ATSPM TRAIN-THE-TRAINER

Mark Taylor, P.E., PTOE
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 (Version 1-3)
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

A Central Signal System is **NOT used** or Needed!
Why **Model** what you can **Measure**?
System Requirements

High-resolution Controller

Communications

Server

1) Get .dat Files
2) Translate Files
   .dat → .csv
3) Store in Database

Software

Detection (optional)

Photo courtesy of the Indiana Department of Transportation
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

<table>
<thead>
<tr>
<th>Active Phase Events:</th>
<th>Detector Events:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0  Phase On</td>
<td>81  Detector Off</td>
</tr>
<tr>
<td>1  Phase Begin Green</td>
<td>82  Detector On</td>
</tr>
<tr>
<td>2  Phase Check</td>
<td>83  Detector Restored</td>
</tr>
<tr>
<td>3  Phase Min Complete</td>
<td>84  Detector Fault - Other</td>
</tr>
<tr>
<td>4  Phase Gap Out</td>
<td>85  Detector Fault - Watchdog Fault</td>
</tr>
<tr>
<td>5  Phase Max Out</td>
<td>86  Detector Fault - Open Loop Fault</td>
</tr>
<tr>
<td>6  Phase Force Off</td>
<td></td>
</tr>
<tr>
<td>7  Phase Green Termination</td>
<td></td>
</tr>
<tr>
<td>8  Phase Begin Yellow Clearance</td>
<td></td>
</tr>
<tr>
<td>9  Phase End Yellow Clearance</td>
<td></td>
</tr>
<tr>
<td>10 Phase Begin Red Clearance</td>
<td></td>
</tr>
<tr>
<td>11 Phase End Red Clearance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preemption Events:</th>
</tr>
</thead>
<tbody>
<tr>
<td>101 Preempt Advance Warning Input</td>
</tr>
<tr>
<td>102 Preempt (Call) Input On</td>
</tr>
<tr>
<td>103 Preempt Gate Down Input Received</td>
</tr>
<tr>
<td>104 Preempt (Call) Input Off</td>
</tr>
<tr>
<td>105 Preempt Entry Started</td>
</tr>
</tbody>
</table>

[http://docs.lib.purdue.edu/jtrpdata/3/](http://docs.lib.purdue.edu/jtrpdata/3/)
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:

<table>
<thead>
<tr>
<th></th>
<th>Phase Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Phase On</td>
</tr>
<tr>
<td>1</td>
<td>Phase</td>
</tr>
<tr>
<td>2</td>
<td>Phase</td>
</tr>
<tr>
<td>3</td>
<td>Phase</td>
</tr>
<tr>
<td>4</td>
<td>Phase</td>
</tr>
<tr>
<td>5</td>
<td>Phase</td>
</tr>
<tr>
<td>6</td>
<td>Phase</td>
</tr>
<tr>
<td>7</td>
<td>Phase</td>
</tr>
<tr>
<td>8</td>
<td>Phase</td>
</tr>
<tr>
<td>9</td>
<td>Phase</td>
</tr>
<tr>
<td>10</td>
<td>Phase</td>
</tr>
<tr>
<td>11</td>
<td>Phase</td>
</tr>
</tbody>
</table>

Preemption Event

<table>
<thead>
<tr>
<th></th>
<th>Preemtion</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Preemtion</td>
</tr>
<tr>
<td>102</td>
<td>Preemtion</td>
</tr>
<tr>
<td>103</td>
<td>Preemtion</td>
</tr>
<tr>
<td>104</td>
<td>Preemtion</td>
</tr>
<tr>
<td>105</td>
<td>Preemtion</td>
</tr>
</tbody>
</table>

Detector Events:

<table>
<thead>
<tr>
<th></th>
<th>Detector Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>Detector Off</td>
</tr>
</tbody>
</table>

11-2012

Indiana Traffic Signal Hi Resolution Data Logger Enumerations

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

Timothy Overman
INDOT

Eric Raamot
Ecomolite 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/
# High-resolution Data

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Event Code</th>
<th>Event Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/27/2013 1:29:51.1</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>6/27/2013 1:29:51.1</td>
<td>82</td>
<td>5</td>
</tr>
<tr>
<td>6/27/2013 1:29:52.2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6/27/2013 1:29:52.2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:29:52.3</td>
<td>82</td>
<td>2</td>
</tr>
<tr>
<td>6/27/2013 1:29:52.8</td>
<td>82</td>
<td>4</td>
</tr>
<tr>
<td>6/27/2013 1:29:52.9</td>
<td>81</td>
<td>4</td>
</tr>
<tr>
<td>6/27/2013 1:29:53.3</td>
<td>81</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:29:54.5</td>
<td>81</td>
<td>2</td>
</tr>
<tr>
<td>6/27/2013 1:30:02.2</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>6/27/2013 1:30:02.2</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:30:02.2</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>6/27/2013 1:30:02.2</td>
<td>33</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:30:02.2</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>6/27/2013 1:30:02.2</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:30:06.1</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>6/27/2013 1:30:06.1</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:30:08.1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>6/27/2013 1:30:13.1</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>6/27/2013 1:30:15.8</td>
<td>81</td>
<td>5</td>
</tr>
<tr>
<td>6/27/2013 1:30:18.5</td>
<td>82</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:30:27.5</td>
<td>81</td>
<td>6</td>
</tr>
<tr>
<td>6/27/2013 1:30:30.4</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
Objective: Vendor Neutrality
PERFORMANCE MEASURES FOR TRAFFIC SIGNAL SYSTEMS

An Outcome-Oriented Approach

POOLED FUND STUDY
INDIANAPOLIS
NOVEMBER 12, 2014
Salt Lake ATSPM Workshop Participants – Jan 2016

170 Representatives from 85 Different Organizations, 28 States, DC, & Canada
PRESENTATIONS FROM JANUARY 26–27, 2016

2016

Tuesday, January 26th

Traffic Signal Performance Measures Workshop
Darcy Bullock, Purdue University

TSM&Q in Florida
Raj Ponnaluri, Florida Department of Transportation

Automated Traffic Signal Performance Measures, AASHTO Innovation Initiative 2013 Focus Technology
Rob Claydon, Utah Department of Transportation

Lessons Learned from ASCT and Systems Engineering
Eddie Curtiss, Federal Highway Administration

Transportation Pooled Fund Program Recap
Jim Stardevant, Indiana Department of Transportation
Richard Denney, Federal Highway Administration

Public/Private Partnerships: Expanding the Reach of Traffic Signals
Lynne Yocom, Utah Department of Transportation

http://docs.lib.purdue.edu/atspmw
Implementation of Automated Traffic Signal Performance Measures

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 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
MITIGATOR TR1 TRAFFIC DAMPER
UDOT

Carl Macchietto, P.E.
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.

**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.
Mitigator TR1 Vibration Damper

Damper Hidden Behind Traffic Signal
Total Weight = 34.7 lbs.
Dimensions = 4.5” diameter x 43” long
Mitigator TR-1 Damper Field Tests with Utah DOT

SR-36 & Bates Canyon Road – P4 Free Vibration Tests
ABOUT Tab – ATSPM website

Signal

Signal Selection

Signal ID

Signal List

Signal Map
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.

<table>
<thead>
<tr>
<th>Tier 1 Assets</th>
<th>Tier 2 Assets</th>
<th>Tier 3 Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement</td>
<td>ATMS / Signal Devices</td>
<td>Cattle Guards</td>
</tr>
<tr>
<td>Bridges</td>
<td>Pipe Culverts</td>
<td>Interstate Lighting</td>
</tr>
<tr>
<td></td>
<td>Signs</td>
<td>Fences</td>
</tr>
<tr>
<td></td>
<td>Barriers &amp; Walls</td>
<td>Curb &amp; Gutter</td>
</tr>
<tr>
<td></td>
<td>Rumble Strips</td>
<td>Rest Areas</td>
</tr>
<tr>
<td></td>
<td>Pavement Markings</td>
<td></td>
</tr>
</tbody>
</table>

Source: https://www.udot.utah.gov/main/uconowner.gf?n=15663419239657232
UDOT Asset Management Tiers (2016 & Future)

- 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.

<table>
<thead>
<tr>
<th>Tier 1 Assets</th>
<th>Tier 2 Assets</th>
<th>Tier 3 Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement</td>
<td>Pipe Culverts</td>
<td>Cattle Guards</td>
</tr>
<tr>
<td>Bridges</td>
<td>Signs</td>
<td>Interstate Lighting</td>
</tr>
<tr>
<td>ATMS / Signal Devices</td>
<td>Barriers &amp; Walls</td>
<td>Fences</td>
</tr>
<tr>
<td></td>
<td>Rumble Strips</td>
<td>Curb &amp; Gutter</td>
</tr>
<tr>
<td></td>
<td>Pavement Markings</td>
<td>Rest Areas</td>
</tr>
</tbody>
</table>

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