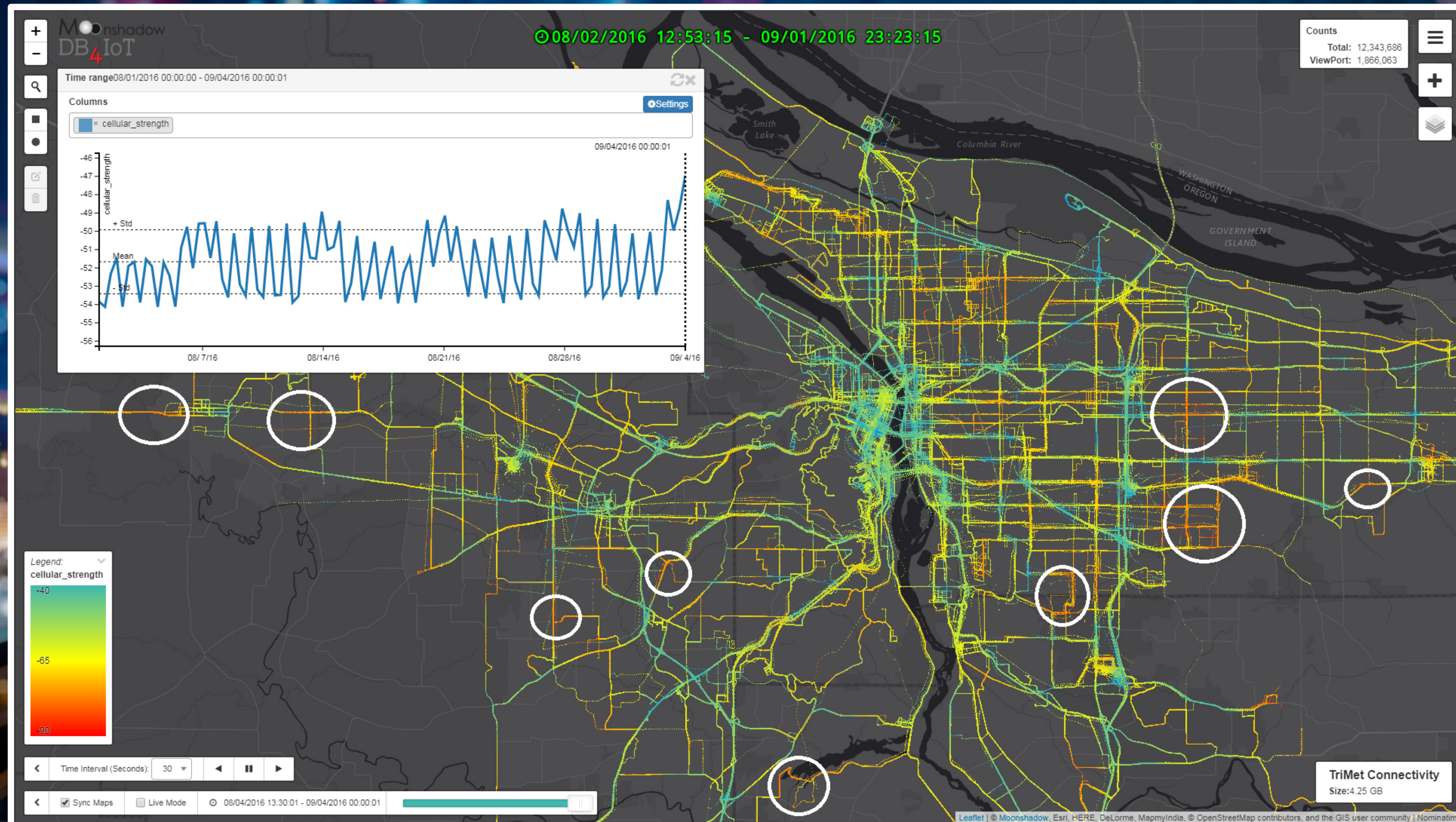
Passenger Boarding and Alighting



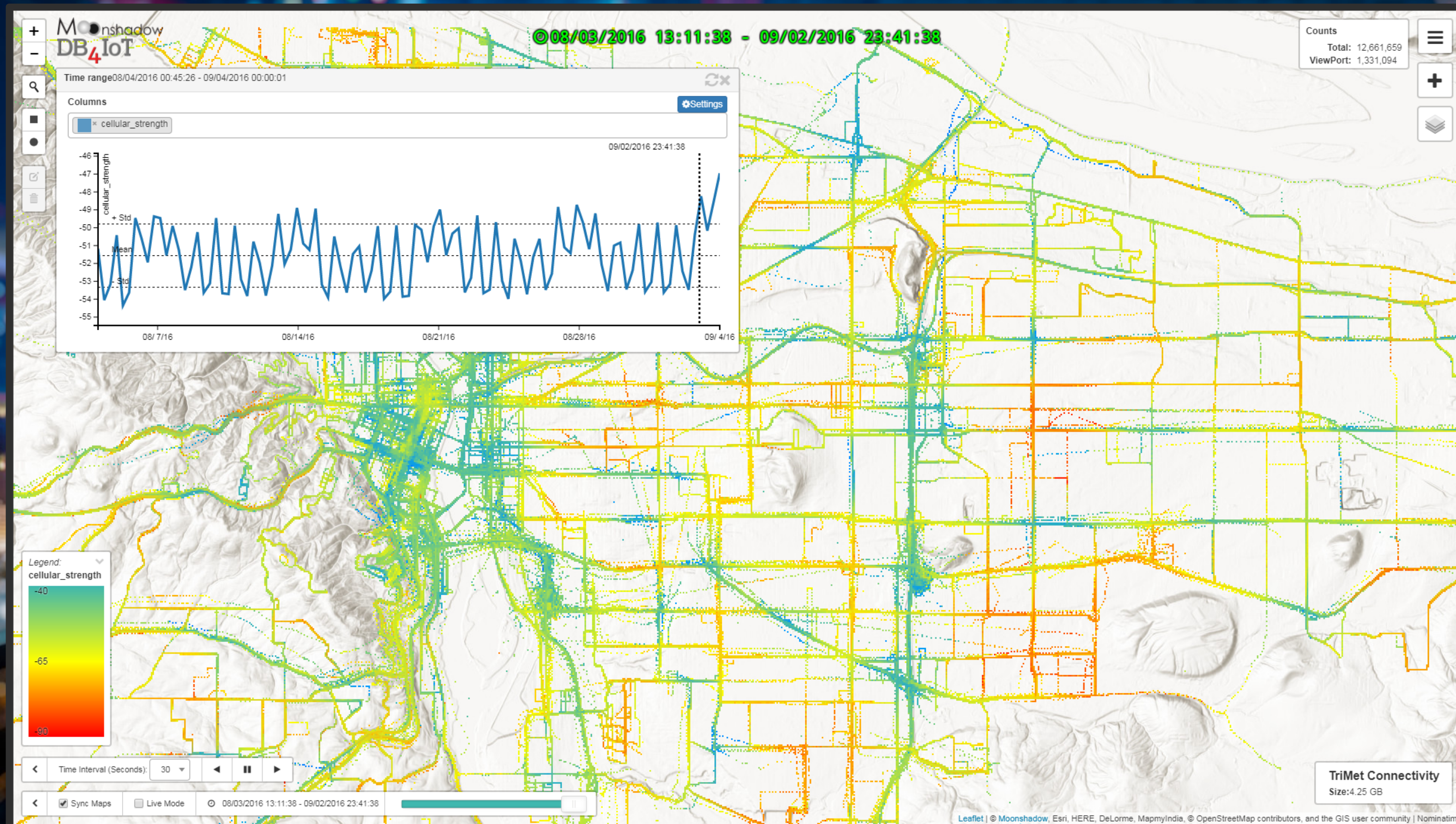
Cellular Connectivity over One Month



Cellular Connectivity: Bad Areas



Comparing Connectivity with Geography





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IoMT Data is **Bigger** Data

Leveraging IoMT Data

Provides Insights, Breakthroughs and Solutions
for Building Livable Communities with Public Transit

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Thank You

Technology

Moonshadow

Data

TRIOMET

Consultant

DKS

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