LIVE:TRAFFIC:DATA™
A REVOLUTION IN TRAFFIC INFRASTRUCTURE

CMAP RTOC

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OVERVIEW

➢ We connect to **all** of your signalized **intersections**, we do not interfere with traffic signal operation – we only collect data.

➢ We generate essential ***performance measures***, using queue length processing,* that agency traffic engineers can use to better manage signalized arterial roadways:

  ➢ Comply with MAP-21 / FAST Performance Measure requirements to qualify for federal funding;

  ➢ Online Real-Time performance monitoring and Off-Line analysis tools;

  ➢ Travel-time & Queue Length;

  ➢ Reduce congestion, fuel consumption, carbon footprint and increase safety.

➢ Our unique approach allows us to connect to any signalized intersection in North America.

➢ Our technology provides accurate traffic flow & traffic signal sequence data to a growing ecosystem of companies that seek to move traffic, people and goods safely & efficiently.

LIVE TRAFFIC DATA LLC

"Queue Length Processing (QLP) is the only way to calculate the accurate wait time of vehicles at traffic lights and deliver ALL the data needed for generating accurate travel times on signalized arterial corridors..."

* U.S. Patent No. 8,279,086

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Problem: High Levels of Congestion and Lost Productivity

- **FHWA has identified some of the principal causes of congestion**

  – **Bottlenecks** - responsible for over 40% of urban congestion

  – **Signal Timing** - responsible for up to 10 % of traffic delay

- According to the 2015 Urban Mobility Scorecard*, congestion caused **6.9 billion hours of delay** in 2014 and **3.1 billion gallons of wasted fuel** with a nation-wide annual cost of **$160 billion** or about $960 per commuter

- **Congestion leads to:**
  - productivity losses from traffic delays
  - Increased air pollution
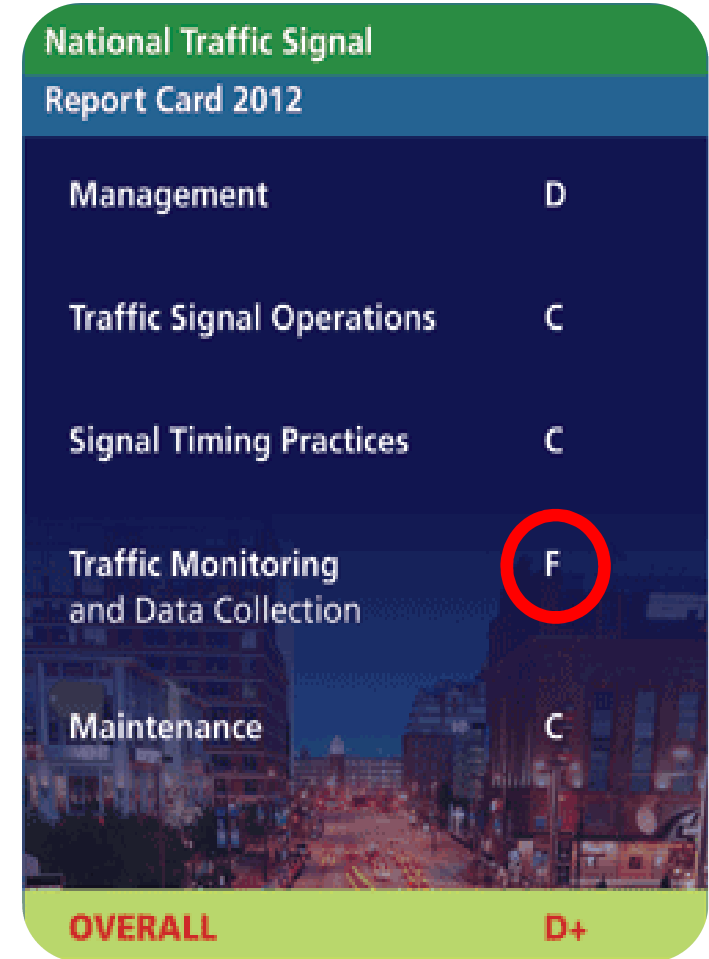 - increased accidents and need for added emergency services

* Texas Transportation Institute Urban Mobility Scorecard published in August 2015   (http://mobility.tamu.edu/ums/)

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Problem: Lack of Funds at Transportation Agencies

The lack of funds has led NTOC to assign a self-assessed Failing Grade on Traffic Monitoring and Data Collection*

- Manual data collection and processing is time-consuming and expensive

- Operational data is neither stored nor analyzed

- Lack of monitoring and analysis tools

- Need for performance measures

¨Transport planners recognize that adding or **expanding roads** quickly induces additional demand, providing **only temporary relief to congestion**¨**

National Traffic Signal
Report Card 2012

Management	D
Traffic Signal Operations	C
Signal Timing Practices	C
Traffic Monitoring and Data Collection	F
Maintenance	C
OVERALL	**D+**

*   Latest report released – National Transportation Operations Coalition, 2012 National Traffic Signal Report Card.
** Mckinsey Global Institute, ¨How to Save $1 Trillion a Year, ¨2013.

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UNIQUE Approach Enables Us to Connect to Any Signalized Traffic Intersection

Supports All Controller Types

✓ NEMA, 170/2070, …

- **Econolite**
- **Siemens**
- **McCain**
- **Peek**
- **Trafficware (Naztec)**
- **Intelight**
- **…**

Supports All Detector Types

✓ Loop

✓ Video

✓ Radar

✓ Magnetic

✓ Hybrid

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UNIQUE Hardware Solution

Gather traffic signal status and traffic flow data

Data Collection Unit (DCU) hardware

- Cabinet hardened plug-and-play device
- Works with all traffic controller cabinets in the U.S. and Canada (TS-1, TS-2, 170/2070)
- No interference with existing signal control
- Works with all vehicle detection devices
- Work with existing detector layouts—no customization required
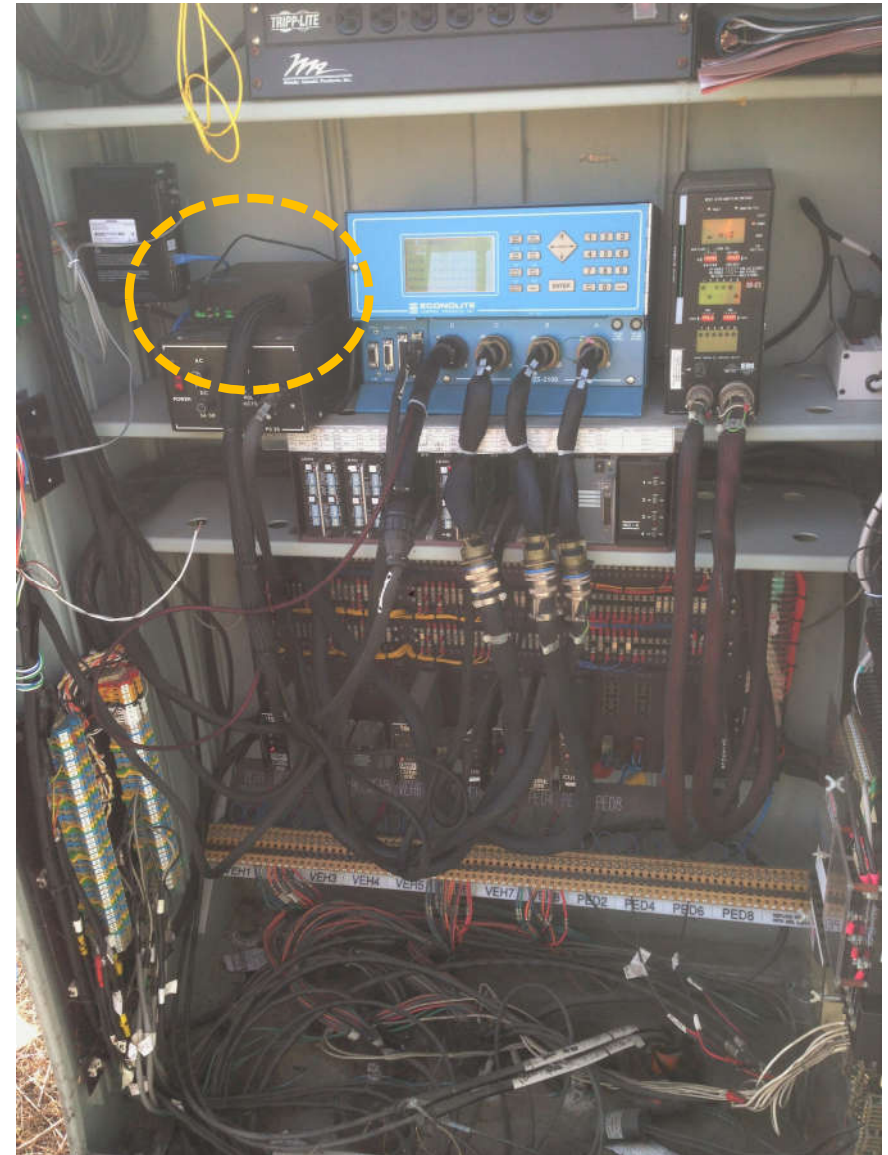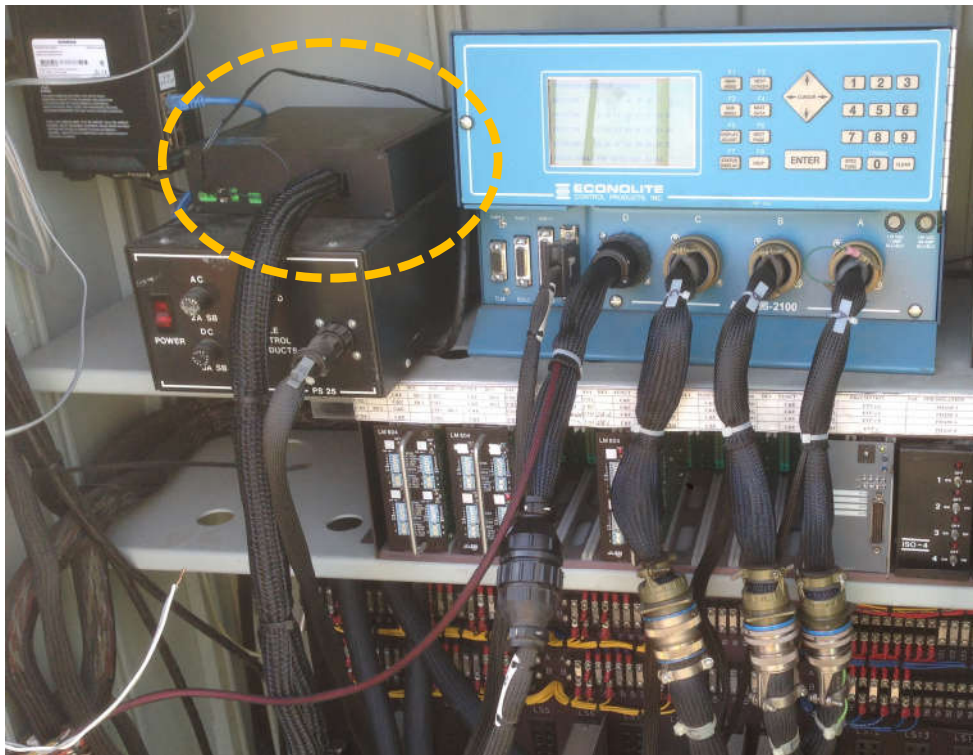- Fiber / Ethernet / serial and wireless communication environments

Field Implementation

🚦 # TS-2 type cabinets
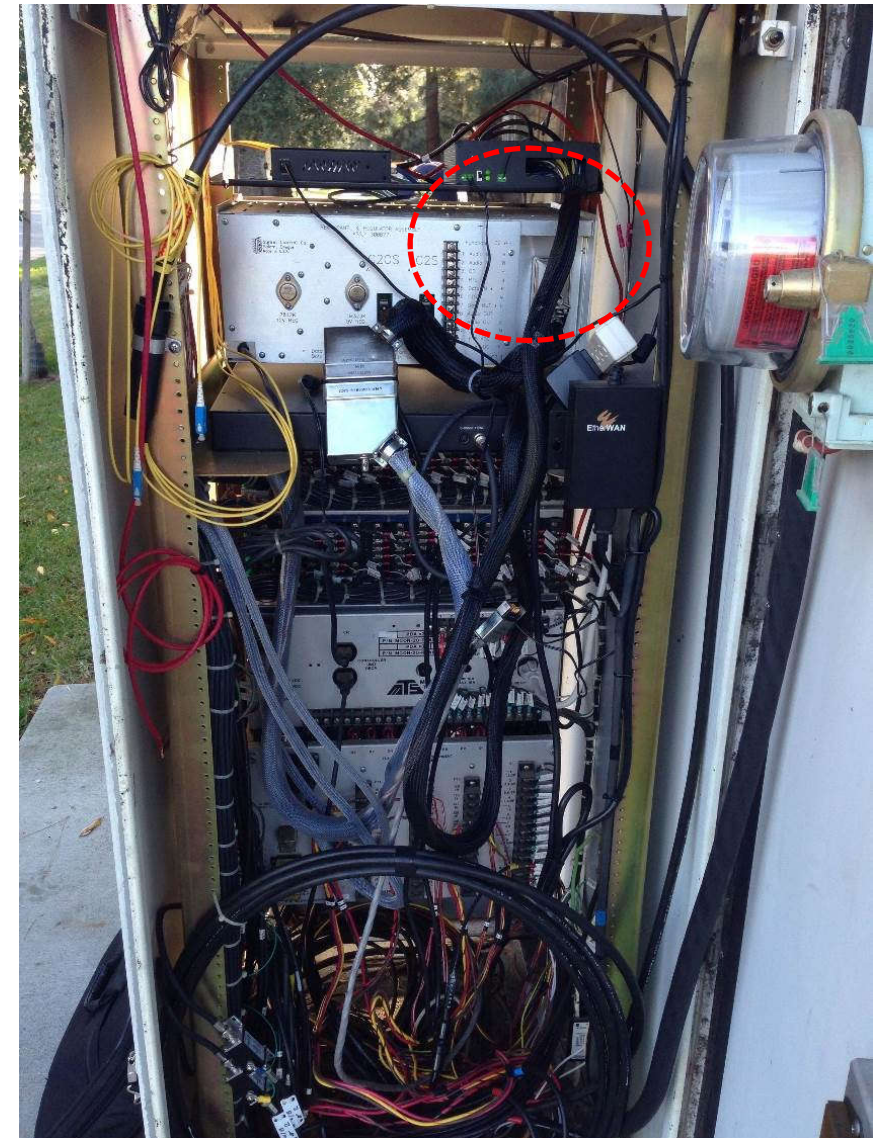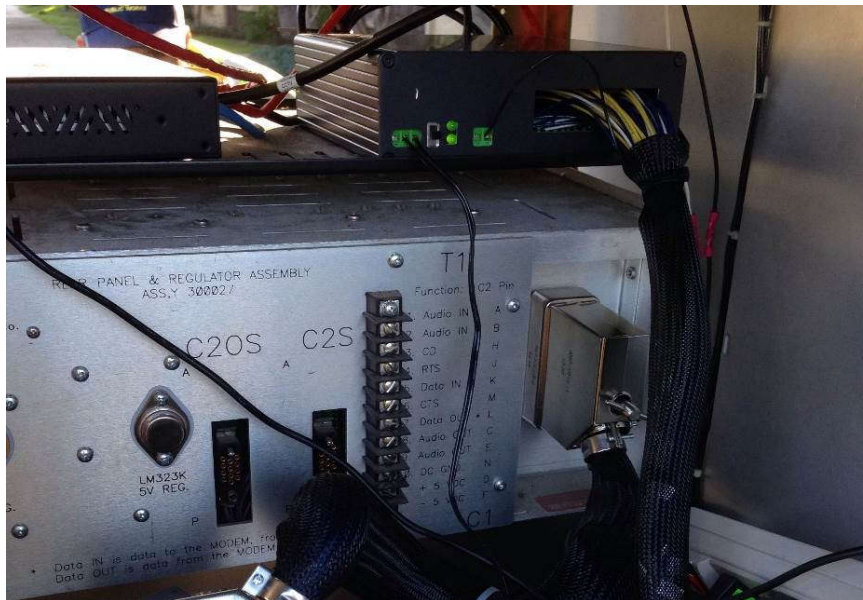
➢ ### Cabinet SDLC bus line
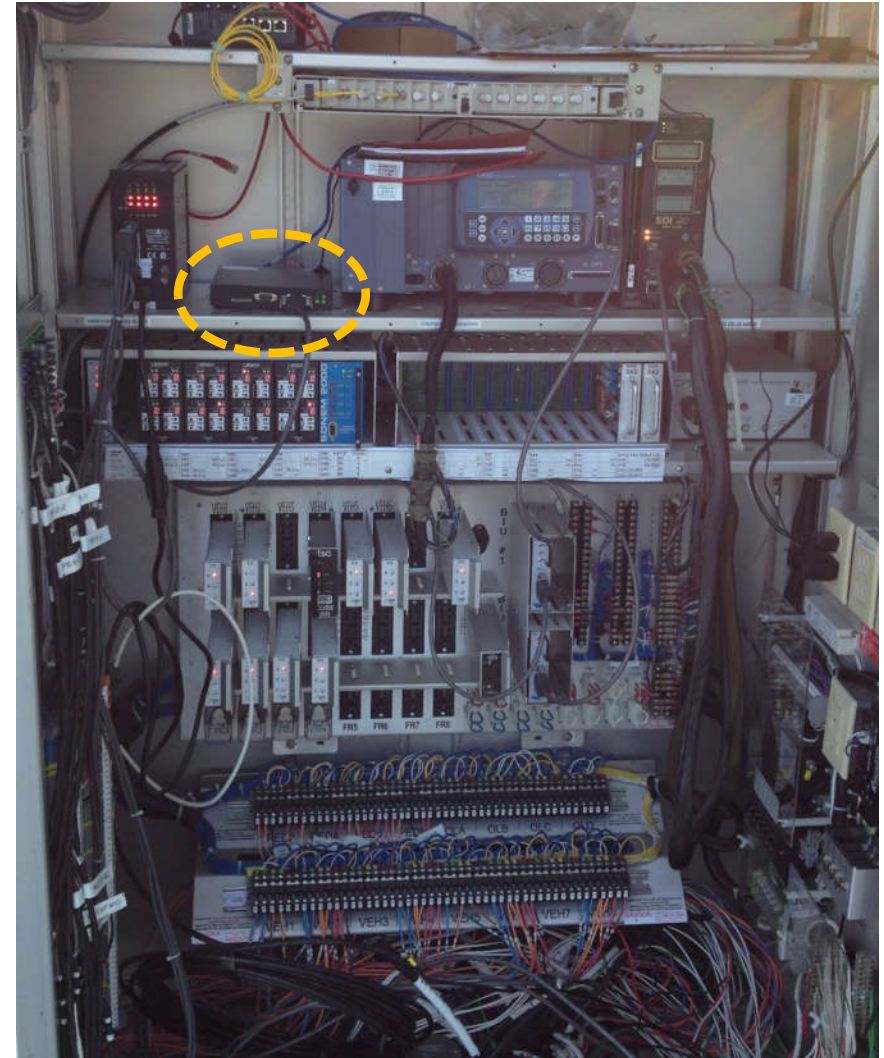
Field Implementation
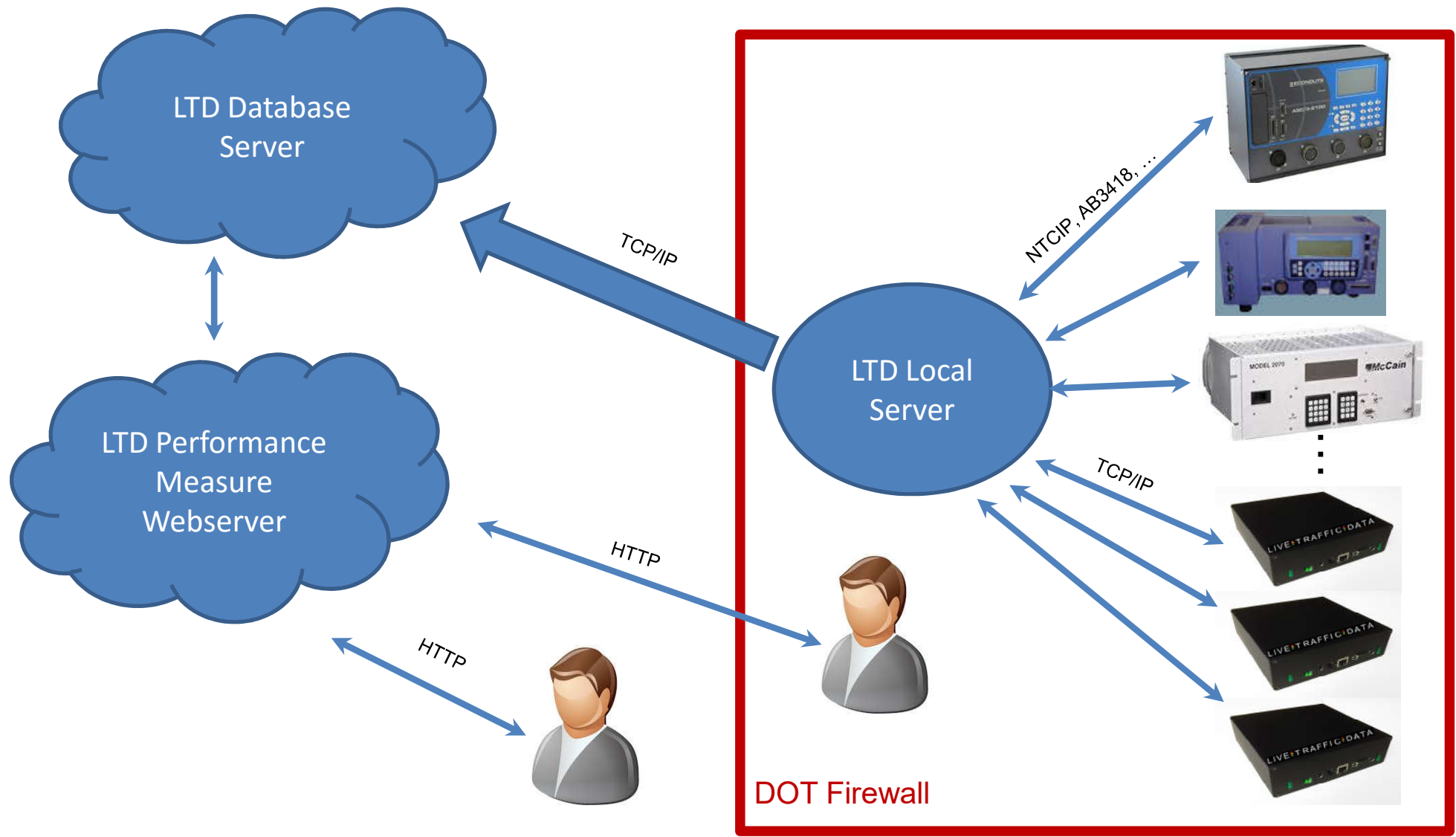
TS-1 type cabinets
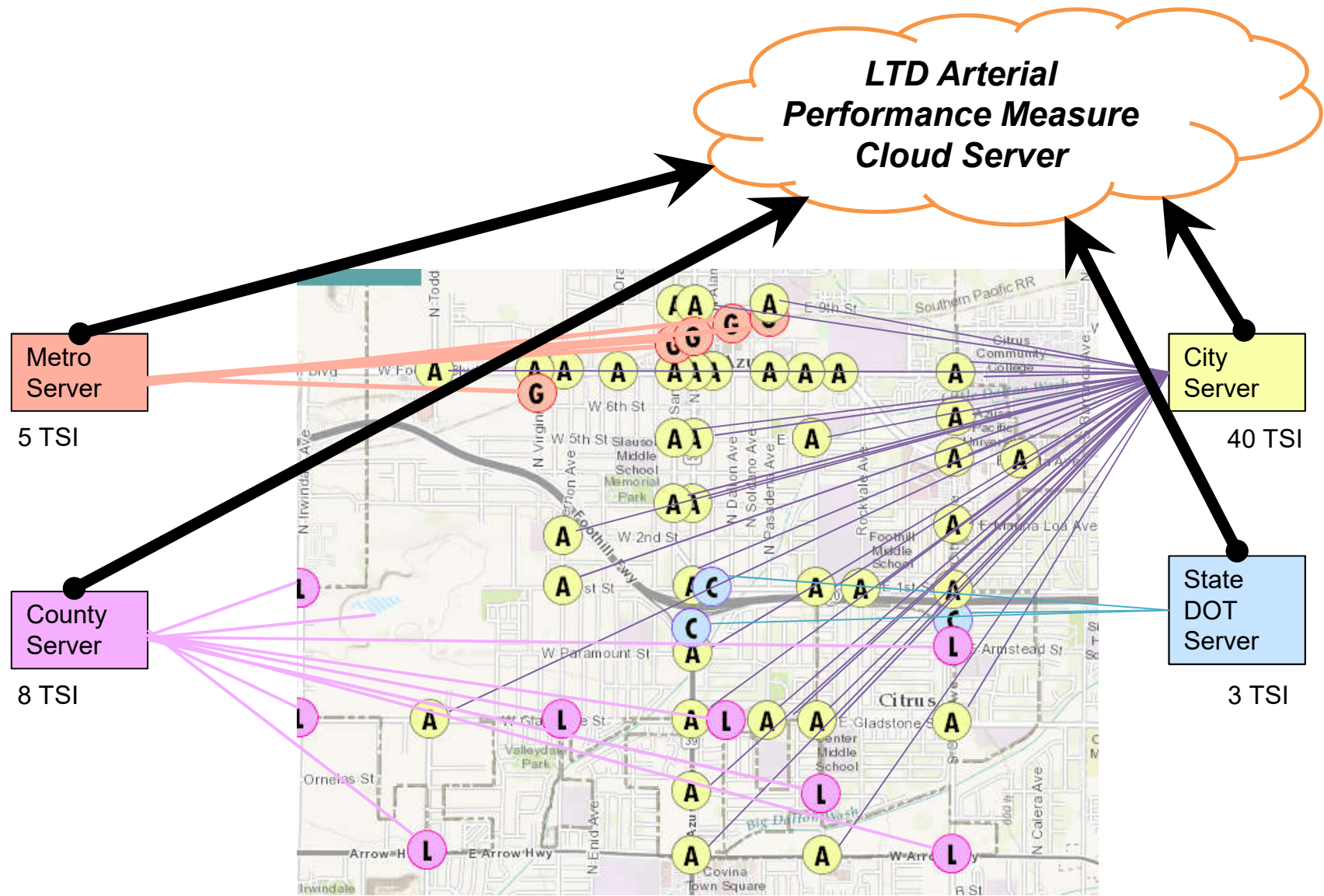
➢ Controller A,B,C,D connectors

Field Implementation

170/2070 type cabinets

➢ Controller C-1 connector

LTD Performance Measure System Architecture

LTD Database Server

LTD Performance Measure Webserver

LTD Local Server

TCP/IP

NTCIP, AB3418, …

TCP/IP

HTTP

HTTP

DOT Firewall

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Multiple Agency Hi-Resolution Data Pushed to Cloud

LTD Arterial Performance Measure Cloud Server

Metro Server

5 TSI

County Server

8 TSI

City Server

40 TSI

State DOT Server

3 TSI

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Regional Access to Performance Measures

LTD Arterial Performance Measure Cloud Server

Metro Workstn 56 TSI

City Workstn 56 TSI

Metro Server — 5 TSI

County Server — 8 TSI

County Workstn 56 TSI

City Server — 0 TSI

State DOT Server — 3 TSI

State DOT Workstn 56 TSI

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We Provide Powerful Monitoring & Analysis Software Suite

On-line Real-time Performance Measures for Traffic Agencies

- Intersection LOS
- Link Delay
- Customized Alerts

Off-line analysis tools for consulting firms and signal timing engineers

- Performance Assessment
- Signal Optimization Preparation
- Fine-tuning Analysis
- Performance Comparison (before vs. after)
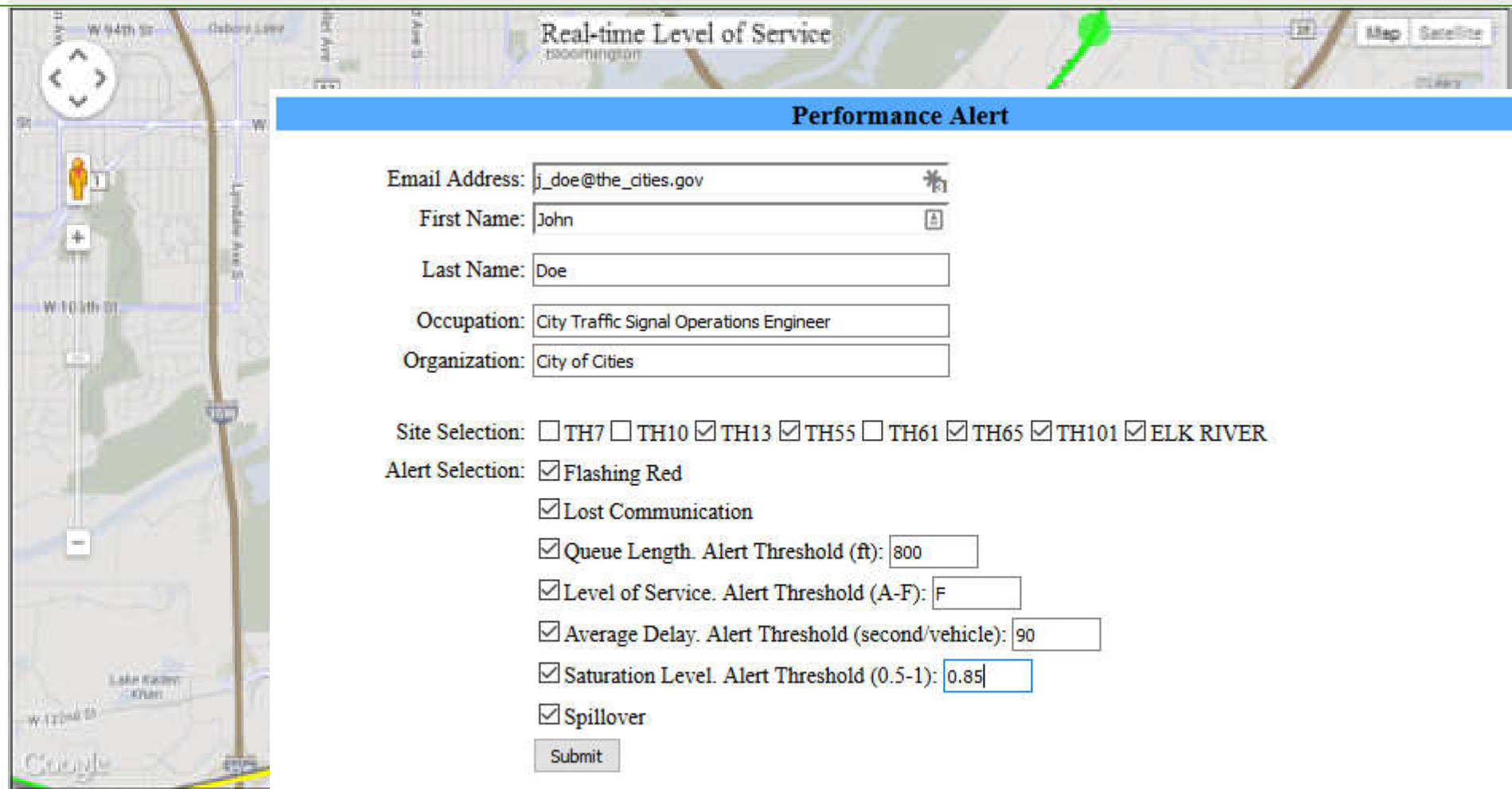- Retiming Benefits Analysis
- Reports

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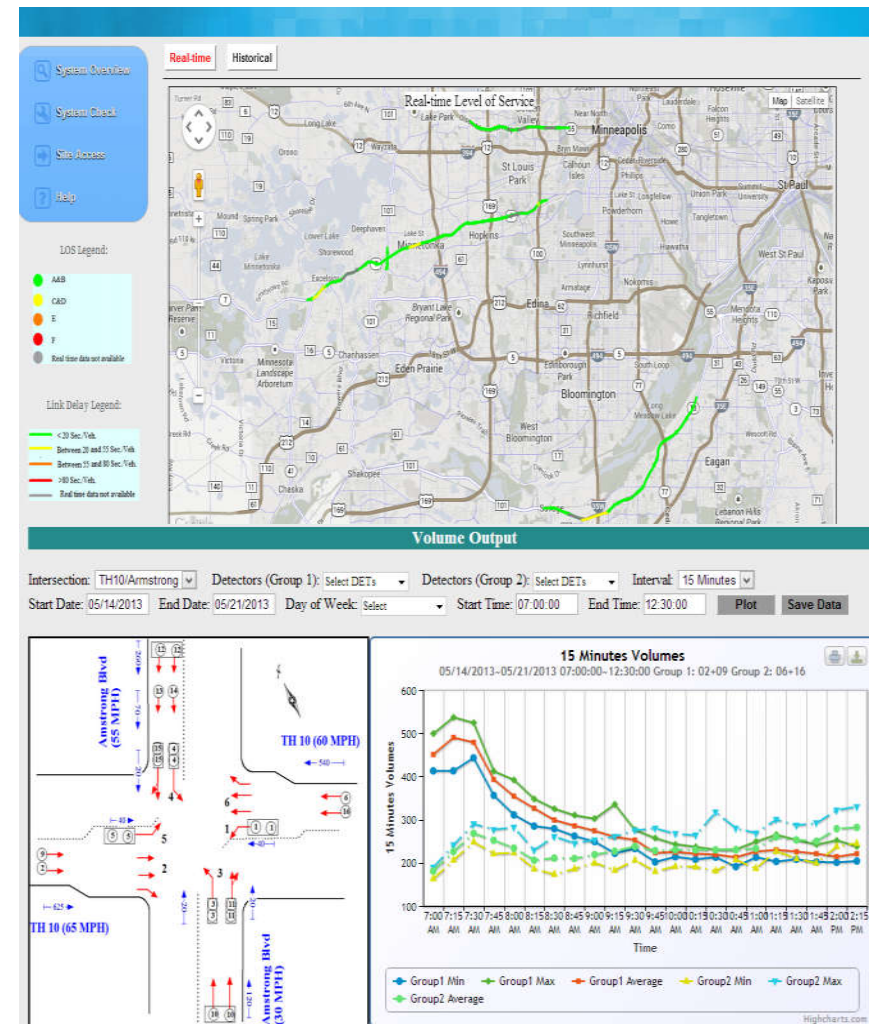
Real-Time Performance Monitoring

Provides real-time performance monitoring for the corridor
  - ➤ Level of service
  - ➤ Link speed
  - ➤ Average delay
  - ➤ Saturation level

Real-time Alerts

Automatic Notification of Service Anomalies

Intersection Performance Comparison

15 Minutes Volumes
Period 1: 10/14/2013~11/17/2013 Period 2: 10/14/2013~11/17/2013 Detectors: EB

Legend:
- Period1 50th Percentile
- Period1 85th Percentile
- Period2 50th Percentile

Performance Measures: Volumes
- Max queue length
- Total delay
- Average delay
- Saturation level
- Number of stops
- Volumes
- Green duration
- Arrival on green
- Fuel & Emission

End Date: 11/17/2013

End Date: 11/17/2013

Time: 19:30:00

Automatic comparison of different performance measures

➢ Queue length
➢ Total / average delay
➢ Saturation level
➢ Arrival on green
➢ Volumes
➢ …

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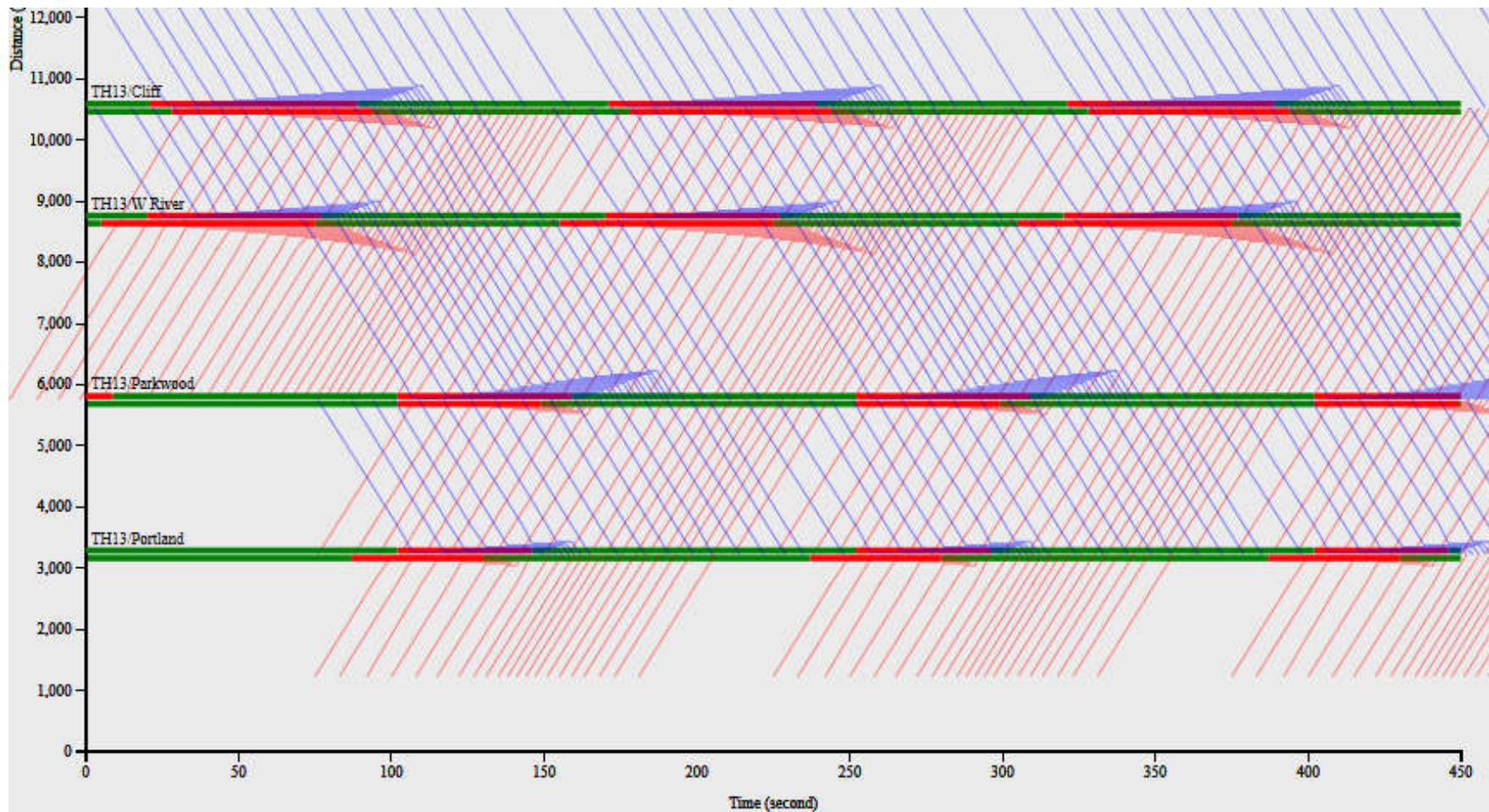
18
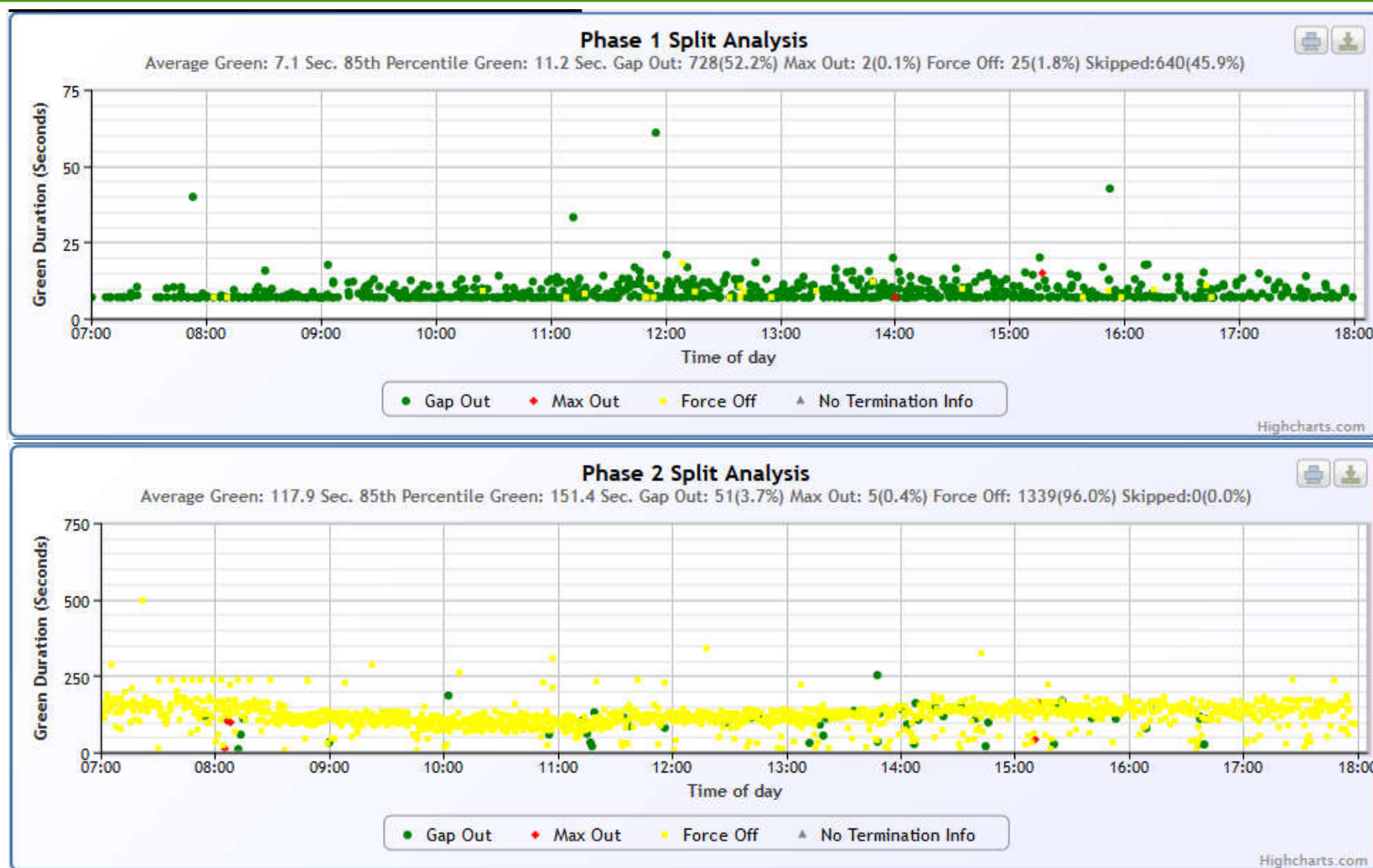
Split Analysis

Use split analysis to evaluate the actual performance of specific phases
  ➢ # of Gap out, Max Out, Force Off, Skipped
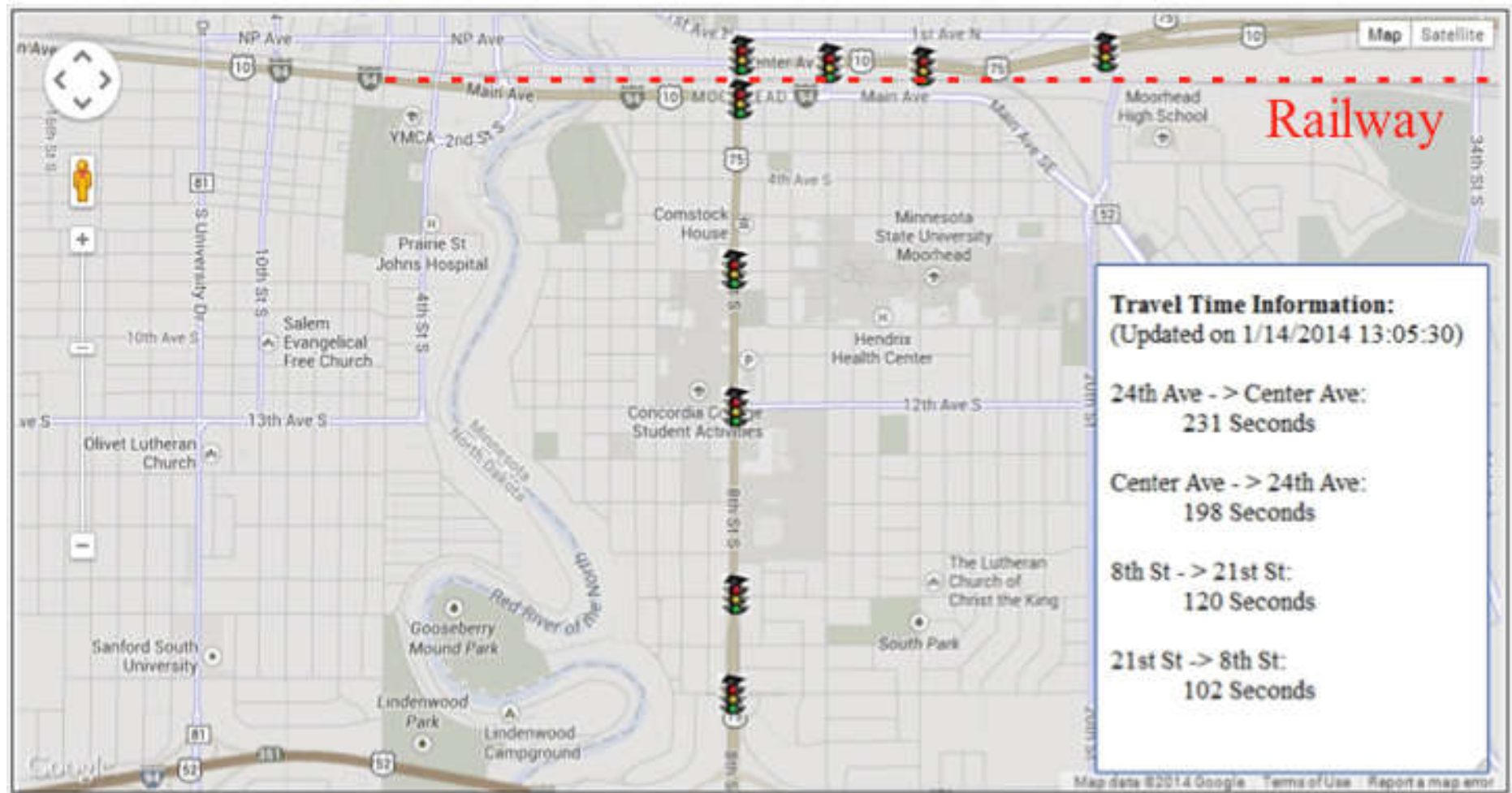
Arterial Performance Time-Space Diagram

Field-data driven T-S Diagram

➢ Evaluate the actual performance
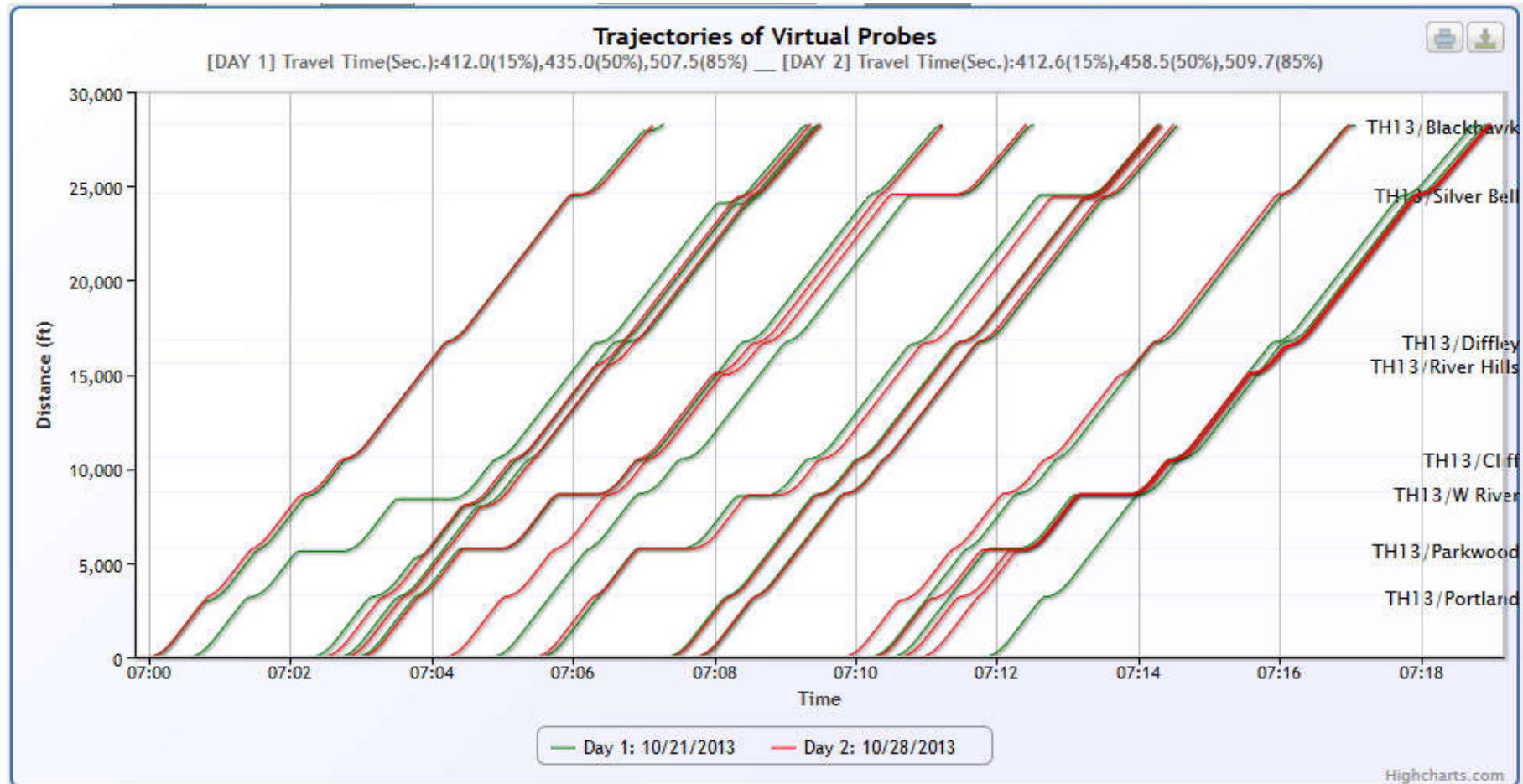➢ Fine-tune coordination

Real-Time Travel Time Estimation

Nine intersections in the City of Moorhead

➢ 6 TS-1 intersections
➢ 3 TS-2 intersections
➢ Siemens Eagle controllers

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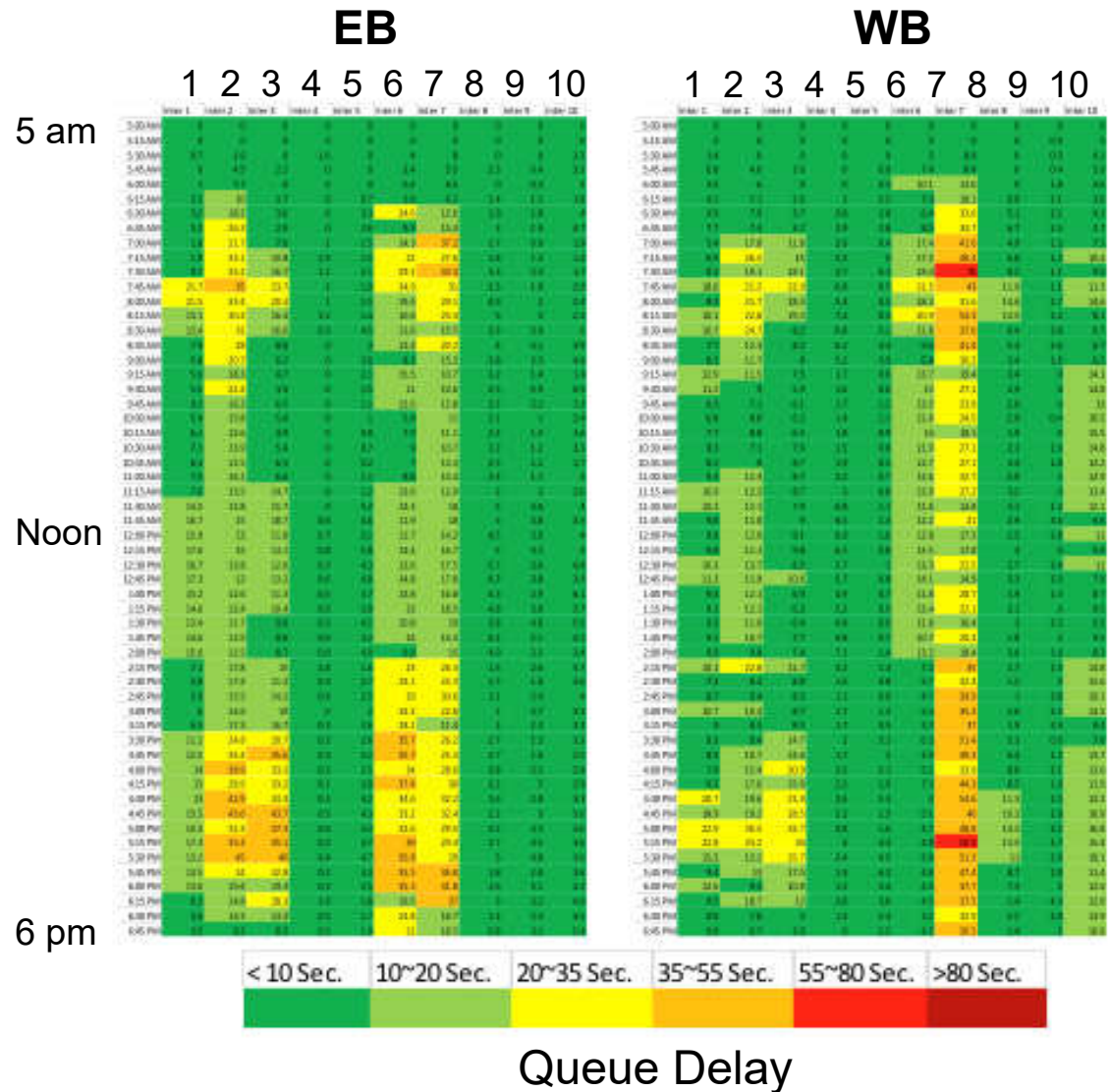
Travel Time / Vehicle Trajectory Comparison

Automatic comparison of travel times and vehicle trajectories

➢ Travel time variation and reliability
➢ Detailed vehicle trajectories
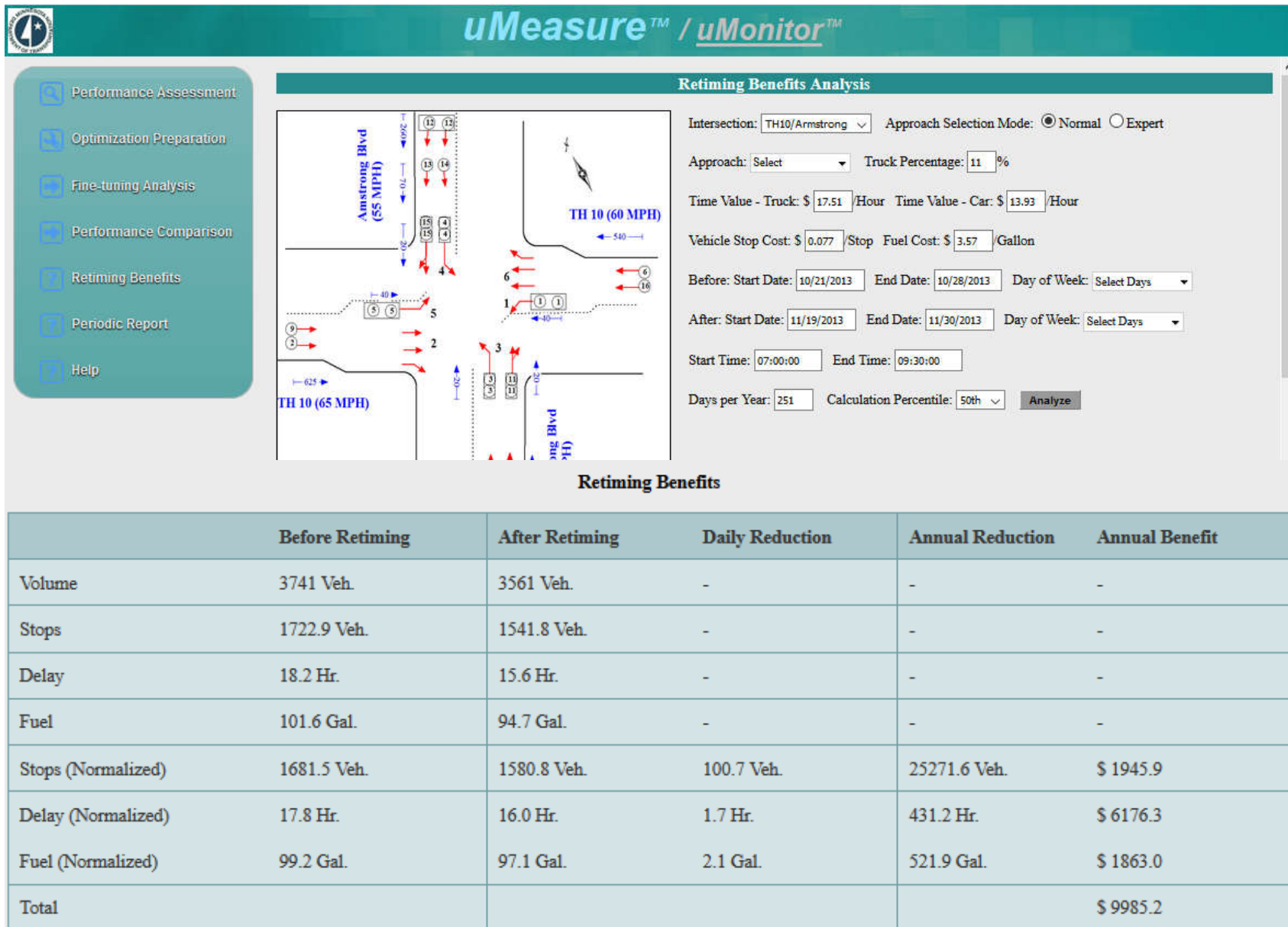➢ Before-and-after studies

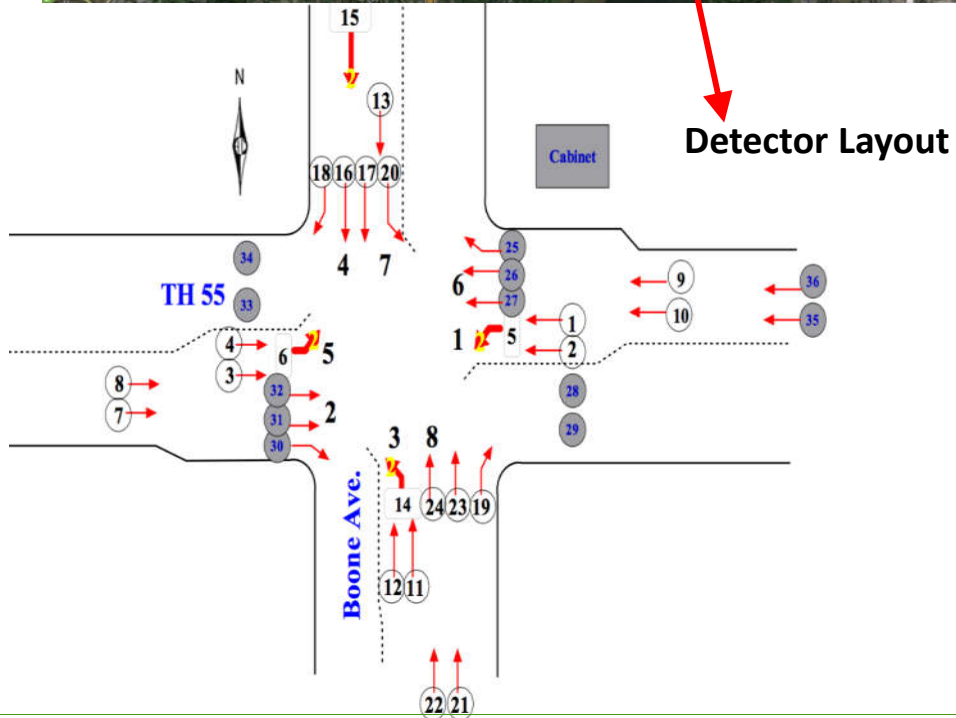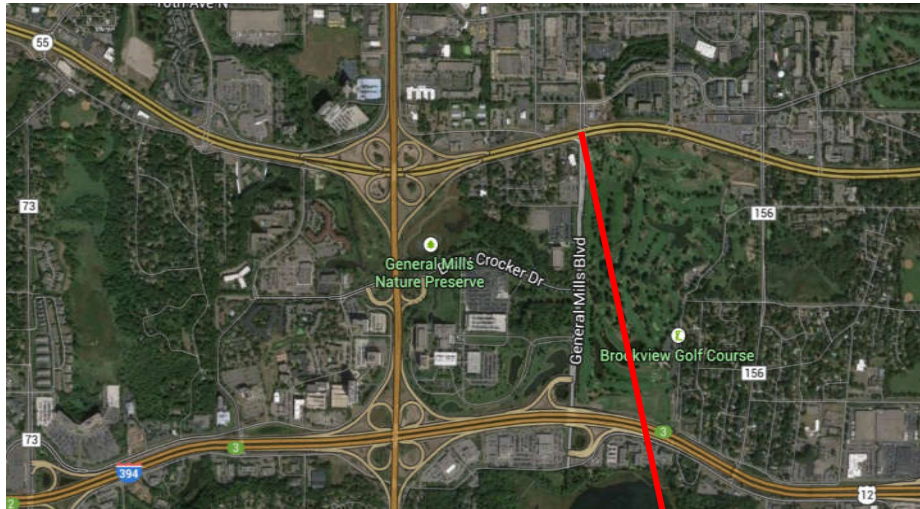# Arterial Congestion Report

- To better understand how congestion evolves

- Different cell colors indicate different congestion levels

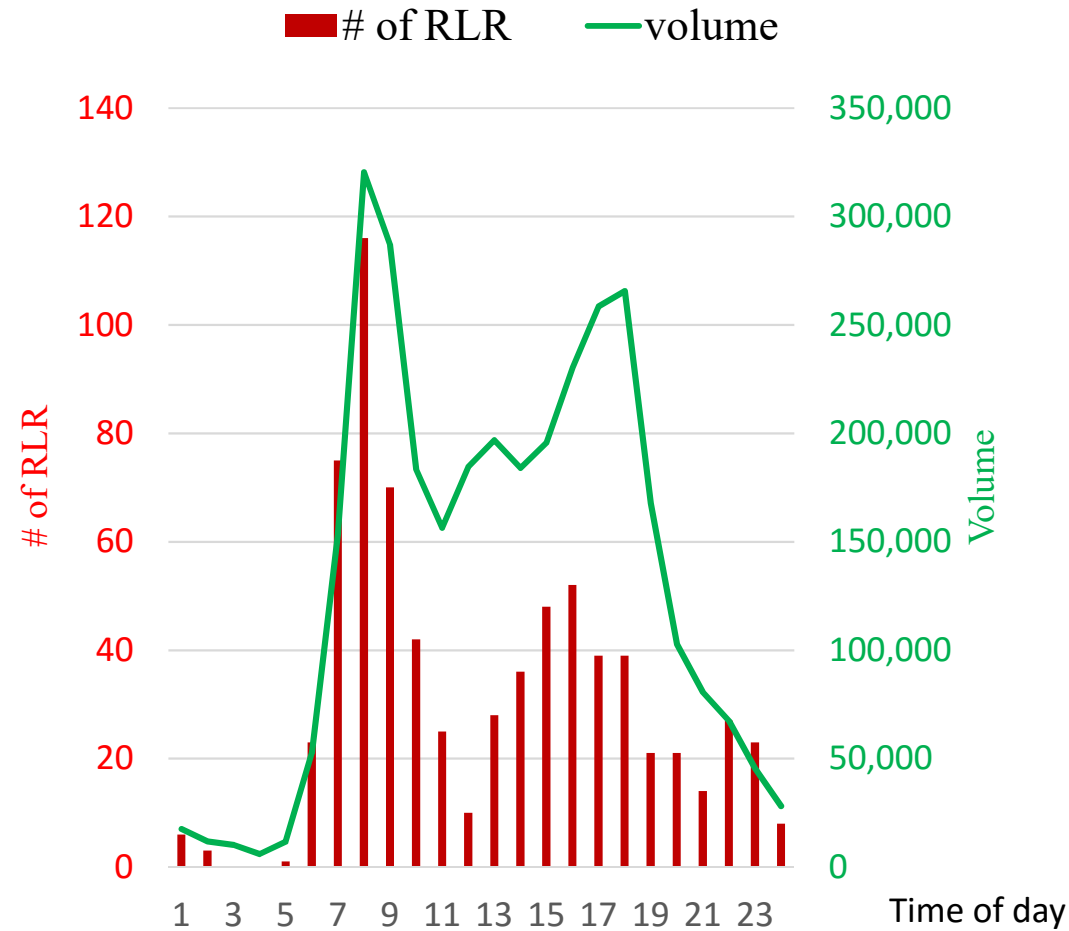- Easily identify the most and least congested time and location

Queue Delay

Retiming Benefits

uMeasure™ / uMonitor™

Retiming Benefits Analysis

Intersection: TH10/Armstrong   Approach Selection Mode: ● Normal ○ Expert

Approach: Select   Truck Percentage: 11 %

Time Value - Truck: $ 17.51 /Hour   Time Value - Car: $ 13.93 /Hour

Vehicle Stop Cost: $ 0.077 /Stop   Fuel Cost: $ 3.57 /Gallon

Before: Start Date: 10/21/2013   End Date: 10/28/2013   Day of Week: Select Days

After: Start Date: 11/19/2013   End Date: 11/30/2013   Day of Week: Select Days

Start Time: 07:00:00   End Time: 09:30:00

Days per Year: 251   Calculation Percentile: 50th   Analyze

Retiming Benefits

	Before Retiming	After Retiming	Daily Reduction	Annual Reduction	Annual Benefit
Volume	3741 Veh.	3561 Veh.	-	-	-
Stops	1722.9 Veh.	1541.8 Veh.	-	-	-
Delay	18.2 Hr.	15.6 Hr.	-	-	-
Fuel	101.6 Gal.	94.7 Gal.	-	-	-
Stops (Normalized)	1681.5 Veh.	1580.8 Veh.	100.7 Veh.	25271.6 Veh.	$ 1945.9
Delay (Normalized)	17.8 Hr.	16.0 Hr.	1.7 Hr.	431.2 Hr.	$ 6176.3
Fuel (Normalized)	99.2 Gal.	97.1 Gal.	2.1 Gal.	521.9 Gal.	$ 1863.0
Total					$ 9985.2

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Ex. 8 – Red Light Running (RLR) Statistics

Detector Layout

RLR and Volume vs. Time of Day (Eastbound)

Live Traffic Data Performance Measures Validated by Independent Consultants

- Alliant Engineering for Minnesota DOT, 2009

- Iteris for the City of Pasadena, CA, 2011

  ✓ Performance Measures, *e.g. Travel Time and Queue Length,* were independently verified in these deployments

- Alliant Engineering for Minnesota DOT, 2014

  ✓ LTD system helped engineers to optimize signal timings in much more efficient & effective ways

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Why Live Traffic Data ™

Proven Reliability:

- ✓ Deployed with DOT's in Minnesota and California since 2007
- ✓ Operate regardless of environmental conditions
- ✓ Do not interfere with the traffic controller--DCUs only collect data
- ✓ Provide desirable monitoring and analysis tools to traffic engineers
- ✓ Can provide direct access to any traffic signal cabinet in the U.S.

Effective:

- ✓ Reduce congestion, fuel consumption and improve signal coordination
- ✓ Monitor arterial performance
- ✓ Before & After evaluation
- ✓ Travel-time, queue length, stops & delays
- ✓ Traffic alerts

Budget Friendly:

- ✓ Subsidized cost for H/W, S/W
- ✓ Save on retiming, signal optimization costs
- ✓ Meet FAST ACT Performance Measure requirements—qualify for federal funding

LIVE:TRAFFIC:DATA ™

LTD Data Accuracy Validation

INDEPENDENT EVALUATIONS

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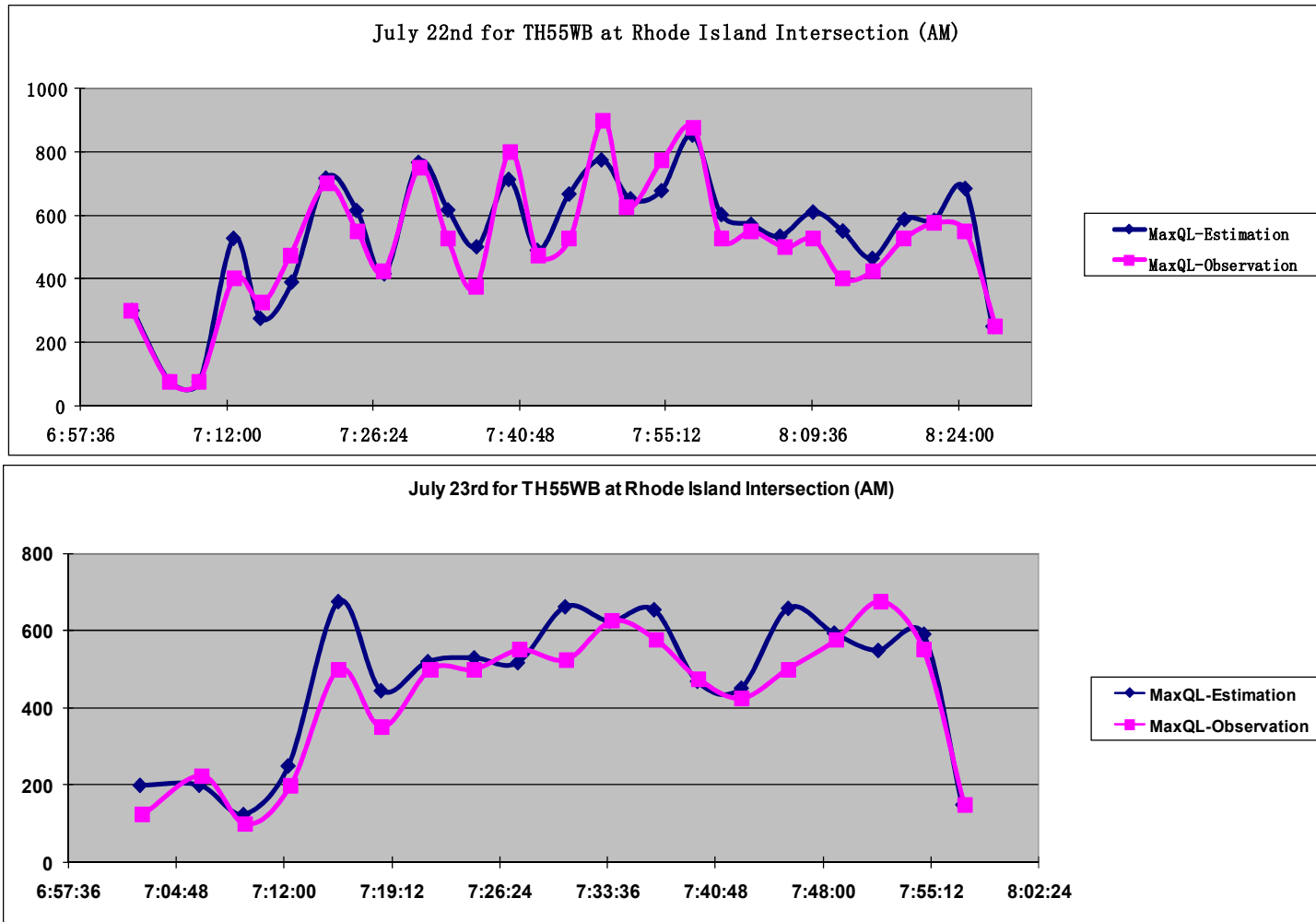
Independent Evaluation: **TH 55, Golden Valley, MN**

- Conducted by Alliant Engineering, Inc.

- July 2009

TH 55 (6 Intersections)
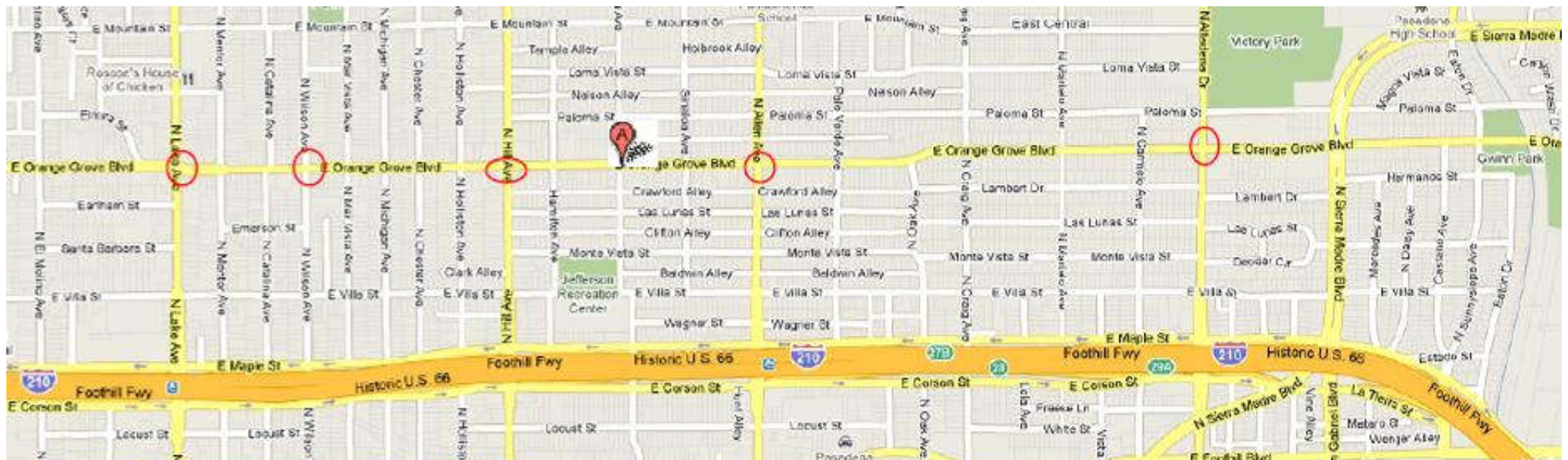
Queue Length Comparison

Travel Time Comparison

Travel Time Estimation vs. Observation(July 22 & 23)
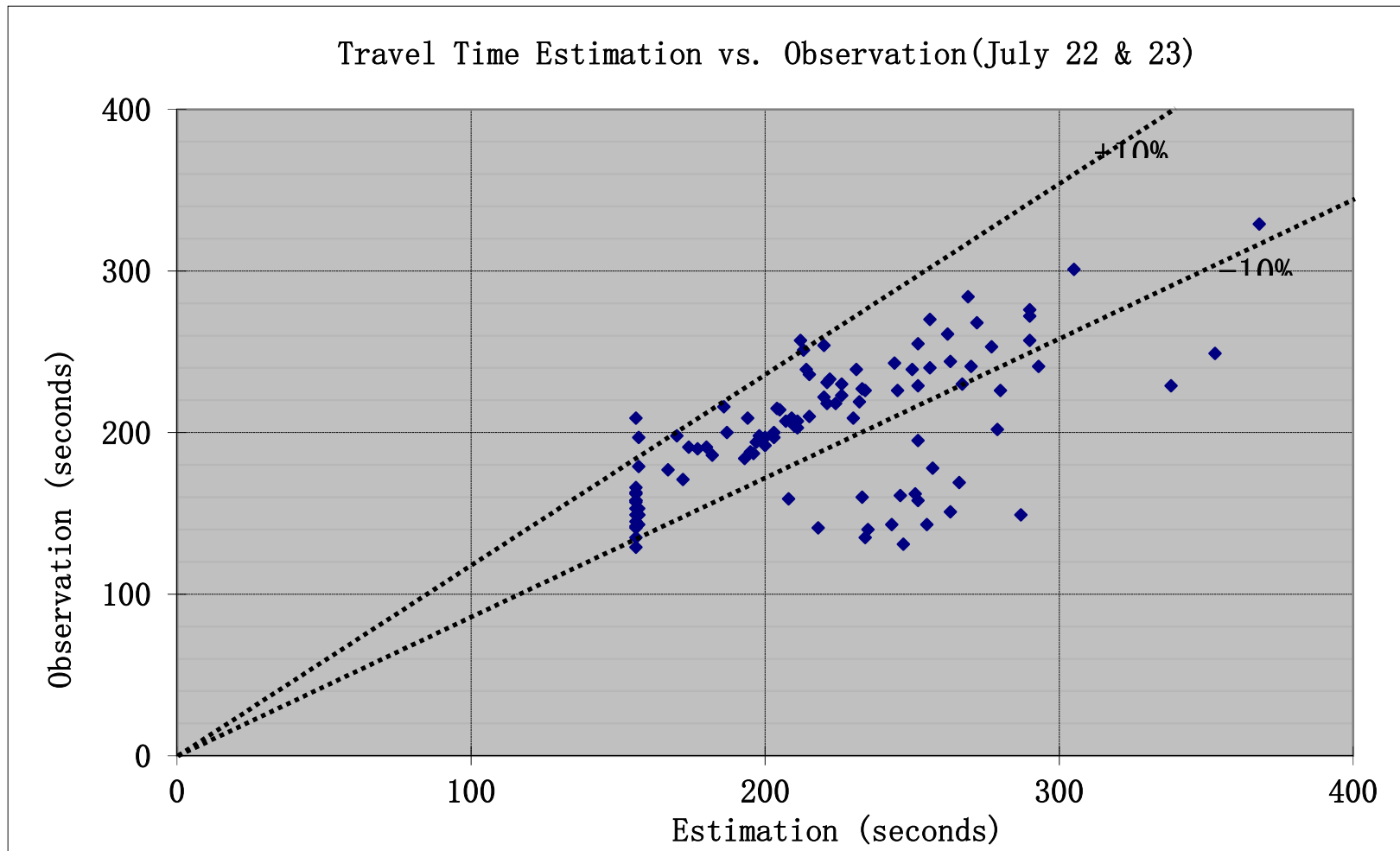
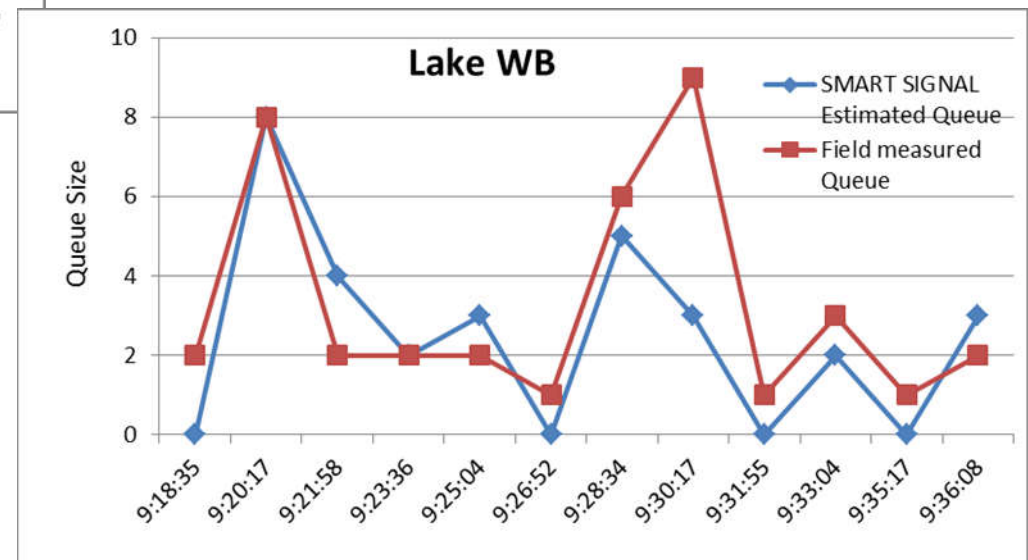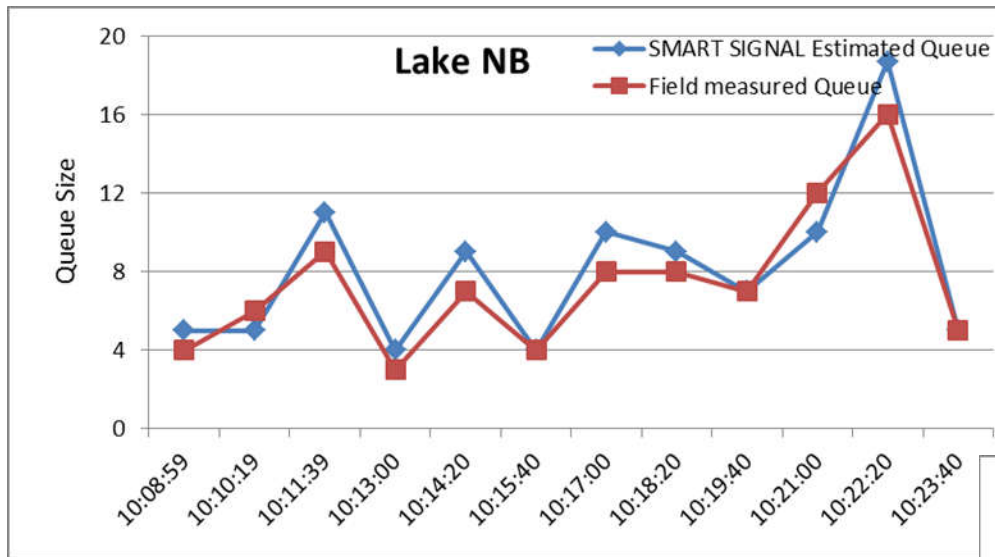# Independent Evaluation: Orange Grove Blvd, Pasadena, CA

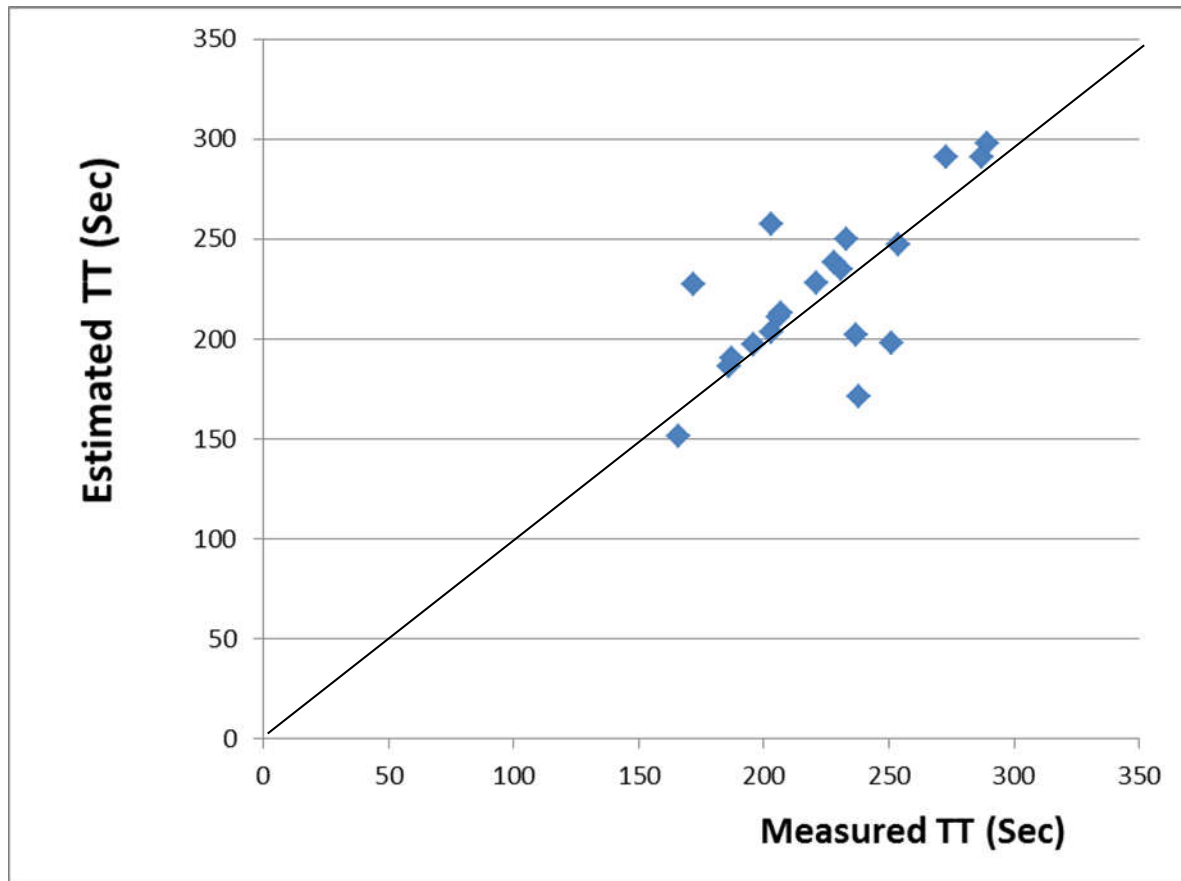- Conducted by Iteris, Inc.
- October 2011

Orange Grove Blvd (6 Intersections)

Queue Length Result

Travel Time Results

: LTD Estimated results vs. Measured results