AUTOMATED TRAFFIC SIGNAL PERFORMANCE MEASURES

RM3: More than Raw Data – Using Performance Measures to Direct System Improvements

National Rural ITS Conference – Snowbird, Utah

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UDOT Keeping Utah Moving

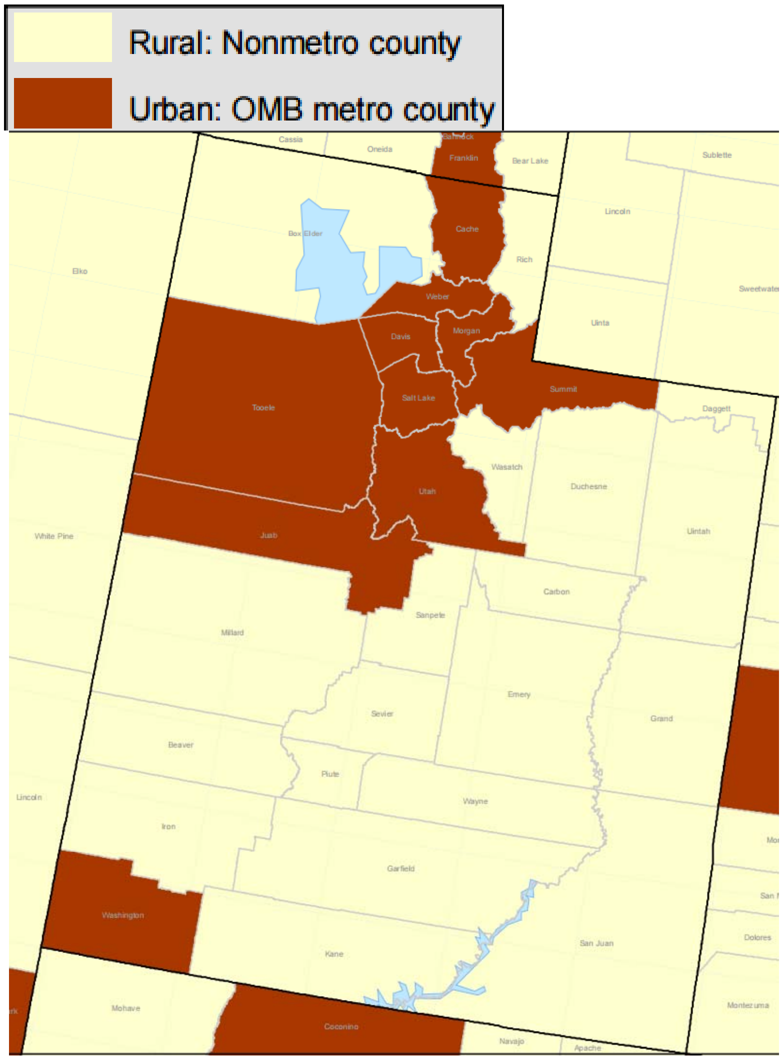
Utah - Brief Facts

- 1954 Traffic Signals in the State of Utah
  - 1163 owned and operated by UDOT (60%)
  - 791 owned and operated by cities /counties (40%)

- All cities share same ITS communications
  - 90% of UDOT signals connected
  - 80% of non-UDOT signals connected

- All cities in Utah & UDOT share same ATMS

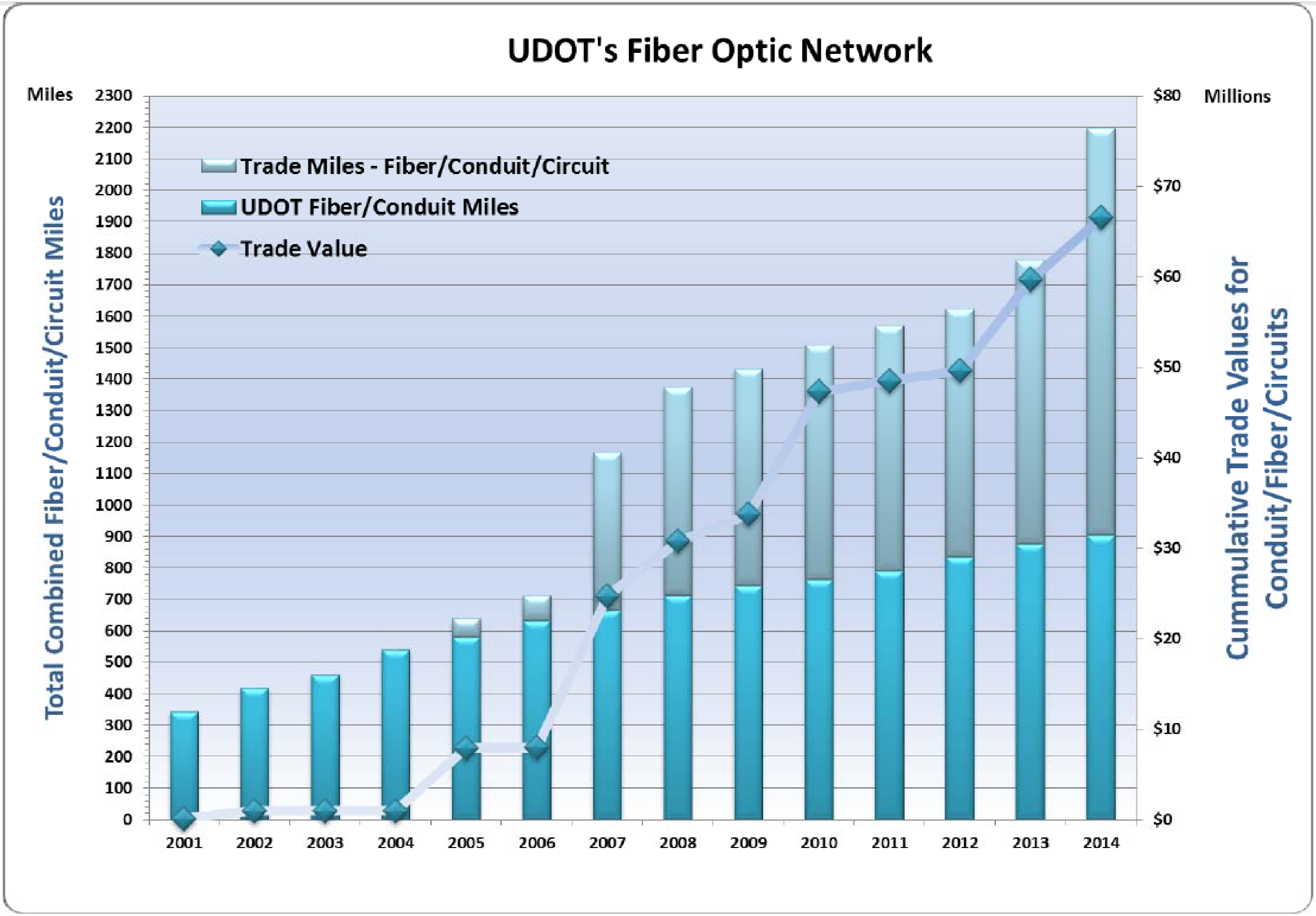
Utah Demographics



- 13th largest, 33rd most populous, 10th least densely populated.
- Population 2.9 million
  - 80% live along Wasatch Front
  - Population to double by 2050.

RURAL Utah

- 87 traffic signals (7.5%)
- 37 signals connected (43%)
  - Within 12 months 30 more (75%)


UDOT's Fiber Optic Network
Miles
Millions
Trade Miles - Fiber/Conduit/Circuit
UDOT Fiber/Conduit Miles
Trade Value
Total Combined Fiber/Conduit/Circuit Miles
Cummulative Trade Values for Conduit/Fiber/Circuits
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
$80
$70
$60
$50
$40
$30
$20
$10
$0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Opportunity – UDOT Executive Leaders - 2011

"What would it take for UDOT's traffic signals to be World-Class?"

"What's the trend – are signal operations improving, staying the same or getting worse?"

"What are our areas of most need?"

John Njord

Carlos Braceras

Some QIT Recommendations (July 2011)

- Require that communications and signal detection be maintained during projects.
- Transition from reactive to proactive signal maintenance by increasing signal maintenance funding.
- **Implement real-time monitoring of system health and quality of operations.**
  - Automated Traffic Signal Performance Measures (SPM's)
    http://udottraffic.utah.gov/performancemetrics/

Keeping Utah Moving

PERFORMANCE MEASURES FOR TRAFFIC SIGNAL SYSTEMS

An Outcome-Oriented Approach

Christopher M. Day, Darcy M. Bullock, Howell Li, Stephen M. Remias, Alexander M. Hainen, Richard S. Freije, Amanda L. Stevens, James R. Sturdevant, and Thomas M. Brennan

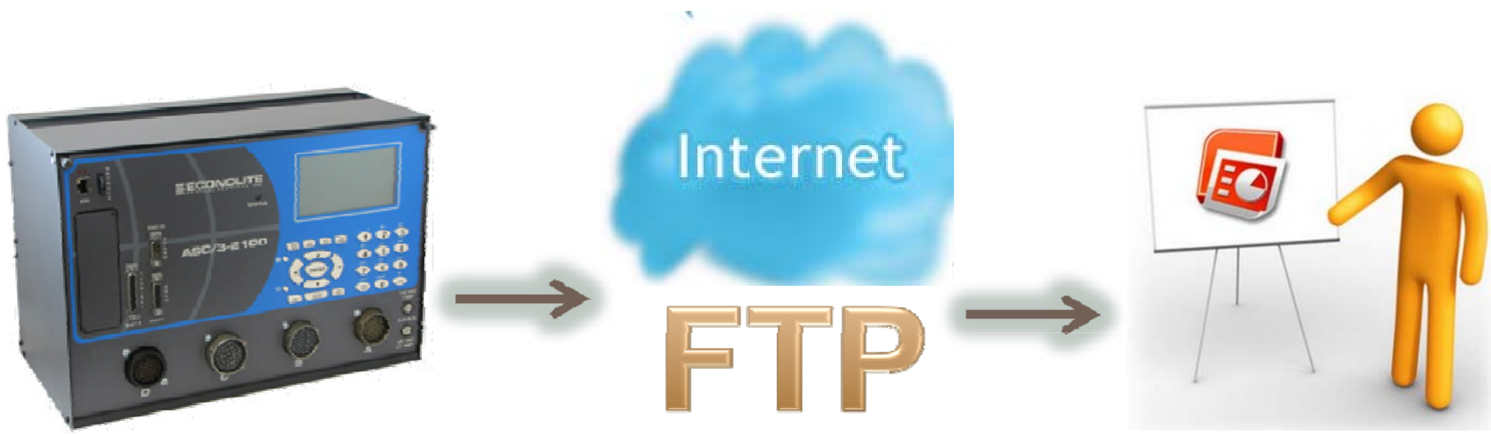
SPM Basic Concept

Automated Data Collection

- Signal controller
- Probe source

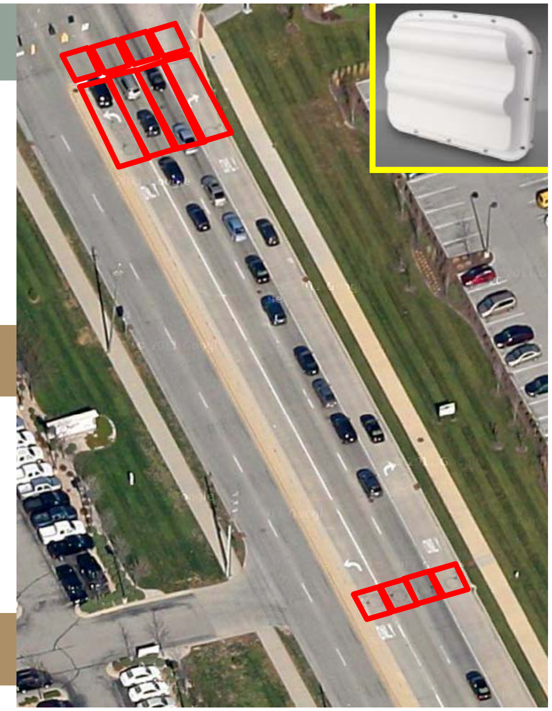
Useful Information about Performance

- Signal
- Corridor
- System



A Central Signal System is NOT used or Needed for these SPM's.

Types of Performance Metrics



Controller high-resolution data only

Purdue Phase Termination

Split Monitor

Pedestrian Delay (future)

Daily Email of Detector Issues

Advanced Count Detection (~400 ft behind stop bar)

Purdue Coordination Diagram

Approach Volume

Platoon Ratio

Purdue Link Pivot

Arrivals on Red

Approach Delay

Executive Summary Reports

Advanced Detection with Speed

Approach Speed (Wavetronix Advance)

Lane-by-lane Presence Detection

Purdue Split Failure (future)

Lane-by-lane Count Detection

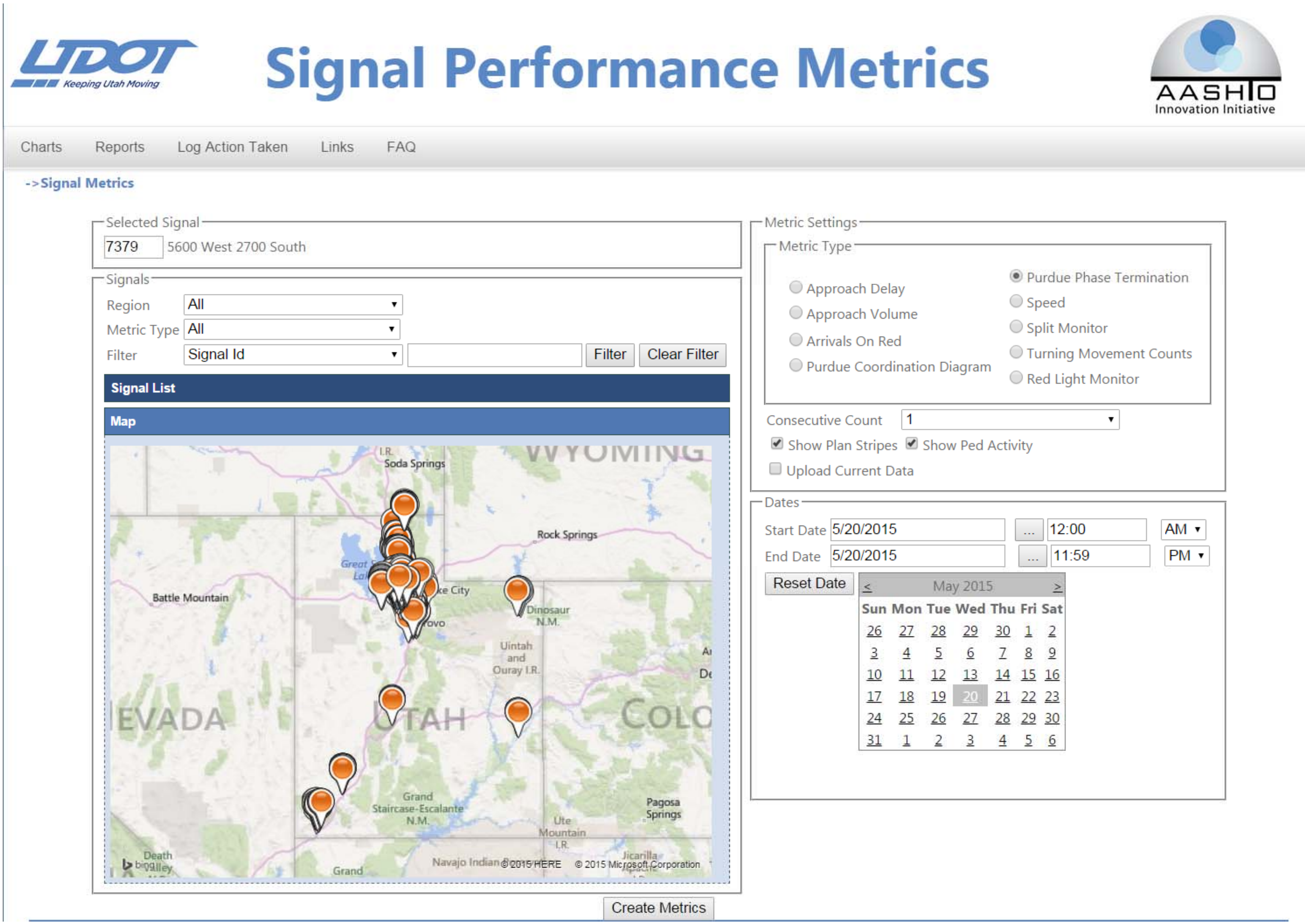
Turning Movement Counts

Red Light Monitoring

Probe Travel Time Data (GPS or Bluetooth)

Purdue Travel Time Diagram

All detectors (except speed metric) can be radar, loops, video, pucks – it doesn't matter.

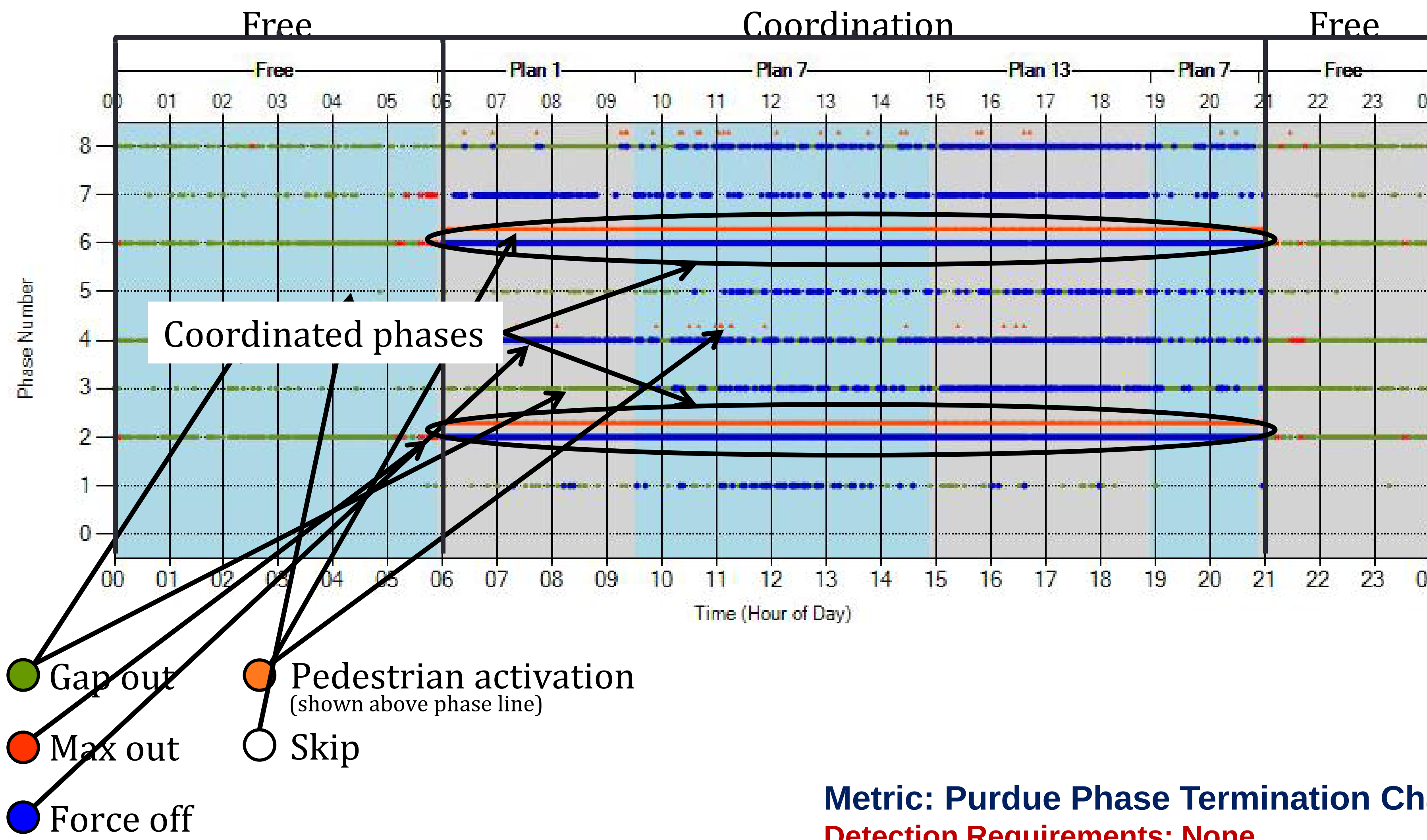


http://udottraffic.utah.gov/signalperformancemetrics

Purdue Phase Termination

How Phases Terminate by Time-of-Day

8-phase signal with working detection



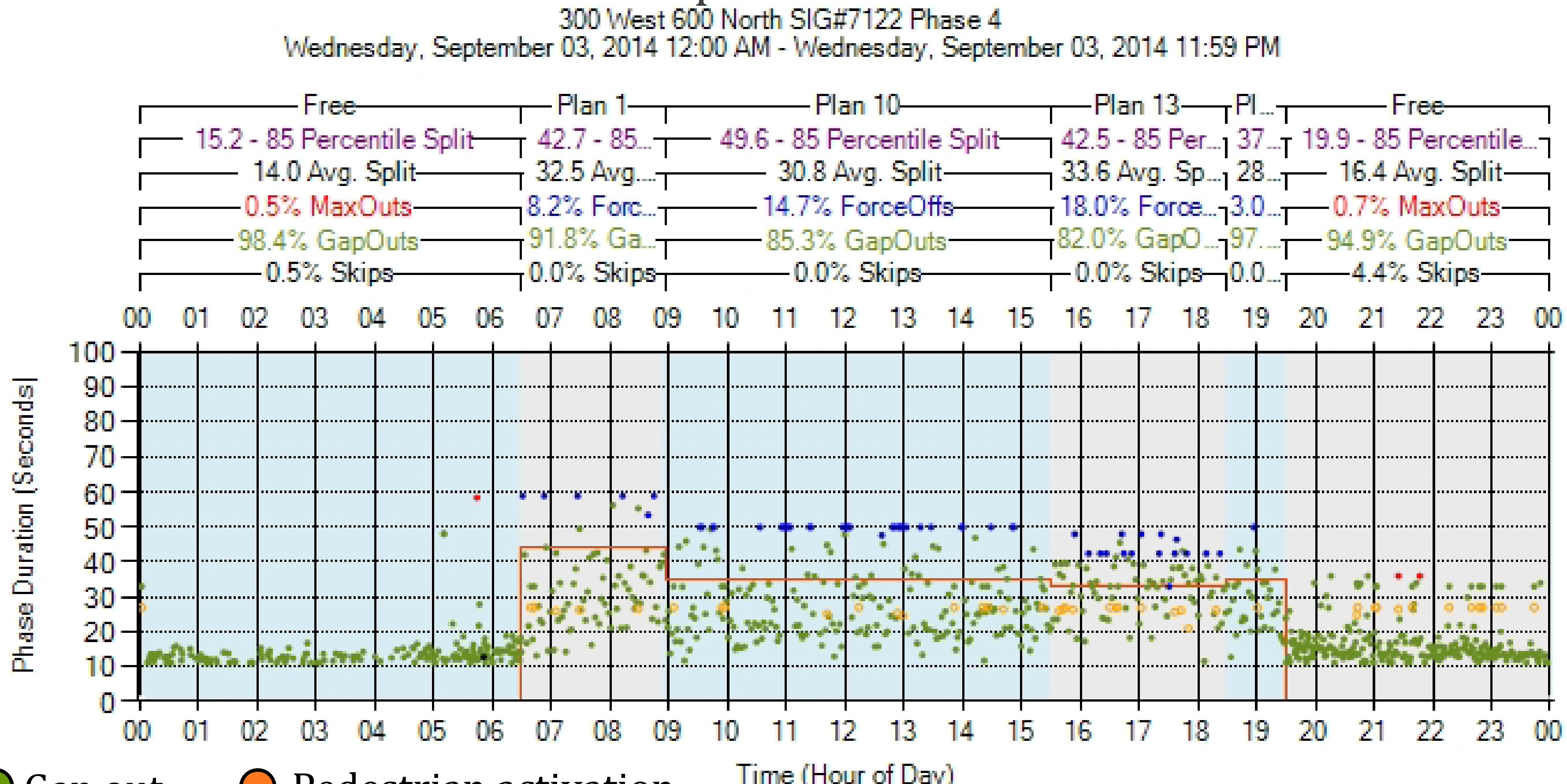
Metric: Purdue Phase Termination Chart

Detection Requirements: None

Split Monitor

Monitoring Duration of Greens by Time-of-Day

1 of 8 phases shown



Gap out

Pedestrian activation

Max out

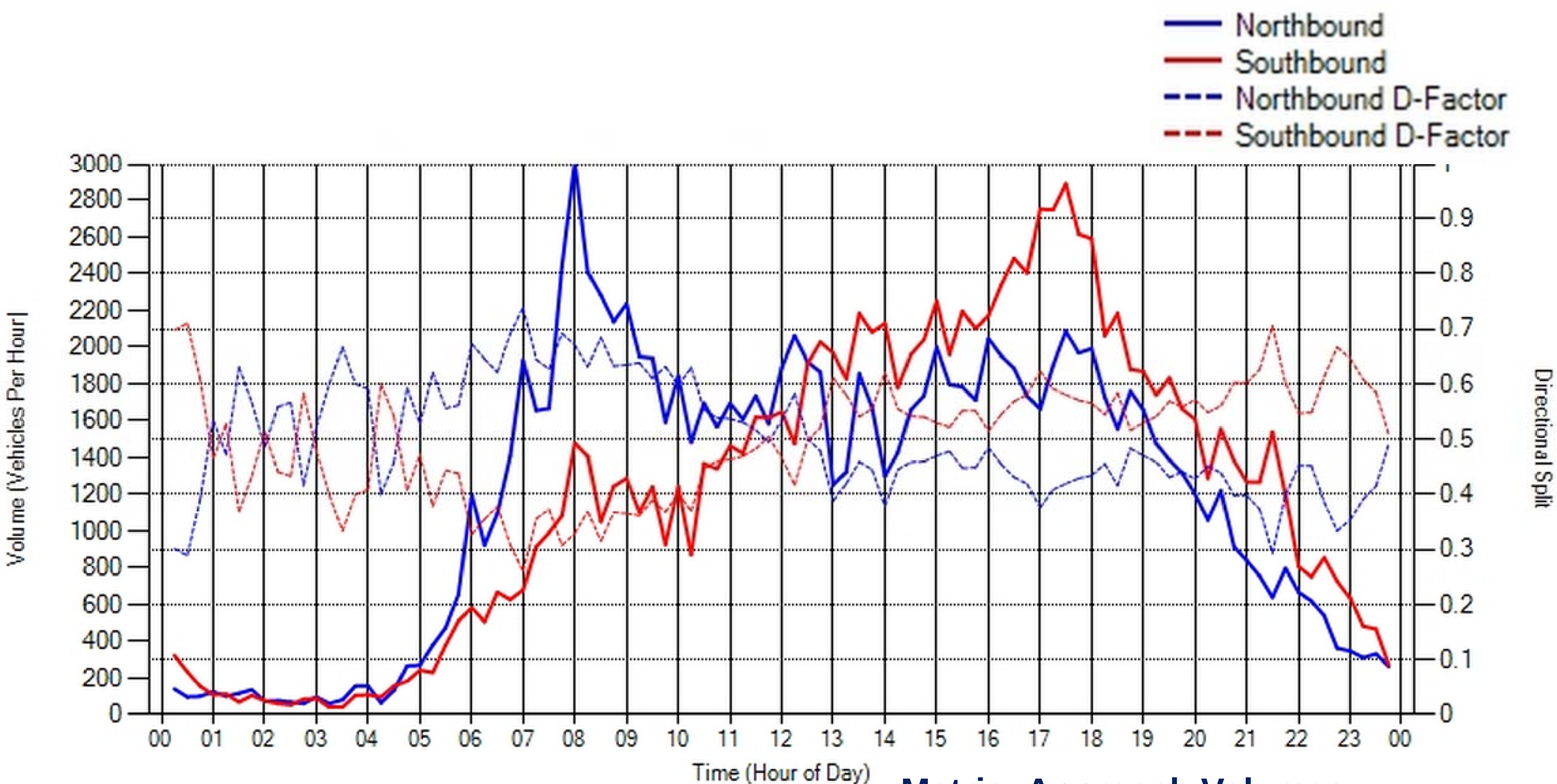
Force off

Metric: Split Monitor

Detection Requirements: None

Approach Volumes

When to Take a Lane for Maintenance Activities, Directional Splits , Traffic Models



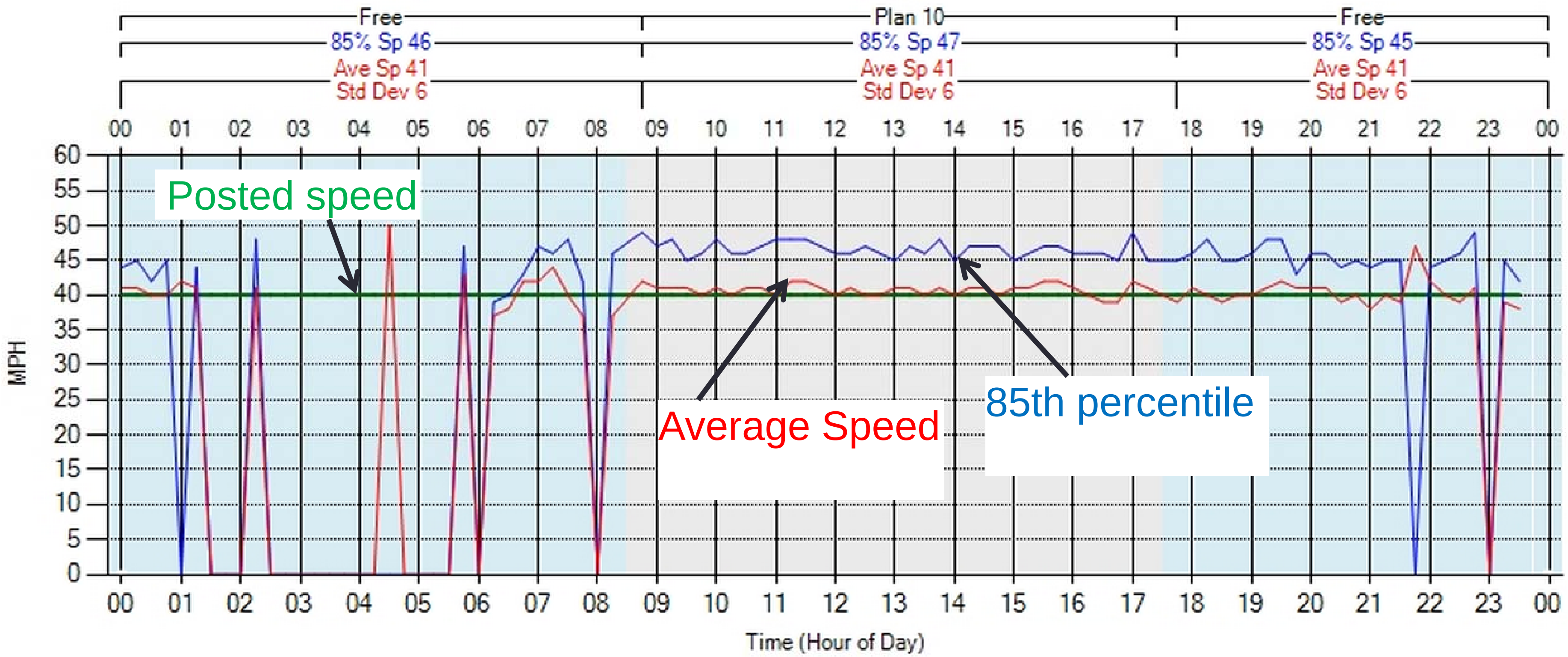
Metric: Approach Volumes

Detection Requirements: Advance Counters

Approach Speeds

Use for Traffic Studies, Severe Weather Timing Plans, and Calculating Yellow and Red Clearance Intervals

Bluff St. & 100 S., St. George, Utah – North Bound

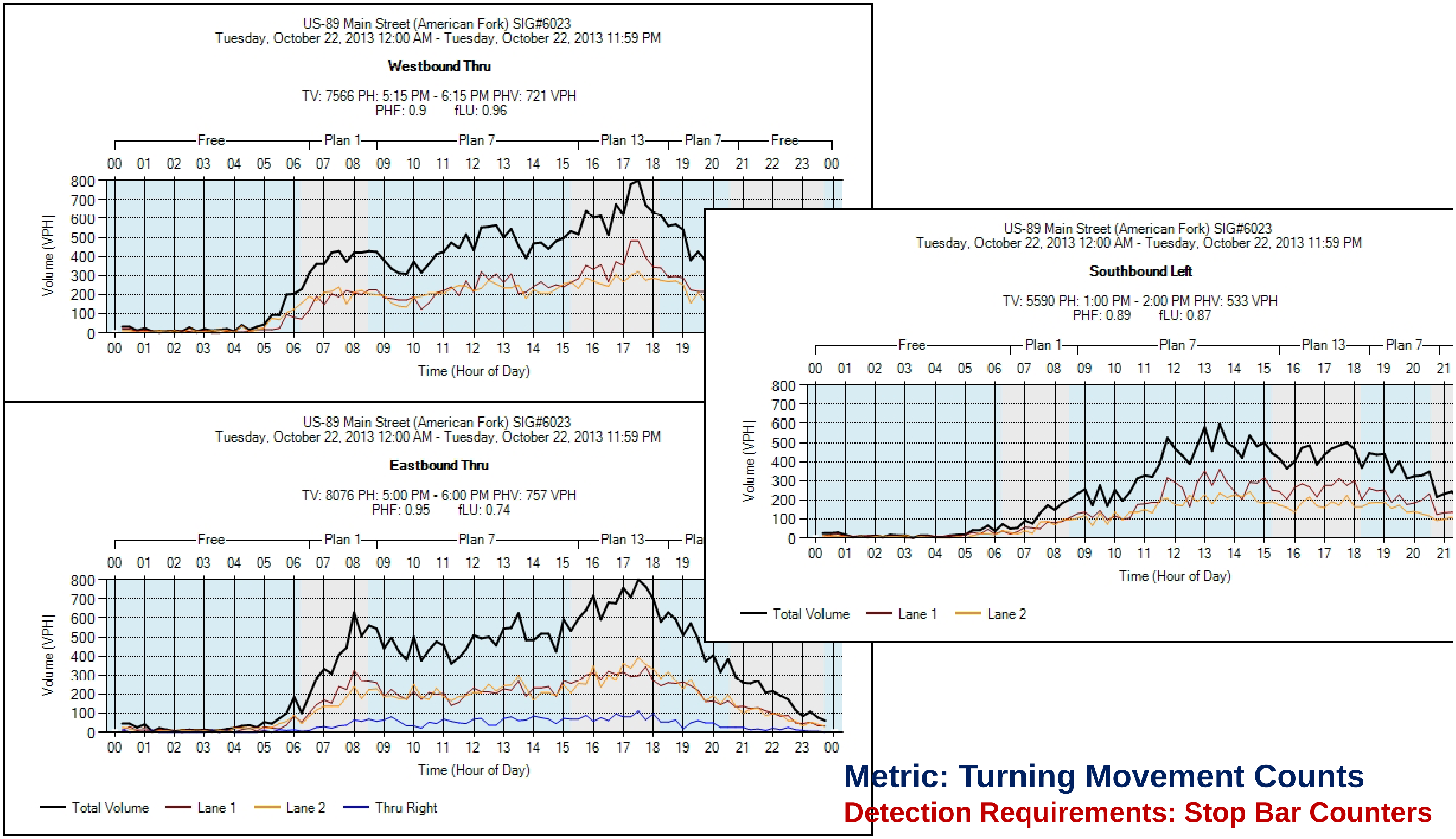


Metric: Approach Speeds

Detection Requirements: Wavetronix Advance Radar

Lane-by-Lane Volume Counts

Use for traffic studies, models, adjust splits, coordination balance

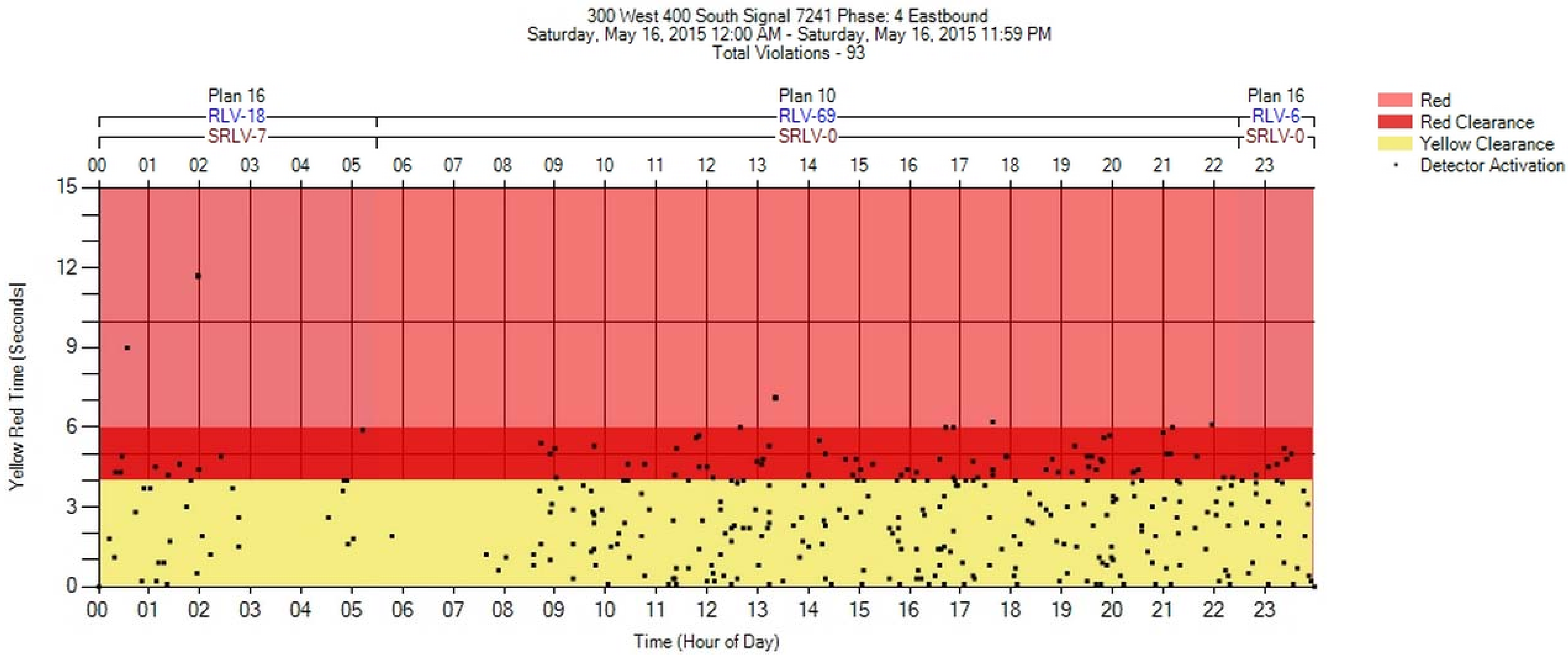


Metric: Turning Movement Counts

Detection Requirements: Stop Bar Counters

Red Light Monitoring

Use for identifying safety trends and engineering countermeasures



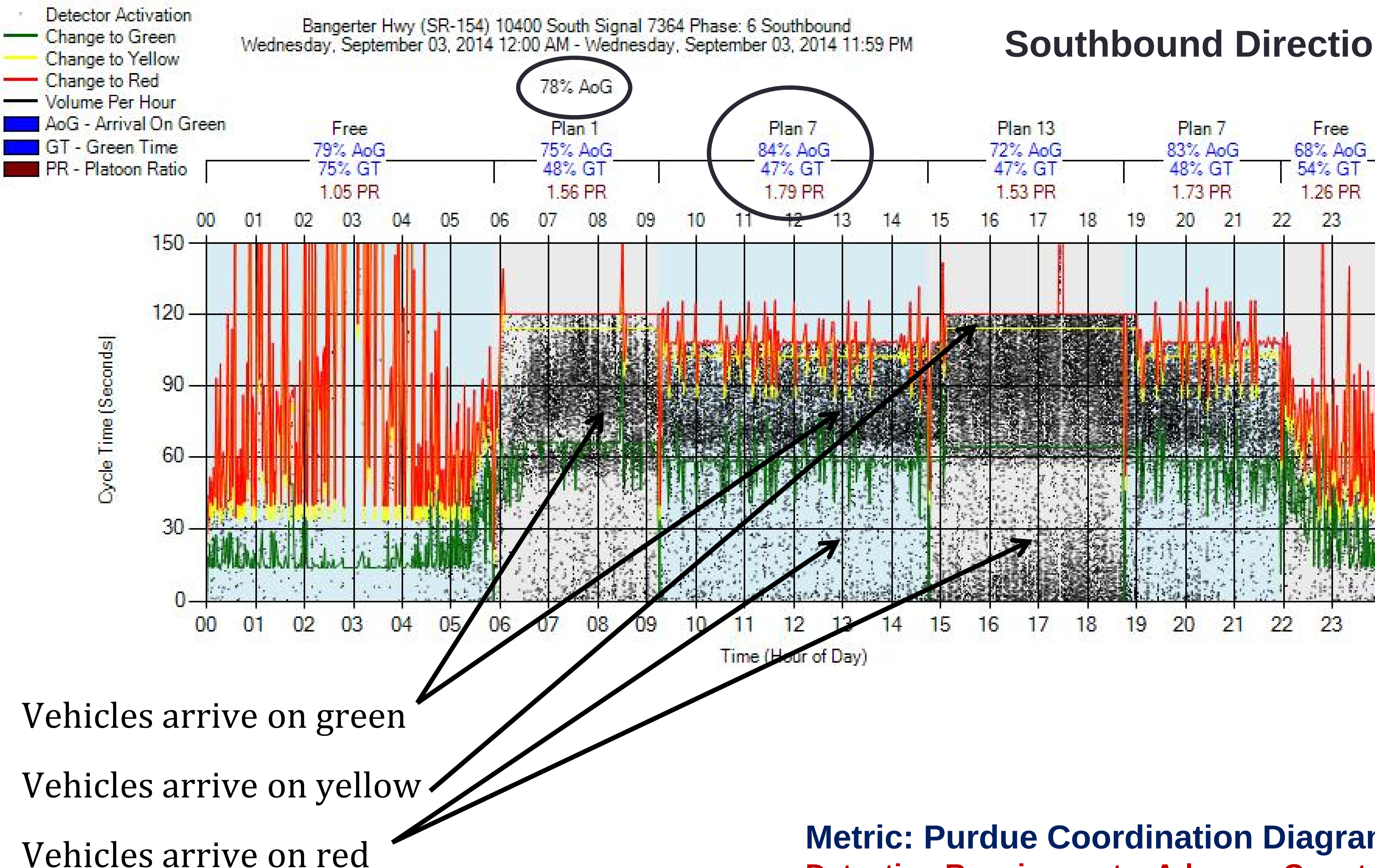
Metric: Red Light Monitoring

Detection Requirements: Stop Bar Counters with speed filter or detectors in intersection

Purdue Coordination Diagram

Evaluating progression quality – Are vehicles arriving on green or red?

Southbound Direction



Metric: Purdue Coordination Diagram

Detection Requirements: Advance Counters

Purdue Link Pivot

Automatically optimizing offsets along a corridor

Charts Reports Log Action Taken Links FAQ

->**Purdue Link Pivot**

Routes: Foothill Blvd

Signals

Starting Point: Foothill Drive Thunderbird / Foothill Drive Mario Capecchi Dr (1950 E.)

Bias: 0 % Downstream

Start Date: 4/29/2015

End Date: 4/29/2015

Start Time: 11:00 AM

End Time: 1:00 PM

Day of Week: Sun Mon Tue Wed Thu Fri Sat

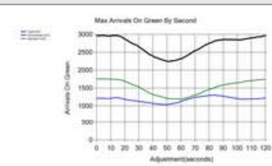
Cycle Length: 120

Run Report

Offset Adjustments

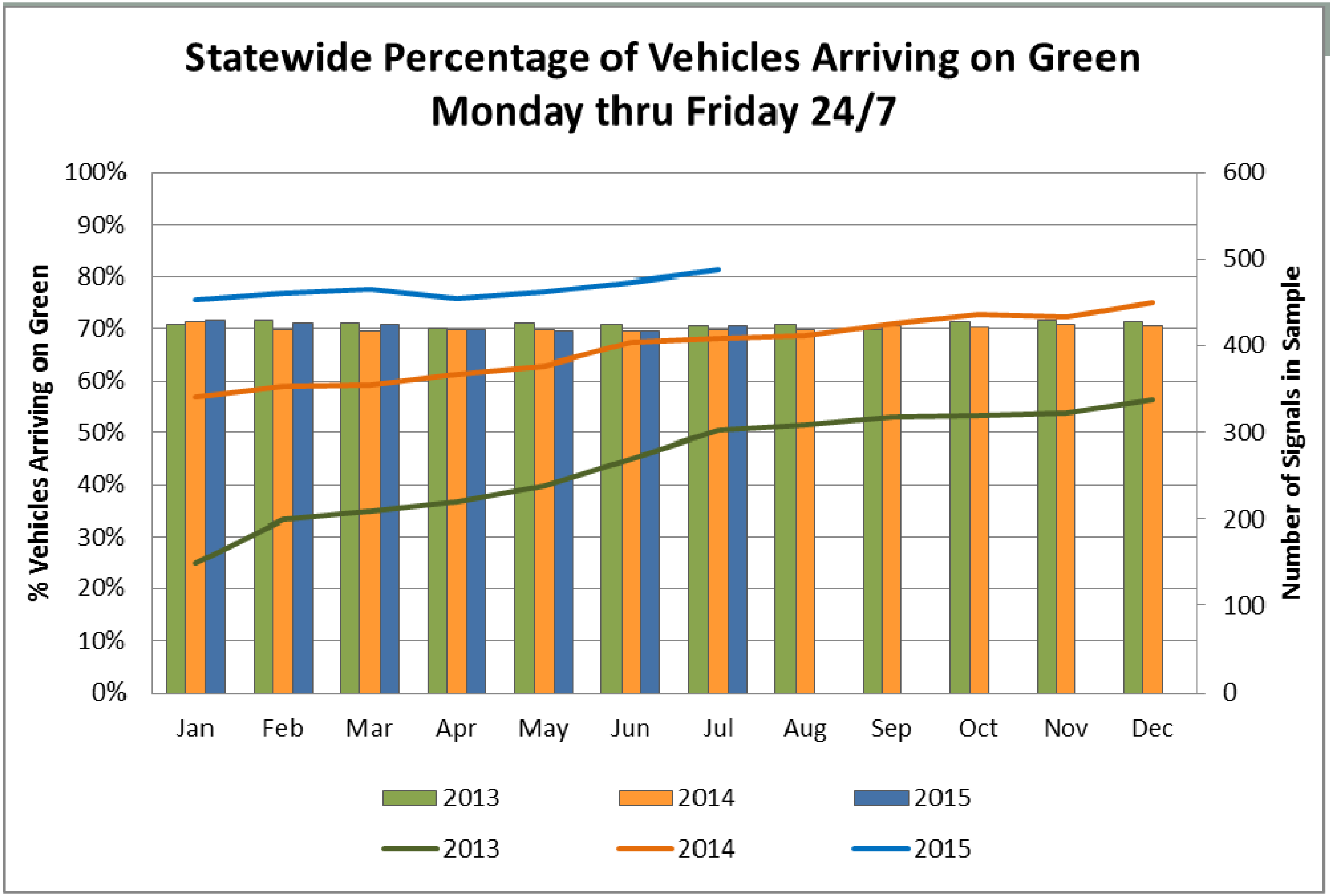
Signal	Location	Delta	Adjustment (+to offset)
7371	Foothill Drive Thunderbird	4	18
7223	Foothill Drive 2100 South	0	14
7222	Foothill Drive 1700 South	4	14
7221	Foothill Drive 2300 East	110	10
7220	Foothill Drive 1300 South	19	20
7503	Foothill Drive 2100 East	16	1
7219	Foothill Drive Sunnyside	110	105
7218	Foothill Drive Wakara Way (660 S.)	115	115
7217	Foothill Drive Mario Capecchi Dr (1950 E.)	0	0
		Avg: 42.0	

Approach Links (Select a link to view PCDs below)

Upstream Signal Id	Upstream Direction	Downstream Signal Id	Downstream Direction	% AOG Upstream Existing	% AOG Upstream Predicted	% AOG Downstream Existing	% AOG Downstream Predicted	AOG Upstream Existing	AOG Upstream Predicted	AOG Downstream Existing	AOG Downstream Predicted	Delta	Results Graph
7371	Southbound	7223	Northbound	96	96	84	85	1755	1756	1211	1215	4	

Metric: Purdue Link Pivot

Detection Requirements: Advance Counters

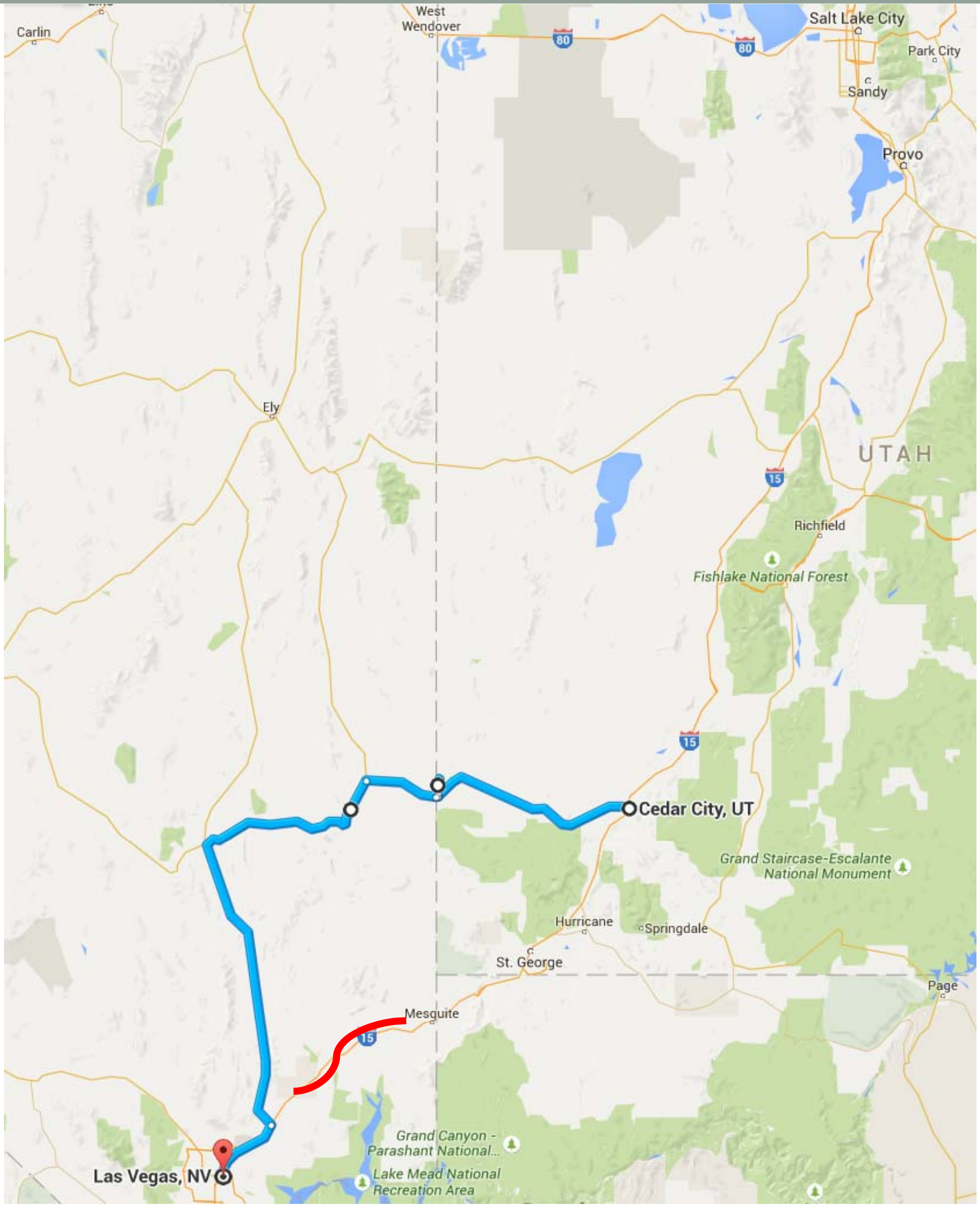


Metric: Executive Reports

Detection Requirements: Advance Counters

Heavy rain rips apart I-15 in Nevada, forces freeway closure

By Ken Ritter, Michelle Rindels , Associated Press | Posted Sep 9th, 2014 @ 7:44pm

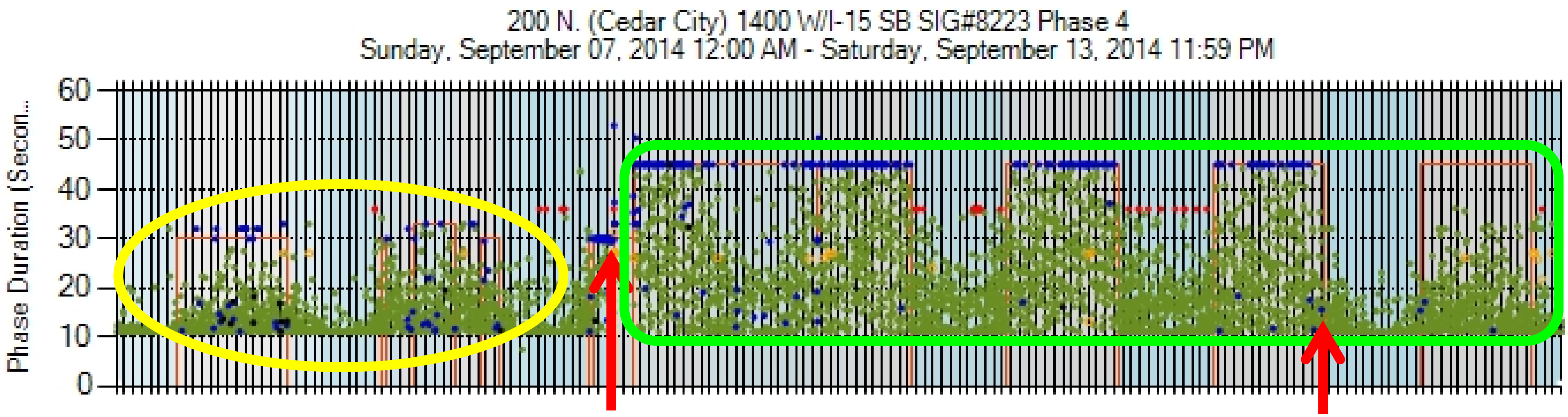


September 9, 2014 – September 12, 2014

- I-15 Closed Southbound in Nevada for 4 days.
- Detour thru Rural Cedar City
- Used ATMS
  - Signals on central system
    - Max Recall adj. signal – Provide gaps on the permissive left.
    - Increased green time.
  - CCTV, VMS, IMT, HAR

Optimization Example: Emergency Freeway Closure

Phase 4 shown – Freeway off-ramp
One week of data



Normal Traffic on Sunday and Monday

Increased traffic beginning Tuesday morning due to freeway washout in Nevada as shown by more frequent force-off and higher split being used

Implemented special timing plan to provide extra split

SB freeway reopened on Friday afternoon as shown by more frequent gap-out and lower split being used

Gap out

Pedestrian activation

Max out

Force off

Detection Requirements: None

Why Model What You Can Measure?

"Our success will not be measured by how much data we collect, but instead how we use the data to improve the operation of our transportation network."

– Steve Kuciemba - Parsons Brinckerhoff

"Well measured results that show a high return-on-investment is the key to receiving additional resources and sustained support."

– Mark Taylor – Utah Department of Transportation

Automated Signal Performance Measures

Purdue & INDOT helped us, in turn, we would like to help you.

2014 Project of the Year

2013 Quality Award

2013 Focus Technology

2014 Governor's Award of Excellence
– Innovation and Efficiency

Automated Traffic Signal Performance Measures

udottraffic.utah.gov/signalperformancemetrics

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AASHTO
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