Using High-Penetration Probe Data to Improve Signal Operations

ITS Texas / TexITE Joint Meeting 2024

We help engineering teams make data-driven decisions.

We are team of specialists in machine learning, artificial intelligence, and software engineering, with over 50 years of experience in developing cutting-edge transportation solutions designed to make roadways cleaner, clearer, and safer for everyone.

Trusted By:

Seattle Department of Transportation

FDOT

Caltrans

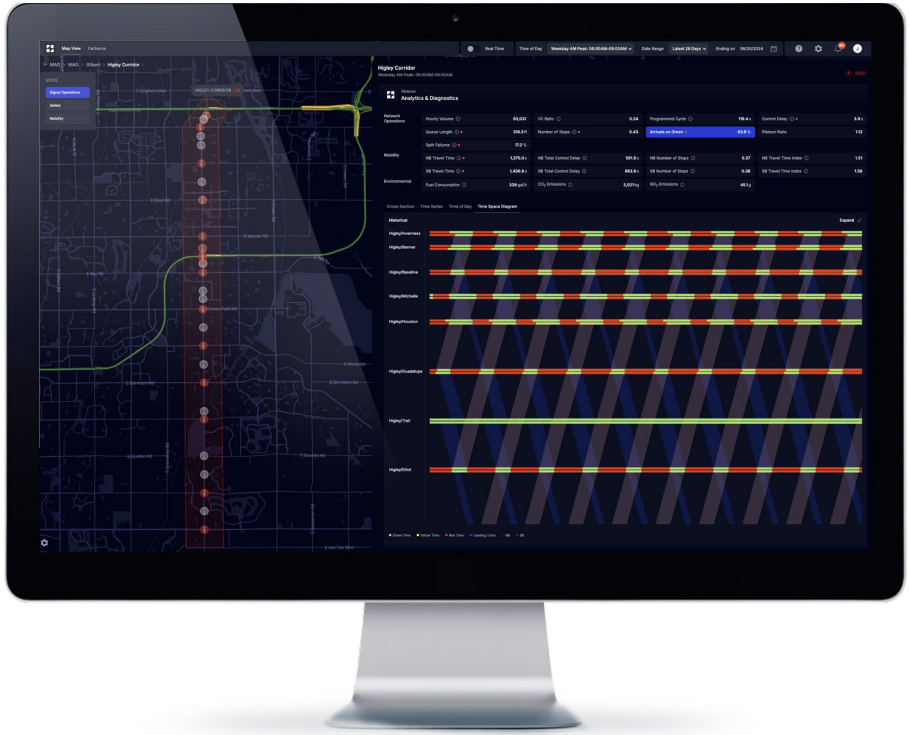
Maricopa Association of Governments

MARC Mid-America Regional Council

VDOT

Presentation Overview

- How poor quality data negatively impacts traffic signal management
- How agencies can generate high quality data today using probe data
- How to apply high quality data to signal operations



GPS DEVICES

tomtom

DASHCAMS

blyncsy

MOVEMENT DATA INTELLIGENCE

SMARTPHONES

MICHELIN MOBILITY INTELLIGENCE

arity

AIRSAGE

LOCUS

STRAVA

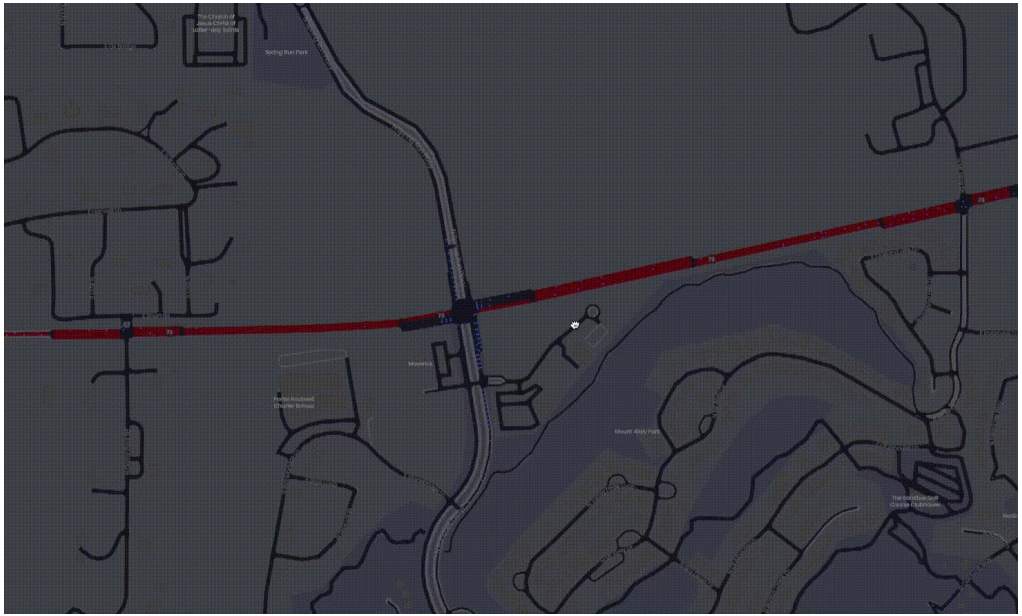
TELEMATICS DEVICES

GEOTAB

TIRE PRESSURE SENSORS

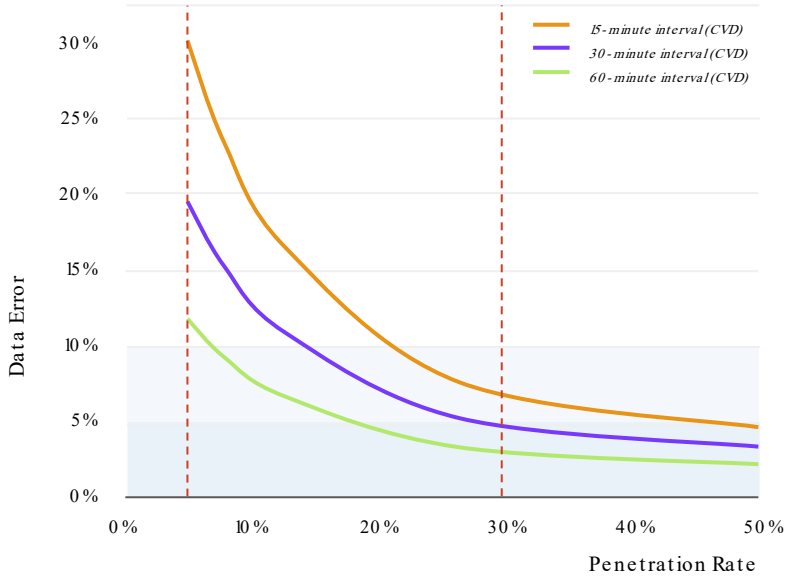
NIRA DYNAMICS

Probe data provides insights into vehicle movements and road user experience



PROBE DATA FOR SIGNAL OPERATIONS

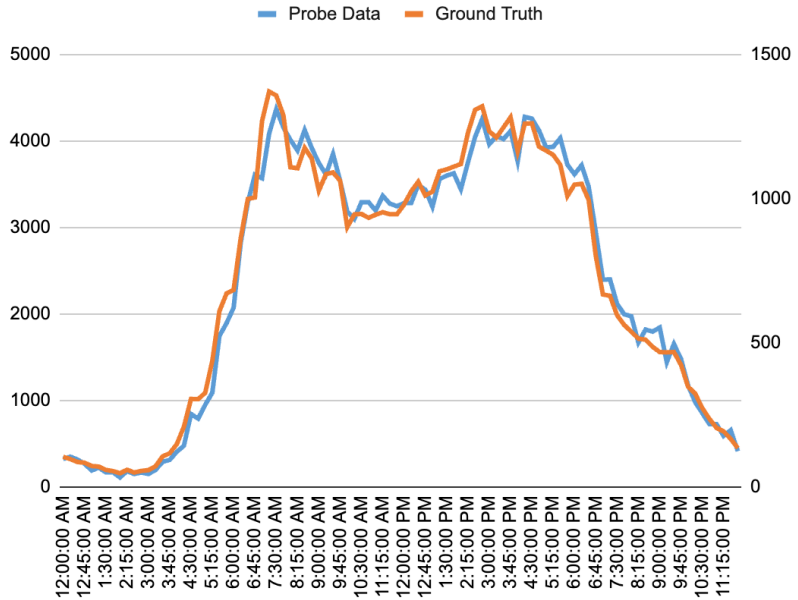
Penetration rates impact the consistency, accuracy, latency, and coverage of probe data



- High-penetration rates means consistently high data accuracy
- Higher coverage
- Lower data latency

HIGH- PENETRATION PROBE DATA

High-Penetration Probe Data (HPPD) can provide reliable, continuous data for traffic operations

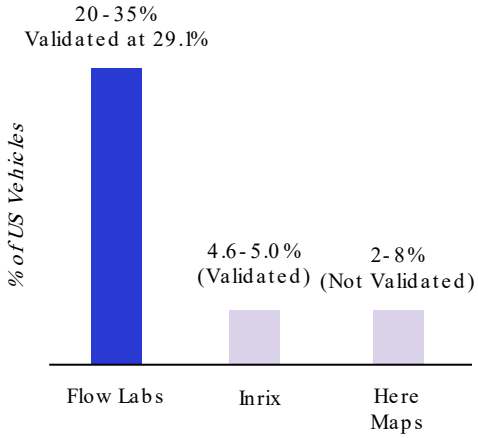


- Recently conducted validation by **Maricopa Association of Governments (MAG)**
- Comparison of Flow Platform data penetration rates comparing with **49 ground truth studies over 18 months** down to 15-minute granularity.
- **Average penetration rate of 29.1%**
- **Stable penetration rates across times of day, days of week, volumes.**
- **Average R^2 value of 0.97**

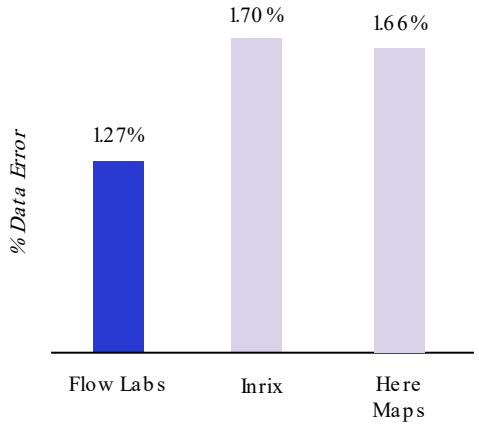
HIGH- PENETRATION PROBE DATA

Higher penetration means higher accuracy volumes and delay measures

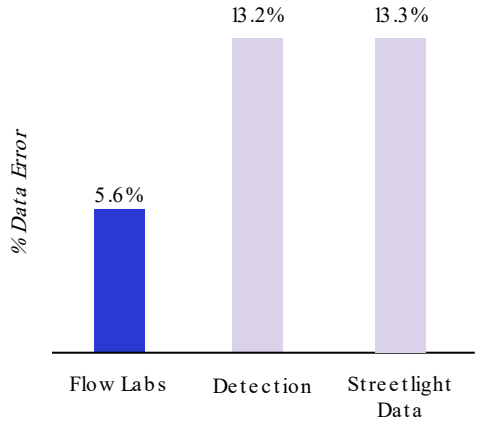
The Flow Platform captures the highest penetration rates in the industry today



Higher penetration rates result in lower data error for speed and delay measures



Higher penetration rates result in lower data error for volume and turning movement counts



PROBE BASED SIGNAL PERFORMANCE MEASURES (PBSPMs)

Probe data can provide detailed, important insights for traffic signal operations

SIGNAL OPERATIONS ANALYTICS

- Arrivals on Green (AOG)
- Split Failures
- Turning Movement Counts
- Green Time
- Volume Capacity Ratio
- Control Delay

INTERSECTION SAFETY ANALYTICS

- Vehicle Speeds
- Hard Braking/Acceleration
- Pedestrian & Bicycle Risk
- Crash & Fatality Rates

CORRIDOR MOBILITY ANALYTICS

- Travel Times
- Travel Time Reliability
- Number of Stops

ENVIRONMENTAL IMPACT

- Vehicle Emissions
- Fuel Consumption

TRAFFIC SIGNAL MANAGEMENT

Traffic signal management requires a lot of work

Proactive Monitoring

- Proactive Corridor Monitoring
- Alerting & Notifications
- Detection Health Monitoring
- Corridor Prioritization
- Reporting

Analysis and Diagnostics

- Real-Time Analysis
- Historical Analysis
- Turning Movement Counts
- Intersection Safety Analytics
- Multi-Modal Analytics

Signal Optimization

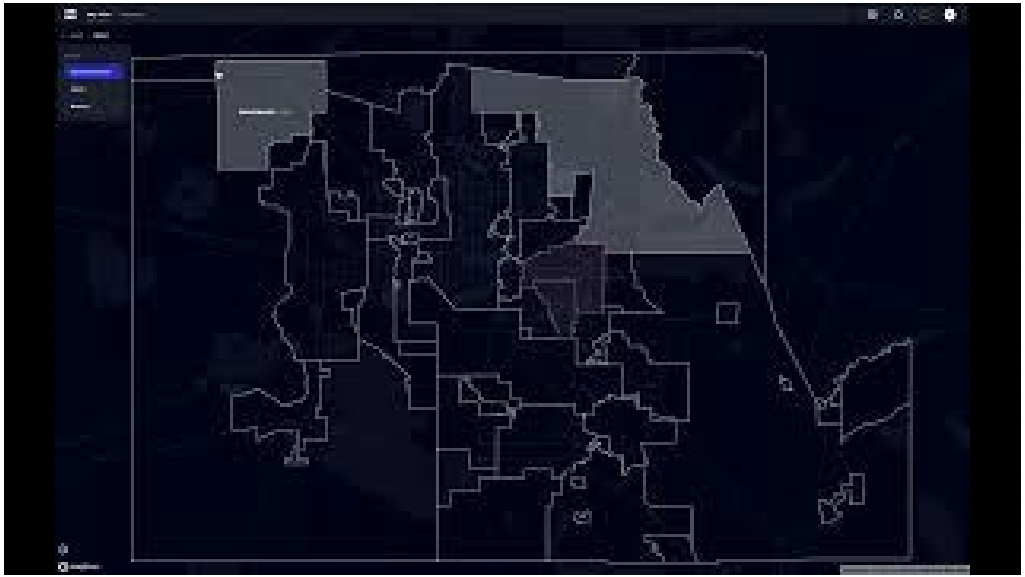
- Timing Plan Optimization
- Time-Space Diagrams
- Signal Timing Recommendation
- Signal Performance Prediction

Benefit-Cost Analysis

- Mobility Impact
- Safety Impact
- Operations Impact
- Emissions Impact
- Economic Impact and Dollarized ROI
- Reporting

USE CASES

Instantly identify signal problems and prioritise corridors



Today, agencies and engineering teams are using Cerberus to:

1. **Proactively Identify Signal Operations Issues:**
   a. Generate Daily/Weekly/Monthly alerts and notifications
   b. Generate real-time incident alerts
   c. Monitor trends
2. **Generate Health Scores and Prioritize Signals**
   a. Create custom scoring systems on-the-fly
   b. Allocate resources effectively
3. **Prioritise Corridors for Retiming**

Key Benefits

- Identify issues instantly
- Prioritise corridors automatically
- Eliminate routine maintenance visits

USE CASES

Streamline data collection and vehicle turning movement counts

	Manual Counts	Pneumatic Tubes	Video Sensors	High Penetration Probe Data
Pedestrian Counts	Yes	No	Yes	NO
Vehicle Classification	Yes	Yes (but limited accuracy)	Yes	NO
Total Time for Data Collection	On-site presence for multiple staff. 3-5 days	Setup, removal, data processing. 3-4 days	Setup, removal, data processing. 3-4 days	24 hours
Ordering Lead Time	1-2 Weeks	1-3 Weeks	2-8 Weeks	24 hours
Timeframe	2-8 hours	24-48 hours	24 hours - 1 month	1Month
Vehicle Count Accuracy	**98.5%**	**90-95%**	**84-98%**	**92-97%**
Cost	**$300 -500**	**$500 -1,200**	**$500 -2,000**	**$75-150**

Simple, intuitive, comprehensive analytics and diagnostics provide complete regional visibility

Today, agencies and engineering teams are using Abacus to:

1. **Visualize Data for their Traffic Signals**
2. **Generate Data for Reporting Purposes**
   a. Easy data export options
   b. Easy chart export options
3. **Diagnose Signal Timing Issues**
   a. Conduct diagnostic analysis
   b. Conduct trend analysis

Key Benefits

- Eliminate unnecessary fieldwork including drive tests
- Identify root causes faster
- Streamline reporting

USE CASES

Conduct a rapid before and after analysis of any signal - related project

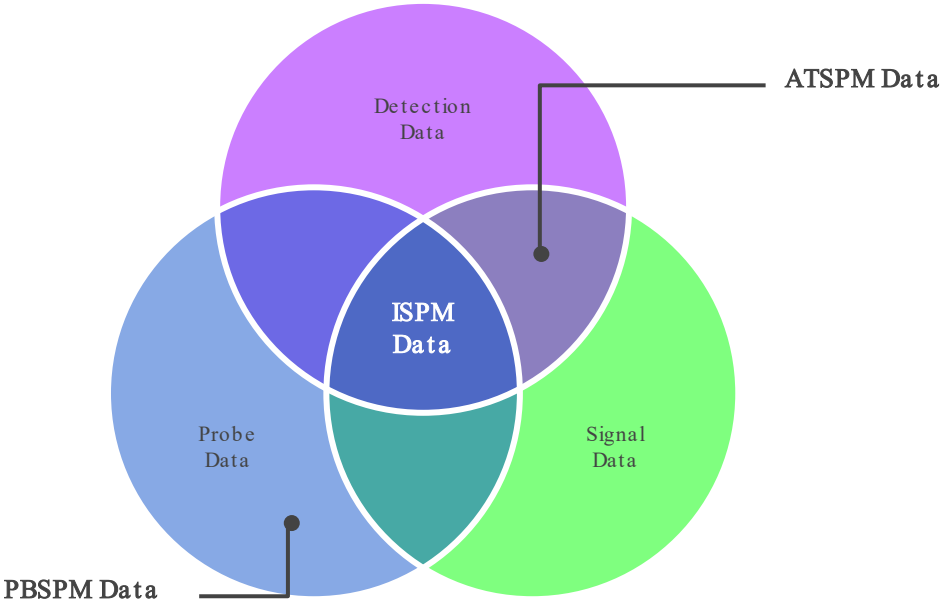
Today, agencies and engineering teams are using Litmus to:

1. **Generate Before-After Analyses**
   a. Easy data export options
   b. Simple attribution of changes
2. **Fine-Tuning Signal Timing Changes**
3. **Project Reporting and Grant Funding**

Key Benefits

- Measure ROI of signal-related projects
- Capture more buy-in and secure funding
- Streamline reporting

Integrating HPPD and ATSPM data can provide consistent, comprehensive data for signal operations



- **Probe Data:** Capture historical and real-time data directly from vehicles.
- **ATSPM Data:** Capture data from detection devices and controller logs.
- **NTCIP Data:** Capture data from controller configurations.

PROBE BASED SIGNAL PERFORMANCE MEASURES (PBSPMs)

Probe data can provide detailed, important insights for traffic signal operations

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- Split Failures
- Turning Movement Counts
- Green Time
- Volume Capacity Ratio
- Control Delay
- Phase Terminations
- Signal Timings
- Pedestrian Delay

INTERSECTION SAFETY ANALYTICS

- Vehicle Speeds
- Hard Braking/Acceleration
- Pedestrian & Bicycle Risk
- Crash & Fatality Rates
- Red Light Running (RLR)
- Dilemma Zone Entry (DZE)

ASSET HEALTH & MONITORING

- Detector Health
- Controller Health
- Ped Push Button Health

CORRIDOR MOBILITY ANALYTICS

- Travel Times
- Travel Time Reliability
- Number of Stops

ENVIRONMENTAL IMPACT

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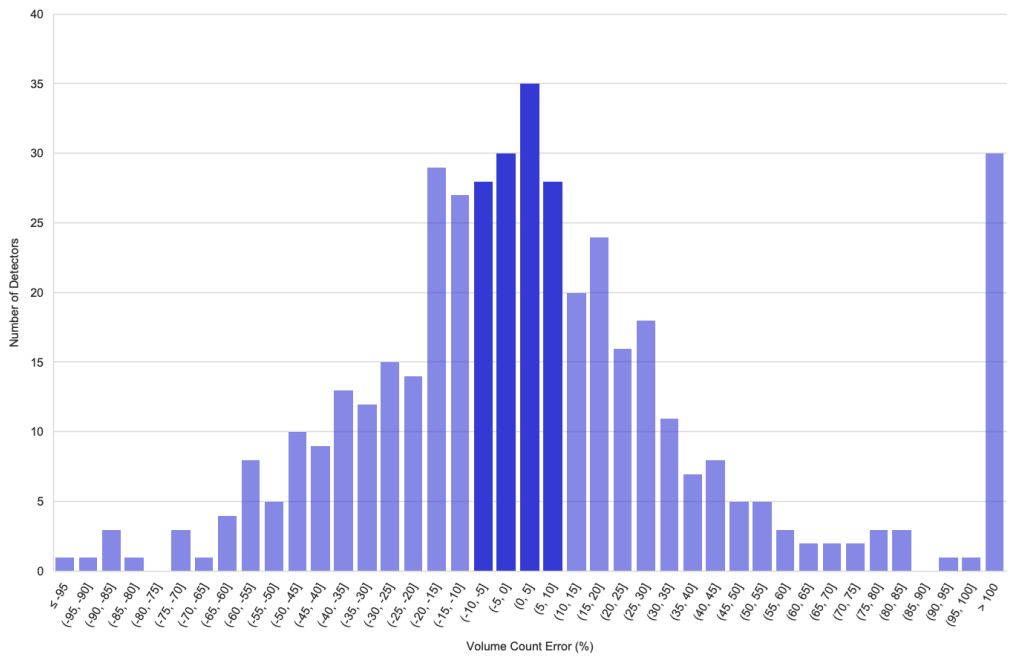
USE CASES

Detection data is inaccurate, which leads to poor traffic signal performance



- Largest detection quality study in the United States in collaboration with **Utah Department of Transportation** studying 435 detectors.
- Average accuracy of **86.8%**
- **Less than 27.8%** were generating data accurate to greater than 90%.

USE CASES

Bad detection means bad performance for all signal systems

Bad Detection Impacts Signal Controllers:

- **50% of signal operation issues** are caused by poorly performing detection

Bad Detection Impacts Signal Performance Measures:

- Of the proactive alerts that were captured by these systems, **49.3% were false alarms.**
- Because of poor data quality, these systems **missed 83.1% of major issues**.

USE CASES

Instantly identify broken, or inaccurate detection and still provide accurate data

Today, agencies and engineering teams are using Detection Health to:

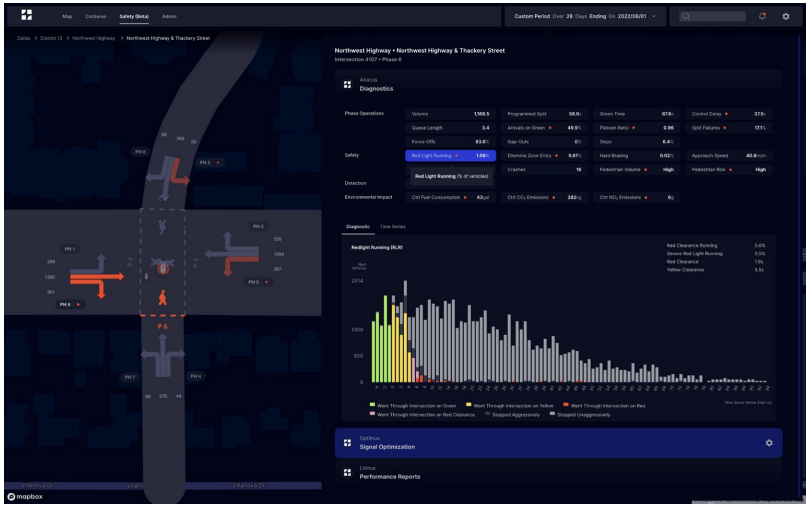
1. **Proactively Monitor Detection**
2. **Prioritize Detection Maintenance**
3. **Measure accuracy of detection technologies**

Key Benefits

- Identify issues instantly
- Prioritise maintenance
- Improve data quality

USE CASES

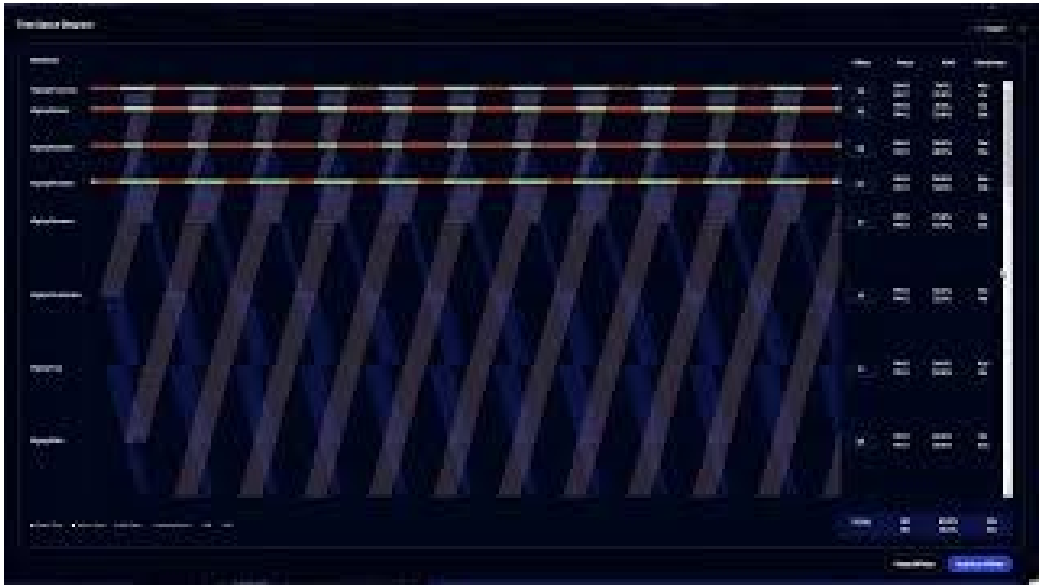
Capture Red Light Running (RLR) without requiring any hardware devices



- **ATSPMs** capture hi-resolution data on signal and detection events at intersections.
- Combining probe data with signal data enables the capture of Red Light Running (RLR) and Dilemma Zone Entry (DZE) without requiring any hardware.
- Use diagnostic tools to identify suitable clearance rates.

USE CASES

Instantly optimize signalized corridors just using probe data



Today, agencies and engineering teams are using Optimus to:

1. **Streamline Signal Optimization Processes**
2. **Predict Signal Timing Change Impacts**
3. **Optimize Corridors for Safety**

Key Benefits

- Reduce signal timing costs and time
- Improve mobility and roadway safety
- Eliminate unnecessary signal timing projects

ACCESSING DATA

At Flow Labs we're making accessing data and insights easier than ever for agencies and engineering firms

Making it easier than ever for agencies to access data quickly and affordably:

1. **Flexible and Affordable Pricing**
2. **Short-Term Data Subscriptions**
3. **Historical and Live Data**
4. **Rapid Deployment**

Get in touch!

sales@flowlabs.ai

Summary

- High-penetration probe data is a necessity for agencies to ensure coverage, accuracy, and redundancy.
- Integrated data can ensure the highest quality of data for mission-critical applications including real-time operations.
- Use accurate digital twins for decision support and accelerate engineering productivity.

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Say Hello to Optimus LT

Expanding Access to AI-Powered Signal Timing with Optimus LT

Flow Labs