

# ATSPM TRAIN-THE- TRAINER

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Traffic Signal Operations Engineer

Utah Department of Transportation

# Brief Utah Update

- 2019 Traffic Signals in the State of Utah
  - 1194 owned and operated by UDOT (59%)
  - 825 owned and operated by cities /counties (41%)



- All cities share same ITS communications
  - 94% of UDOT signals connected
  - 79% of non-UDOT signals connected



- All cities in Utah & UDOT share same ATMS





Started Development November 2012.

Estimate 6,000 hours of UDOT development  
November 2012 to January 2017.

# Old UDOT ATSPM Website (Verion 1-3)



## Signal Performance Metrics



Charts Reports Log Action Taken Links FAQ

->Signal Metrics

Selected Signal  
No Signal Selected

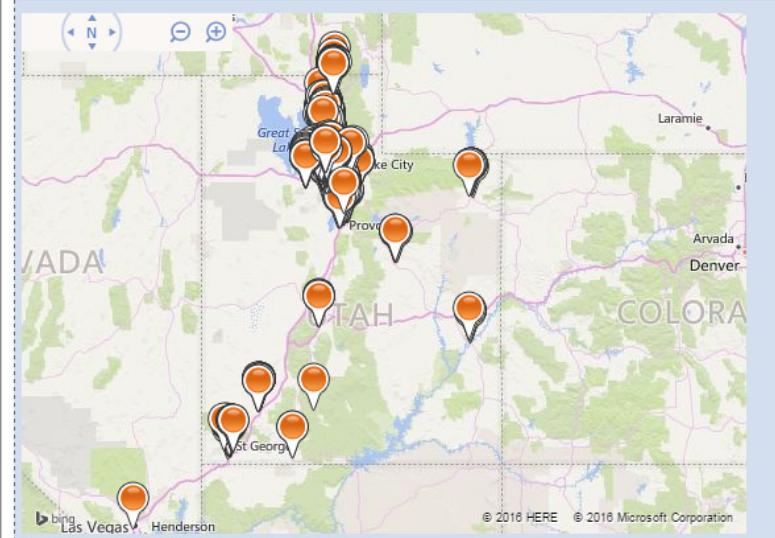
Signals

Region All  
Metric Type All  
Filter Signal Id

Filter Clear Filter

Signal List

Map



Metric Settings

Metric Type

- Purdue Phase Termination
- Approach Volume
- Split Monitor
- Approach Delay
- Pedestrian Delay
- Arrivals On Red
- Preemption Details
- Approach Speed
- Turning Movement Counts
- Yellow and Red Actuations
- Purdue Coordination Diagram
- Purdue Split Failure

Time Y Axis Maximum

150

Volume Y Axis Maximum

2000

Volume Bin Size

15

Dot Size

Small

Show Plan Statistics

Show Volumes

[Export Data](#)

Upload Current Data

Dates

Start Date 8/11/2016

12:00

AM

End Date 8/11/2016

11:59

PM

Reset Date

August 2016						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

[Create Metrics](#)

Version 3.1.5. Release Date: May 2016

# UDOT's New ATSPM Website (Version 4)

## <http://udottraffic.utah.gov/ATSPM>



Measures Reports Log Action Taken Links FAQ Admin About



Hello defaultadmin@spm.gov! Log off

Signal

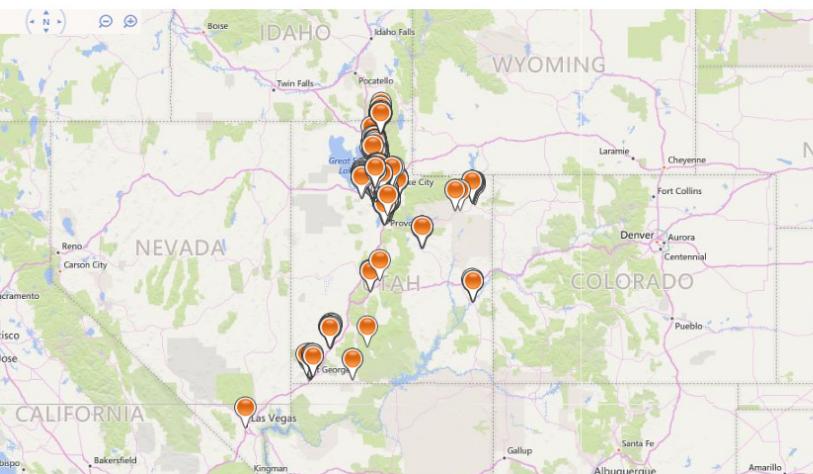
**Signal Selection**

**Signal ID**  
7220 Foothill Drive @ 1300 South

**Signal List**

**Signal Map**

Region: --Select Region-- Metric Type: --Select a Metric--



**Chart Selection**

**Metrics List**

- Purdue Phase Termination
- Split Monitor
- Pedestrian Delay
- Preemption Details
- Turning Movement Counts
- Purdue Coordination Diagram
- Approach Volume
- Approach Delay
- Arrivals On Red
- Approach Speed
- Yellow and Red Actuations
- Purdue Split Failure

**Phase Termination Options**

**V-axis Max**  
Auto

**Consecutive Count**  
1

Show Plans

Show Ped Activity

**Date Selection**

Start Date: 12/07/2016 12:00 AM

End Date: 12/07/2016 11:59 PM

Reset Date

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

**Create Chart**

Automated Traffic Signal Performance Measures Ver 4.0

**1749 (87%) Utah's traffic signals**

# ATSPM Basic Concept

Hi Def Data Logger  
included in controller  
firmware

Hi Def logs retrieved  
every 10-60 minutes  
from controller to server

Website to display  
SPM's



(Or...Retrieve data logs  
from controller manually  
using Raspberry Pi)

**A Central Signal System is NOT used or Needed!**

**Why Model what you can Measure?**

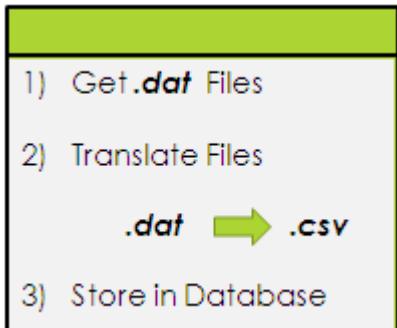
# System Requirements



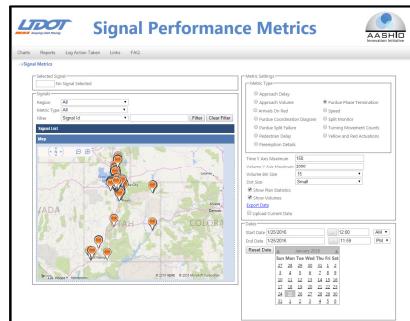
High-resolution Controller



Communications



Server



Software



Detection  
(optional)

# System Requirements

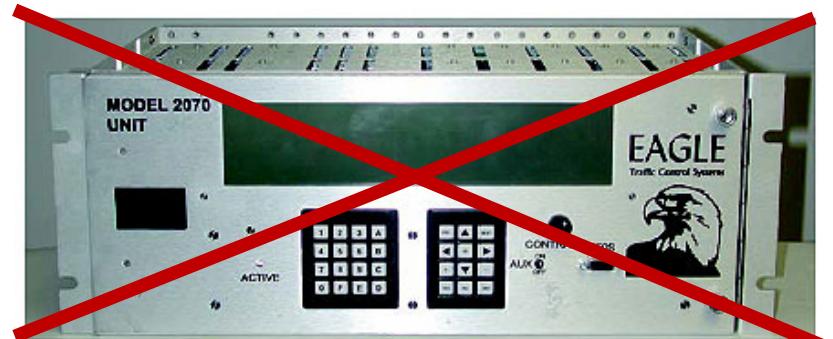


**High-resolution Controller with built in data logger using Indiana Enumerations**

- Econolite Cobalt: Any Version
- Econolite ASC3 NEMA: V. 2.50+
- Econolite 2070 with 1C CPU Module: V. 32.50+
- Intelight Maxtime: V. 1.7.0+
- Peek ATC Greenwave 03.05.0528+
- Trafficware 980ATC V. 76.10+
- McCain ATC eX NEMA: V. ?
- Siemens M50 Linux & M60 ATC
  - ECOM V. 3.52+
  - NTCIP V. 4.53+

**Data Logger records to the 1/10 second resolution**

**2070's don't work without 1C CPU**



# Objective: Vendor Neutrality



# Controller Enumerations

## Active Phase Events:

- 0 Phase On
- 1 Phase Begin Green
- 2 Phase Check
- 3 Phase Min Complete
- 4 Phase Gap Out
- 5 Phase Max Out
- 6 Phase Force Off
- 7 Phase Green Termination
- 8 Phase Begin Yellow Clearance
- 9 Phase End Yellow Clearance
- 10 Phase Begin Red Clearance
- 11 Phase End Red Clearance

## Detector Events:

- 81 Detector Off
- 82 Detector On
- 83 Detector Restored
- 84 Detector Fault- Other
- 85 Detector Fault- Watchdog Fault
- 86 Detector Fault- Open Loop Fault

## Preemption Events:

- 101 Preempt Advance Warning Input
- 102 Preempt (Call) Input On
- 103 Preempt Gate Down Input Received
- 104 Preempt (Call) Input Off
- 105 Preempt Entry Started

11-2012

# Indiana Traffic Signal Hi Resolution Data Logger Enumerations

James R. Sturdevant

*INDOT, jsturdevant@indot.in.gov*

Timothy Overman

*INDOT*

Eric Raamot

*Econolite Group Inc.*

Ray Deer

*Peek Traffic Corporation*

Dave Miller

*Siemens Industry, Inc.*

*See next page for additional authors*

**<http://docs.lib.purdue.edu/jtrpdata/3/>**

# Controller Enumerations

## Active Phase Events:

- 0 Phase On
- 1 Phase
- 2 Phase
- 3 Phase
- 4 Phase
- 5 Phase
- 6 Phase
- 7 Phase
- 8 Phase
- 9 Phase
- 10 Phase
- 11 Phase

## Preemption Event

- 101 Preempt
- 102 Preempt
- 103 Preempt
- 104 Preempt
- 105 Preempt

## Detector Events:

- 81 Detector Off

Purdue University  
Purdue e-Pubs

JTRP Data Papers

11-2012

Indiana Traffic Signal Hi Resolution Data Logger  
Enumerations

James R. Sturdevant  
*INDOT, jsturdevant@indot.in.gov*

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<http://docs.lib.purdue.edu/jtrpdata/3/>

See next page for additional authors

# High-resolution Data

Timestamp	Event Code	Event Parameter
6/27/2013 1:29:51.1	10	8
6/27/2013 1:29:51.1	82	5
6/27/2013 1:29:52.2	1	2
6/27/2013 1:29:52.2	1	6
6/27/2013 1:29:52.3	82	2
6/27/2013 1:29:52.8	82	4
6/27/2013 1:29:52.9	81	4
6/27/2013 1:29:53.3	81	6
6/27/2013 1:29:54.5	81	2
6/27/2013 1:30:02.2	8	2
6/27/2013 1:30:02.2	8	6
6/27/2013 1:30:02.2	33	2
6/27/2013 1:30:02.2	33	6
6/27/2013 1:30:02.2	32	2
6/27/2013 1:30:02.2	32	6
6/27/2013 1:30:06.1	10	2
6/27/2013 1:30:06.1	10	6
6/27/2013 1:30:08.1	1	8
6/27/2013 1:30:13.1	32	8
6/27/2013 1:30:15.8	81	5
6/27/2013 1:30:18.5	82	6
6/27/2013 1:30:27.5	81	6
6/27/2013 1:30:30.4	8	8

# Objective: Vendor Neutrality





**PURDUE**  
UNIVERSITY



# 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



# POOLED FUND STUDY

## INDIANAPOLIS

NOVEMBER 12, 2014



PERFORMANCE MEASURES FOR  
TRAFFIC SIGNAL SYSTEMS

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*An Outcome-Oriented Approach*



Christopher M. Day, Darcy M. Bullock, Howell Li, Stephen M. Romas, Alexander M. Hansen, Richard S. Freije, Amanda L. Stevens, James R. Shastevan, and Thomas M. Brinavan

 PURDUE  


# Salt Lake ATSPM Workshop Participants – Jan 2016



***170 Representatives from 85 Different Organizations, 28 States, DC, & Canada***

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## PRESENTATIONS FROM JANUARY 26-27, 2016



2016

### Tuesday, January 26th

**Traffic Signal Performance Measures Workshop**

*Darcy Bullock, Purdue University*

**TSM&O in Florida**

*Raj Ponnaluri, Florida Department of Transportation*

**Automated Traffic Signal Performance Measures, AASHTO Innovation Initiative 2013 Focus Technology**

*Rob Clayton, Utah Department of Transportation*

**Lessons Learned from ASCT and Systems Engineering**

*Eddie Curtis, Federal Highway Administration*

**Transportation Pooled Fund Program Recap**

*Jim Sturdevant, Indiana Department of Transportation  
Richard Denney, Federal Highway Administration*

**Public/Private Partnerships: Expanding the Reach of Traffic Signals**

*Lynne Yocom, Utah Department of Transportation*



ITE 3-part Webinar  
April, May, June 2014

BOOKSTORE EMPLOYMENT CENTER TECHNICAL INFORMATION

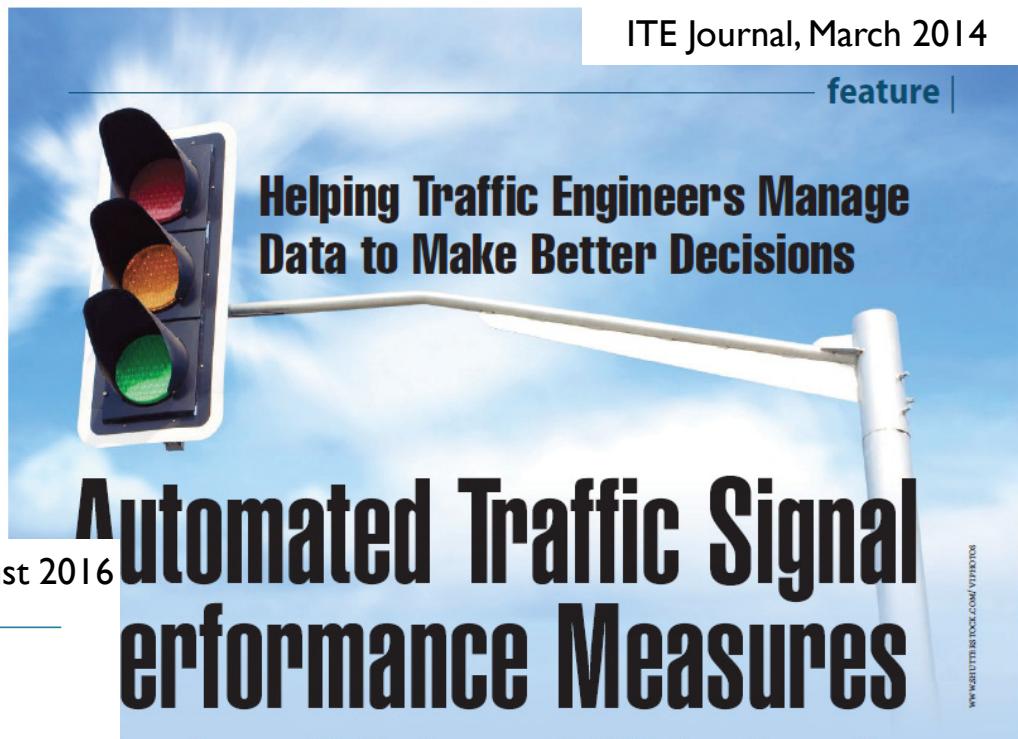
ABOUT ITE JOIN ITE TODAY! COUNCILS

Automated Traffic Signal Performance Measures

ITE Journal, August 2016

# Implementation of Automated Traffic Signal Performance Measures

BY CHRISTOPHER M. DAY, PH.D., MARK TAYLOR, P.E., PTOE,  
JAMIE MACKEY, P.E., PTOE, ROB CLAYTON, P.E., PTOE,  
SHITAL K. PATEL, P.E., GANG XIE, P.E., HOWELL LI,  
JAMES R. STURDEVANT, P.E., AND DARCY BULLOCK, P.E.



ITE Journal, March 2014

feature |

## Helping Traffic Engineers Manage Data to Make Better Decisions

# Automated Traffic Signal Performance Measures

DARCY BULLOCK, P.E., ROB CLAYTON, P.E., PTOE, JAMIE MACKEY, P.E.,  
SHITAL K. PATEL, P.E., PTOE, GANG XIE, P.E., HOWELL LI,  
JAMES R. STURDEVANT, P.E., AND MARK TAYLOR, P.E., PTOE

- Improved signal operations with smooth and equitable traffic flow are goals for most traffic engineers; however the limited snapshot-view retiming methods that involve manual data collection, traffic signal modeling, and field fine-tuning are resource intensive and unresponsive to changes in traffic patterns. The National Transportation Operations Coalition's 2012 National Traffic Signal Report Card has led agencies to focus on these activities and develop methodologies to examine all the components of traffic signal operations.<sup>1</sup> These data-driven program management plans provide objective methods for identifying shortcomings and encourages coordination with neighboring jurisdictions. In addition, agencies need tools to prioritize activities when resources are constrained.

# Public Records (GRAMA) – What Do We Do?

- We give them raw records of what they are asking for – what we have - if we have it.
  - This may include the entire signal database for the intersection being requested.
    - We will define direction with phase number since this is not in the database.
  - This may include the raw hi def data logs (CSV format).
    - We give them a link to the Purdue website that defines the enumerations.
    - They have no idea what to do with the raw data.
- We DO NOT create new records or refer them to ATSPM website.
- We DO NOT interpret or explain any of the data, even if they call or visit us. We do not help them sue us.

# Sample – No headers, no contact info

This is in response to the request for the timing sequence for the traffic signal at ADDRESS on DATE & TIME. Provided is the database from the traffic signal controller that was in use on the above referenced date.

Also provided are the high resolution data logs from the signal controller from TIME AND DATE TO TIME AND DATE. In interpreting these logs, please reference *Indiana Traffic Signal Hi Resolution Data Logger Enumerations*, published by Purdue University, November 2012, available at (<http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1002&context=jtrpdata>). These logs are generated automatically and have not been checked for completeness.

In the provided database from the traffic signal controller, the phase numbers reference these movements (PLEASE SELECT OR MODIFY THE DESCRIPTION BELOW):

- Phase 1: Eastbound to northbound left
- Phase 2: Westbound thru
- Phase 3: Southbound to eastbound left
- Phase 4: Northbound thru
- Phase 5: Westbound to southbound left
- Phase 6: Eastbound thru
- Phase 7: Northbound to westbound left
- Phase 8: Southbound thru



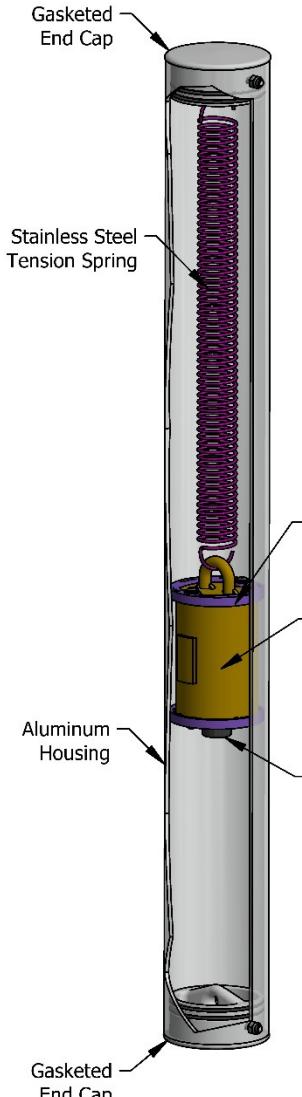
STRUCTURES

# MITIGATOR TR1 TRAFFIC DAMPER UDOT

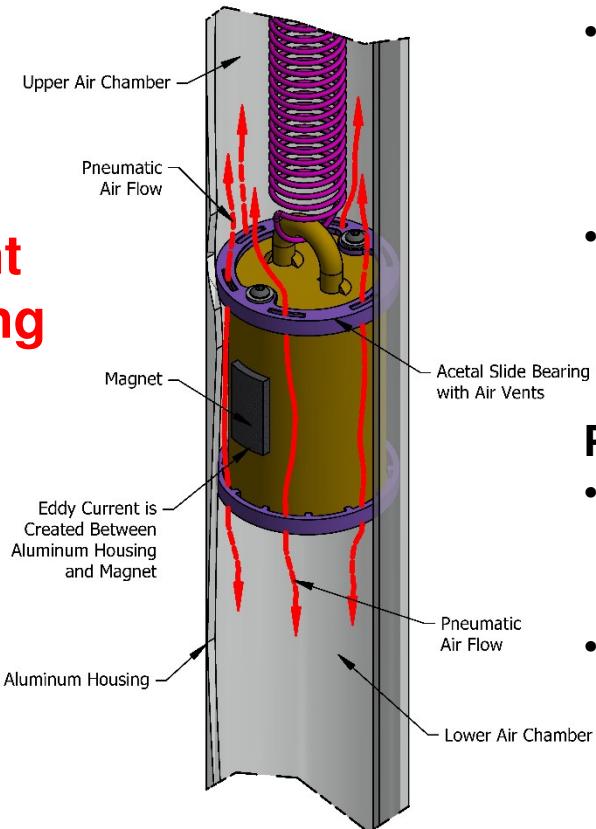
LTCS Engineering  
01-19-2017

Carl Macchietto, P.E.

# TR1 Damper Technology (Eddy Current + Pneumatic)



**Patent Pending**



## Eddy Current:

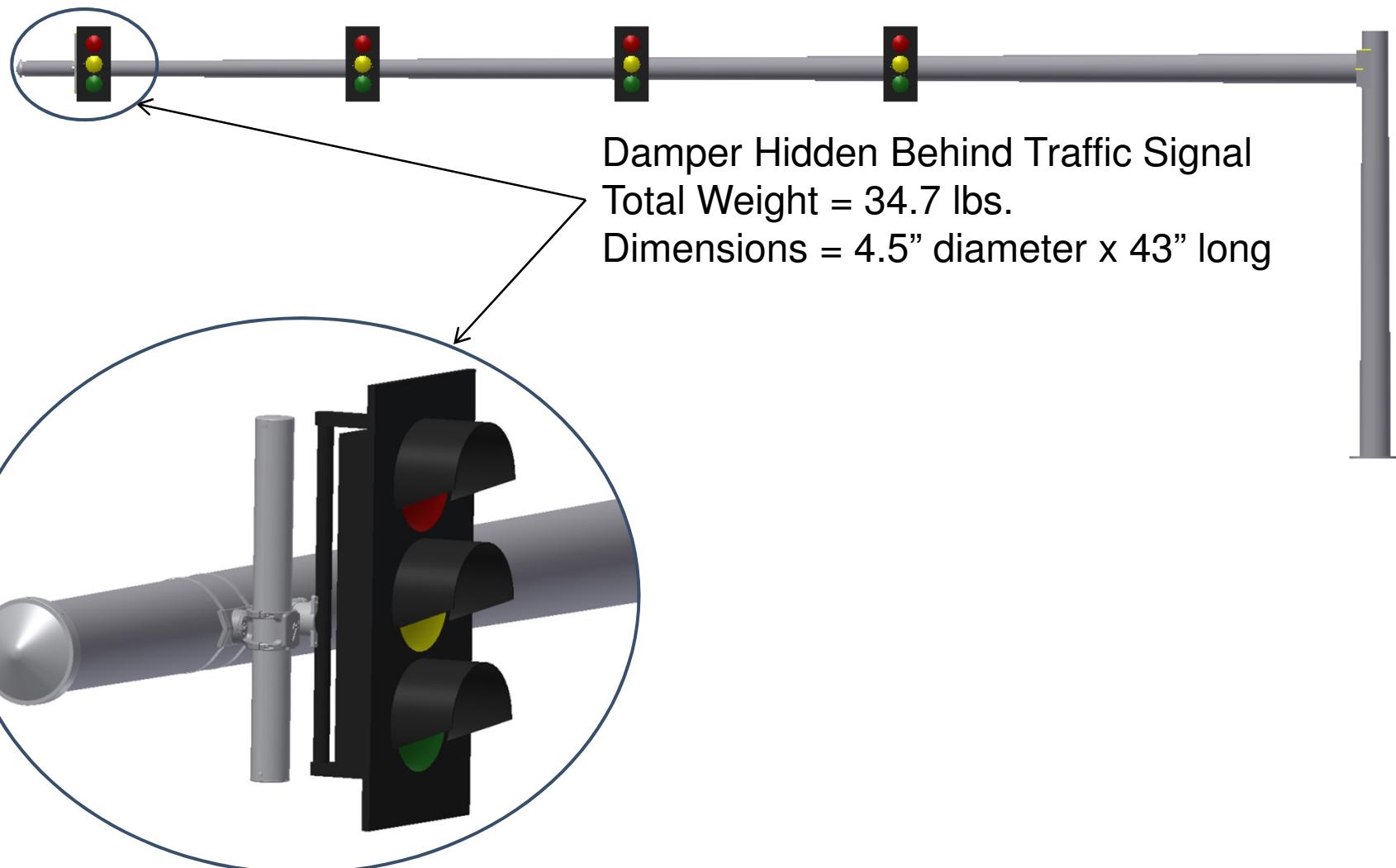
- Eddy currents are circular electric currents induced within conductors by the movement of a magnet next to the conductive material.
- These circular currents are opposite the direction of movement creating a resistance and thus damping.

## Pneumatic:

- Pneumatic Damping occurs as steel weight translates up and down within a sealed chamber.
- The exchange of air from the upper air chamber to the lower air chamber creates this resistance.

The Valmont TR1 Vibration Damper has both eddy current damping and pneumatic damping resulting in a reduction of mast arm movement generally over 90% in most situations.

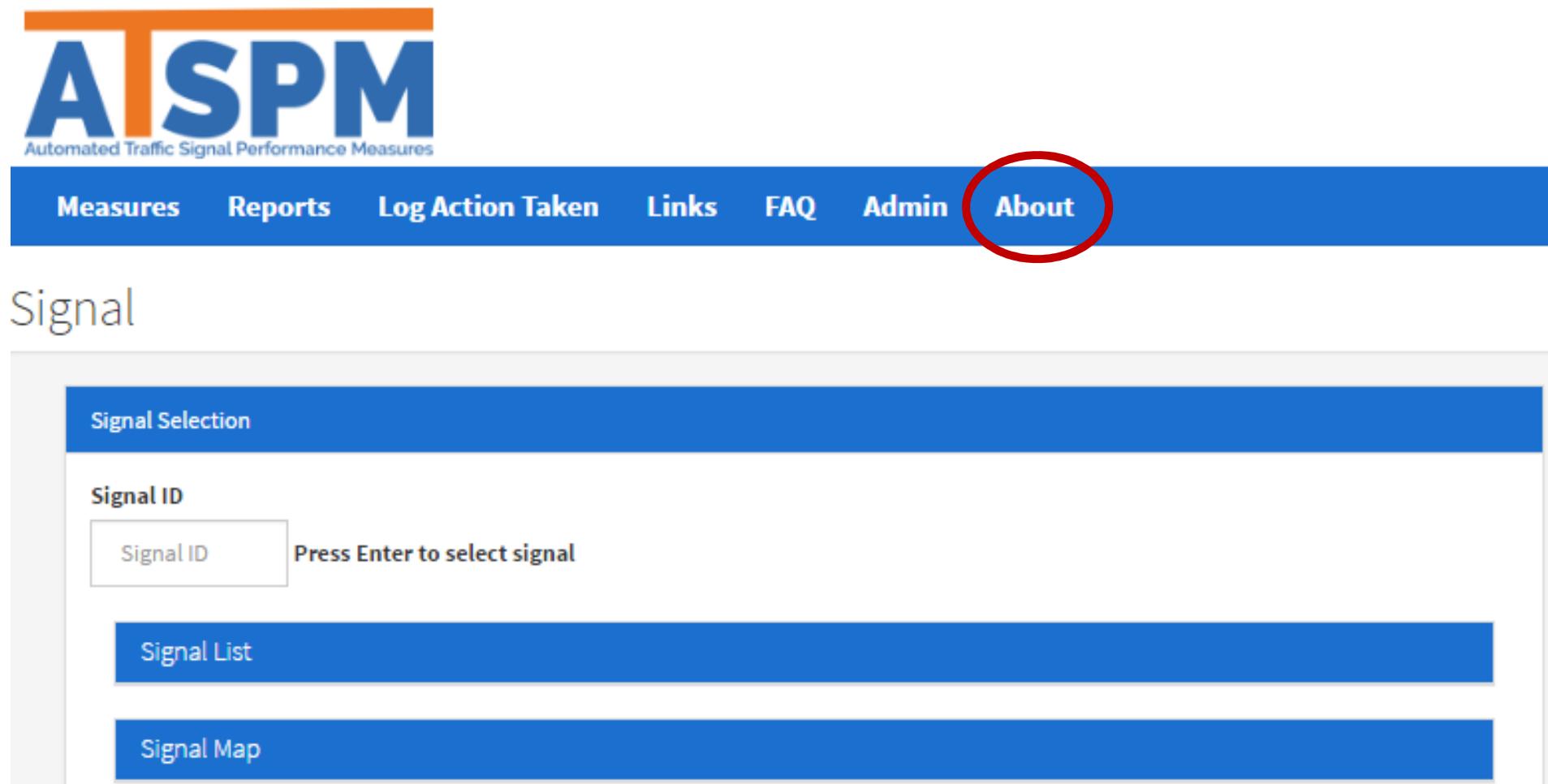
# Mitigator TR1 Vibration Damper



# Mitigator TR-1 Damper Field Tests with Utah DOT

SR-36 & Bates Canyon Road – P4 Free Vibration Tests

# ABOUT Tab – ATSPM website



The screenshot shows the ATSPM website interface. At the top, there is a navigation bar with the following links: Measures, Reports, Log Action Taken, Links, FAQ, Admin, and About. The 'About' link is circled in red. Below the navigation bar, the word 'Signal' is displayed in a large, bold, brown font. Underneath 'Signal', there is a 'Signal Selection' section. This section includes a 'Signal ID' input field containing the placeholder text 'Signal ID' and the instruction 'Press Enter to select signal'. There are also two other buttons: 'Signal List' and 'Signal Map', both in blue text on blue backgrounds.

# ABOUT Tab Information – What's New & Up Next

## What's New

### Version 4.0

- Mobile Friendly
- ADA Compliant
- Enhanced Security
- Link Pivot Redone
- Easier Installation
- Conversion to use Entity Framework
- Conversion to MVC with Bootstrap
- New About Page
- New Logo

## What's Next

UDOT is continually improving and updating the software. Currently we are working on the following features:

- Read-Only signal configuration option
- Modify Preemption Metric so it is more readable
- Modify Purdue Split Failure to accommodate permissive left turns
- Modify Yellow and Red Actuations to accommodate permissive left turns
- Comprehensive GDOT documentation

# Currently Being Worked On (part 1)

- Add a read-only signal configuration table & route setup that is viewable and accessible by all.
- Modify preemption metric so it is more readable.
- Modify Purdue Split Failure to accommodate permissive left turns.
- Modify Yellow & Red actuations to accommodate permissive left turns.
- Add detector type & accuracy information to configuration tool and charts.

# Currently Being Worked On (part 2)

- Add summary table to Turning Movement Counts (like approach volumes).
- Standardize chart headers
- Fix calendar so it displays entire weeks, including possibly last few days of the last month and/or first few days of the next month.
- Add additional text to the FAQ's.
- Route configuration – add some text at the top explaining how to add phase/directions.
- Security – Provide a table showing users and roles. Also, to allow a user to be deleted from system.

# What's Up Next – Mid Future (??)

- Bring back Executive Reports
- Vegas Metrics
  - Defining phase direction
  - Time-Space Diagram
- Purdue Link Pivot – high-level analysis tracker & alert
- Cycle-by-Cycle metric (bicycle crash example)
- Daily Alert enhancements
- QC check of all metrics

# UDOT Asset Management Tiers (2015 & Prior)

- Asset Management Tiers range from 1 to 3
- Tier 1 assets:
  - Highest value combined with highest risk of negative financial impact for poor management.
  - Very important to UDOT.
  - Receive separate funding source.
  - Targets and measures are set and tracked.

Tier 1 Assets	Tier 2 Assets	Tier 3 Assets
Pavement	ATMS / Signal Devices	Cattle Guards
Bridges	Pipe Culverts	Interstate Lighting
	Signs	Fences
	Barriers & Walls	Curb & Gutter
	Rumble Strips	Rest Areas
	Pavement Markings	

Source: <https://www.udot.utah.gov/main/uconowner.gf?n=15663419239657232>

# UDOT Asset Management Tiers (2016 & Future)

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## Tier 1 Assets

Pavement

Bridges

ATMS / Signal Devices



## Tier 2 Assets

Pipe Culverts

Signs

Barriers & Walls

Rumble Strips

Pavement Markings

## Tier 3 Assets

Cattle Guards

Interstate Lighting

Fences

Curb & Gutter

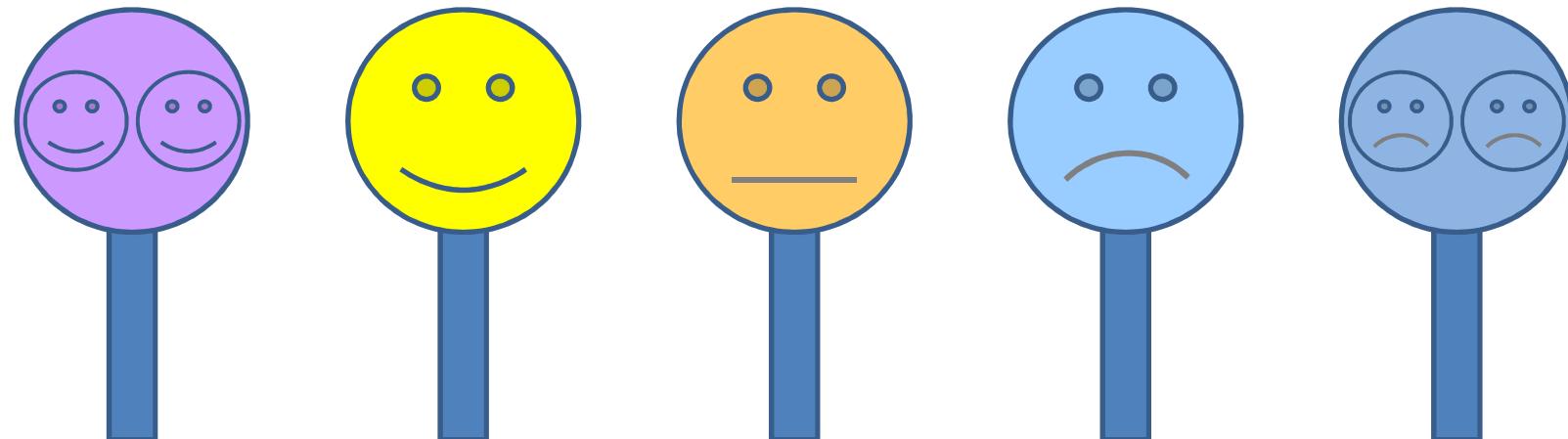
Rest Areas

# UDOT Signal Timing Focus Group (July 2014)

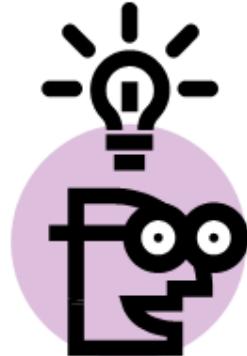
- *How do you feel about UDOT?*



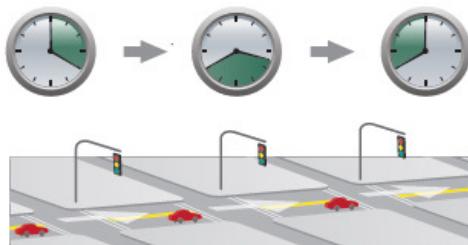
- *How do traffic signals make you feel?*



# Focus Group Key Findings (July 2014)



UDOT is perceived positively, with innovation as the primary driver of positive impressions.



Drivers believe traffic signal synchronization is improving.



Drivers feel UDOT should be open about its accomplishments in a way that protects its credibility.

# 60 S Commercial – Love green lights? So do UDOT traffic engineers



<http://udot.utah.gov/greenlights>



[udottraffic.utah.gov/ATSPM](http://udottraffic.utah.gov/ATSPM)

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