CONFIGURATION UTILITY

UDOT Automated Traffic Signal Performance Measures

Jamie Mackey, P.E, PTOE
UDOT Statewide Signal Engineer
jamiemackey@utah.gov

UDOT ATSPM Train-the-trainer Workshop • Salt Lake City, UT • January 18-19, 2017
ATSPM Configuration

Signal

- Signal ID
- Street Names
- IP Address
- Lat/long
- Region
- Controller Type
- Chart Notes

Approach

- Direction
- Protected Phase
- Permissive Phase
- Description

Detector

- Detector Channel
- Detection Type
- Lane & Movement Type
- Date Added
- Internal Comment
- Detection-specific Parameters
ATSPM Configuration - Signal

If unchecked, signal will still show in Signal List. If unchecked and IP is configured, the system will still retrieve data.

Expand to create notes that will appear when displaying a metric for this signal.
ATSPM Configuration – Approach

### SBL Ph1 (3 Detector(s))

<table>
<thead>
<tr>
<th>Direction</th>
<th>Description</th>
<th>Protected Phase</th>
<th>Permissive Phase</th>
<th>Overlap</th>
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- **Approach direction**: Indicates the number in Protected Phase is the overlap number.
- **Informational text for Phase/Direction header**: Detector’s primary phase. Usually the phase for through movement and the protected phase for P&P left turns.
- **Secondary phase for detector**: Usually 0 for through movements and protected-only left turns. Input the permissive phase for P&P left turns.

### SBL Ph1(6) (2 Detector(s))

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<tr>
<th>Direction</th>
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<th>Overlap</th>
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- **Approach direction**: Indicates the number in Protected Phase is the overlap number.
ATSPM Configuration – Detection

EBT Ph 4 (7 Detector(s))

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Detectors

- Detector 722036
- Detector 722039
- Detector 722040
- Detector 722041
- Detector 722042
- Detector 722051
- Detector 722052
ATSPM Configuration – Detection

Detector 722020

Det Channel | Lane Number (Lane-by-lane Count) | Date Added
---|---|---
20 | 1 | 3/27/2015 12:00:00 AM

Detection Types
- Advanced Count
- Advanced Speed
- Lane-by-lane Count
- Lane-by-lane with Speed Restriction
- Stopbar Presence

Movement Type (Lane-by-lane Count)
- Thru-Right

Lane Type (Lane-by-lane Count)
- Vehicle

Currently unused

Internal only
## ATSPM Configuration – Configuration Table

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DETECTION TYPES

UDOT Automated Traffic Signal Performance Measures

Jamie Mackey, P.E, PTOE
UDOT Statewide Signal Engineer
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<tr>
<th>Detection</th>
<th>Metric</th>
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<td>Lane-by-lane Stop Bar Count</td>
<td>Turning Movement Counts Approach Volume</td>
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<td>Purdue Coordination Diagram Approach Volume</td>
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<td>Advanced Speed</td>
<td>Approach Speed (requires detection with speed service)</td>
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Detection – Lane-by-lane Presence

**Date detector added. Currently has no impact but may be used to set the valid dates for the configuration.**

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**Detection Types**
- Advanced Count
- Advanced Speed
- Lane-by-lane Count
- Lane-by-lane with Speed Restriction
- Stopbar Presence

**Movement Type (Lane-by-lane Count)**
- Thru

**Detector Comment**
- 11/16/2016 4:48:04 PM - Added
- 3/8/2016

**Optional**
Detection – Lane-by-lane Count

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Detection Types:
- Advanced Count
- Advanced Speed
- Lane-by-lane Count
- Lane-by-lane with Speed Restriction
- Stopbar Presence

Movement Type (Lane-by-lane Count):
- Thru

Lane Type (Lane-by-lane Count):
- Vehicle

Detector Comment
Detection – Lane-by-lane Count w/ Speed Restriction

Detector 709524

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**Detection Types**
- Advanced Count
- Advanced Speed
- Lane-by-lane Count
- Lane-by-lane with Speed Restriction
- Stopbar Presence

**Movement Type (Lane-by-lane Count)**
- Thru

**Lane Type (Lane-by-lane Count)**
- Vehicle

Detector Comment

Optional
**Detection – Advanced Count & Speed**

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**Applies only to PCD metric:** Detector distance from stop bar in feet. Detector actuations will be offset to arrival at the stop bar based on the distance and MPH configured.

**Optional**

**Applies only to Speed metric:**
- Speeds below this number (mph) will not be included in the speed metric.
- Number of seconds after start of green to start using speed data. Should be roughly the queue clearance time to the detector. Usually 15s.
Wavetronix Matrix
Standard Detection Layout w/ Click 650

Detection Channel Order
1. Presence zones, inside to outside. If P&P zones, the queue zone is first.
2. Count channels, inside to outside
3. YRA zones, inside to outside
4. Count zones in exit lanes, inside to outside (often skipped)

Matrix Sensor Order
1. Phase 2
2. Phase 6
3. Phase 4
4. Phase 8

Queue zone for P&P left turns
Presence zones can be combined within lane groups
No presence or YRA in right-turn lane

Protected-only left-turn lanes
Presence zones can be combined within lane groups
No YRA in shared through/right lane

65’ or 50’ Presence zone, used for Split Failure
15’ Presence zone w/ 3-sec delay in controller, not used for SPMs
Small zone, used for Turning Movement Counts
Small zone with 15 mph min speed filter, used for Yellow & Red Actuations (Note: Place immediately in front of stop bar and do not use in lanes that permit turns on red)
Wavetronix Matrix Configuration for TMC & YRA

Turning Movement Counts

Yellow & Red Actuations
Ch1 is for Dilemma Zone and Queue

Monitor trackers and place count zone at distance with good detection
Appendix A. Wavetronix SmartSensor Advance Configuration

In order to use a Wavetronix SmartSensor Advance with the ATSPM Speed Listener, it is necessary to configure the hardware to communicate with the system. There are two components of relevance to ATSPM, a Serial to Ethernet converter and the SmartSensor Device itself. UDOT has used the Digi PortServer TS 4 serial to Ethernet converter (aka “Digis”) in order to retrieve speed data from the Wavetronix SmartSensor Advance; however, other serial to Ethernet converters may work as well.

This appendix only covers configuration specifically related to ATSPM connection using Digi PortServers. For further information on SmartSensor configuration, please contact Wavetronix.

A.1. Serial to Ethernet Converter Configuration

Configure each port pushing speed data on the Digis as follows:

Set the Port Profile to either TCP or UDP Sockets (Select Change Profile to make a change). TCP sockets are preferred as they are more secure, more reliable and are native to the Wavetronix Advance and Matrix SmartSensors (as they are written around TCP internet protocols).

TCP:

1. Under the TCP Server Port Security Settings, check the box Only allow network access from the following devices or networks. In the IP Address box, type in the IP address of the server to receive the data. Under the Advanced Settings Terminal Type: box, type in “vt100”, enable VERBOSE connection status message and enable Enable RTS Toggle with 0 ms for both Pre-delay and Post-delay.
2. Click the Apply button.

UDP:

1. Under the UDP Client enter the following settings: In the Send data to: box, type the name of the SMP server in Description, its IP address in Send To, “10088” in UDP Port, then click the Add button. Both this IP address and port must be publicly accessible.
### Econolite Controllers: Count Detector Setup

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</table>

Enable ECPI Log for count zones on channels assigned to Phase 0.
Econolite Controllers: Data Logger Setup

DATABASE DIAGNOSTICS

CONFIGURATION TRANSFER IN PROGRESS.. UP

DATABASE STATE................. ALL SAVED

DIAG CMD.. NO ACTION VIOT TRACE ENA. NO
METRICS

UDOT Automated Traffic Signal Performance Measures

Jamie Mackey, P.E, PTOE
UDOT Statewide Signal Engineer
Metric: Phase Termination Chart

Detection Requirements: None
Complaint: Long red at 2 a.m., no other traffic

Before

Video detection not working at night

Minor street through & left turn max out at night only

Metric: Purdue Phase Termination
Detection Requirements: None
Complaint: Long red at 2 a.m., no other traffic

After

New detection technology installed

Phases are rarely used at night

Gap out  Pedestrian activation
Max out  Skip
Force off

Metric: Purdue Phase Termination
Detection Requirements: None
Metric: Split Monitor

Detection Requirements: None
Complaint: Long queue, short green

Split Monitor shows mostly gap outs

Passage time increased.

Detection Requirements: None
Example: I-15 Freeway Closure, September 9-12, 2014

Southbound I-15 Closed in Nevada
- 4-day closure
- Detour to Las Vegas: Exit I-15 in Cedar City

Detour

Closure
Split Monitor for Incident Management

Implemented timing plans

Full freeway closure
Metric: Pedestrian Delay

Detection Requirements: None

EVENT CODES
45 – Ped Call on
21 – Ped Walk on

Phase 2
Coordinated phase

Phase 4
Side street
Metric: Purdue Split Failure

**Green Occupancy Ratio (GOR)** = % of time stop bar detector is ON during GREEN

**Red Occupancy Ratio (ROR5)** = % of time stop bar detector is ON during FIRST 5s of GREEN

**Split Fail** = GOR & ROR5 ≥ 80%
Metric: Turning Movement Counts

Detection Requirements: Stop bar counts

US-89 Main Street (American Fork) SIG#6023
Tuesday, October 22, 2013 12:00 AM - Tuesday, October 22, 2013 11:59 PM

Eastbound Thru
TV: 8076 PH: 5:00 PM - 6:00 PM PHV: 757 VPH
PHF: 0.95 fLU: 0.74

Volume (VPH)

Time of Day

Metric: Turning Movement Counts
Detection Requirements: Stop Bar Counters
Is green time too short? – Would increasing the split fix the problem?
Is coordination poor? – Would more vehicles arriving on green fix this?
Is sight distance poor? – Are there trucks or other obstructions blocking signal?
Is law enforcement needed? – Time can be pinned down for law enforcement.
Metric: Purdue Coordination Diagram

Detection Requirements: Approach counts

Vehicle arrivals
Phase Green
Phase Red
Queuing past sensor
Optimization Example: Progression Quality
Detection Requirements: Stop bar counts or approach counts

Metric: Approach Volume
Detection Requirements: Stop bar counts or approach counts

Metric: Approach Volume

<table>
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<th>Value</th>
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<td>Peak Hour Volume</td>
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<td>Peak Hour Factor</td>
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<td>Total Volume</td>
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<td>Northbound Peak Hour</td>
<td>7:45 AM - 8:45 AM</td>
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<tr>
<td>Northbound Peak Hour D Value</td>
<td>0.408</td>
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<tr>
<td>Northbound Peak Hour K Value</td>
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<tr>
<td>Northbound Peak Hour Volume</td>
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<td>Northbound Peak Hour Factor</td>
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<tr>
<td>Northbound Total Volume</td>
<td>-</td>
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<td>Southbound Peak Hour</td>
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<tr>
<td>Southbound Total Volume</td>
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Metric: Approach Delay

Detection Requirements: Approach counts

Simplified Approach Delay. Displays time between approach activation during the red phase and when the phase turns green. Does NOT account for start up delay, deceleration, or queue length that exceeds the detection zone.
Detection Requirements: Approach counts

Metric: Arrivals on Red

University Avenue @ East Bay Boulevard Signal 6402 Phase: 2 Northbound
Tuesday, January 17, 2017 12:00 AM - Tuesday, January 17, 2017 11:59 PM

Total Detector Hits = 11725 Total AoR = 5170
Percent AoR for the select period = 44

Free
24% AoR
17% RT

Plan 1
25% AoR
36% RT

Plan 7
47% AoR
48% RT

Plan 13
62% AoR
47% RT

Plan 7
39% AoR
38% RT

Plan 19
25% AoR
27% RT

Time in Cycle (s)

Time of Day
Detection Requirements: Approach speed

Metric: Approach Speed

SR-126 (1900 W) 5700 South (Roy) Signal 5088 Phase 6 Southbound
Wednesday, September 30, 2015 12:00 AM - Wednesday, September 30, 2015 11:59 PM
Detector Distance from Stop Bar: 350 feet; Min Speed Filter: 5 MPH;
Time Filter: 15s after start of green to start of yellow
Speed Accuracy: + - 5 MPH

- Free
- 85% Sp 38
- Ave Sp 32
- Std Dev 8

- Plan 1
- 85% Sp 39
- Ave Sp 31
- Std Dev 10

- Plan 7
- 85% Sp 40
- Ave Sp 32
- Std Dev 8

- Plan 13
- 85% Sp 38
- Ave Sp 31
- Std Dev 9

- Plan 7
- 85% Sp 40
- Ave Sp 33
- Std Dev 8

- Free
- 85% Sp 38
- Ave Sp 33
- Std Dev 7

Speed (MPH)

Time of Day

- Posted Speed
- 85th Percentile Speed
- Average MPH
Detection Requirements: Approach speed

Metric: Approach Speed

Riverdale Rd Shopko Signal 5008 Phase 2 Northbound
Thursday, January 10, 2013 6:00 AM - Thursday, January 10, 2013 11:00 PM
Detector Distance from Stop Bar: 350 feet; Min Speed Filter: 5 MPH;
Time Filter: 15s after start of green to start of yellow
Speed Accuracy: ± 5 MPH

Snow storm starts
ROUTE CONFIGURATION

UDOT Automated Traffic Signal Performance Measures

Jamie Mackey, P.E, PTOE
UDOT Statewide Signal Engineer
# Route Configuration for Link Pivot

## R2: Foothill Blvd

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<tr>
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<tr>
<td>7223 - Foothill Drive 2100 South Northbound Phase 2</td>
<td>2</td>
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<tr>
<td>7222 - Foothill Drive 1700 South Northbound Phase 2</td>
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<tr>
<td>7221 - Foothill Drive 2300 East Northbound Phase 2</td>
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<tr>
<td>7220 - Foothill Drive 1300 South Northbound Phase 2</td>
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<td>7503 - Foothill Drive 2100 East Northbound Phase 2</td>
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<td>7219 - Foothill Drive Sunnyside Northbound Phase 2</td>
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<td>7217 - Foothill Drive Mario Capecchi Dr (1950 E.) Northbound Phase 2</td>
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*Direction of travel to next signal*

*Edit | Details | Delete*
Purdue Link Pivot

Purdue Link Pivot Analysis

Report Options

Route
R2: Foothill Blvd

Cycle Length
120

Start Date
01/12/2017

End Date
01/12/2017

Start Time
11 AM

End Time
1 PM

Advanced

Days to Include

- Sunday
- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday

Starting Point
Downstream

Bias
0

Bias Direction
Downstream
# Purdue Link Pivot

## Adjustments

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## Purdue Link Pivot

### Approach Link Comparison

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<td>66%</td>
<td>84%</td>
<td>88%</td>
<td>92%</td>
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**Legend:**
- Red indicates predicted **negative** change in AOG
- Green indicates predicted **positive** change in AOG

**Corridor Summary**
- Upstream: 39585, 44992, 32610, 36968, 72195, 81960
- Downstream: 72%, 82%, 68%, 77%, 70%, 80%
2013 Purdue Coordination Diagrams

- **Sunnyside Avenue**
  - 1300 S
  - 2300 E
  - 1700 S
  - 2100 S

- **Foothill Boulevard**
  - Mario Cappechi
  - Wakara Way

**Initial Percent Arrival on Green**
- **Corridor Midday Arrival on Green**
  - 74%
  - Increase in Percent Arrival on Green
  - 7%
  - Decrease in Percent Arrival on Green
  - Max: 20%
  - Min: 1%

Legend:
- Light Green: Initial Percent Arrival on Green
- Green: Increase in Percent Arrival on Green
- Red: Decrease in Percent Arrival on Green
ATSPM ALERTS

UDOT Automated Traffic Signal Performance Measures

Jamie Mackey, P.E, PTOE
UDOT Statewide Signal Engineer
System Health Alerts

1. **No SPM data:** identifies signals with less than 500 records in the database between midnight and midnight the previous day.

2. **Too many max outs:** identifies phases with more than 90% max outs in at least 50 activations between 1 a.m. and 5 a.m.

3. **Too many force offs:** identifies phases with more than 90% force offs in at least 50 activations between 1 a.m. and 5 a.m.

4. **Too many ped calls:** identifies phases with more than 200 pedestrian activations between 1 a.m. and 5 a.m.

5. **Low PCD detector count:** identifies phases with PCD detectors that have less than 100 vehicles counted between 5 p.m. and 6 p.m. the previous day.
## Alert Evaluation

<p>| | | | | |</p>
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<th></th>
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<th></th>
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</thead>
</table>
| **1** | No ATSPM data | Check communication to signal  
Check controller clock  
Check IP address in SPM configuration  
Check VIO = NO & DB State = All Saved (Econolite MM 9-3-1 SpFn*3)  
Try enabling Upload Current  
Create a WO to cold start the controller |
| **2** | Too many max outs | Check for recalls  
Check for constant call on a detector channel  
Consider whether a bandaid is necessary |
| **3** | Too many force offs | Should the signal be in coordination?  
Is a non-coordinated phase maxing out?  
Skip only 2-6 pairs and dummy phases |
| **4** | Too many ped calls | Check for recalls  
Check for constant call on a detector channel |
| **5** | Low PCD detector count | Note: Evaluate the VOLUME on the PCD charts, not the phase data  
Is count channel configured correctly in SPM Config Tool?  
Is ECPI Log enabled for count channel?  
Is the detector working?  
Is the detector communicating to the controller?  
Try resetting the sensor and VERIFY with Upload Current |
1. No SPM Data

- Data Lost
- Clock Reset
- SPMs evaluated for Data

Alert email sent
Phase 4 starts constant call

SPMs evaluated for % max outs

Alert email sent

4/8/2014

4/9/2014

Metric: Purdue Phase Termination Detection Requirements: None
3. Too many force offs

Phases evaluated for % Force Offs

Alert email sent

Incident Plans Scheduled

5/30/2016
5/31/2016
6/1/2016
Too many ped calls

SPMs evaluated for Ped Activations

Alert email sent

Ph6 Ped Constant Call

5/21/2016

5/22/2016
Low PCD detector count

SPMs evaluated for PCD Detector Volume

Sensor quits working

Alert email sent

Sensor Reset

High PCD detector count
6 High PCD detector count

Volume report for Washington 12th on the Northbound and Southbound approaches.
8/4/2016 12:00:00 AM - 8/4/2016 11:59:00 PM - Using Advanced Detection

Too high
Normal
Work Orders

# Work Orders for ATMS Equipment
July 2015 to July 2016
LOG ACTION TAKEN

UDOT Automated Traffic Signal Performance Measures

Jamie Mackey, P.E, PTOE
UDOT Statewide Signal Engineer
## Log Action

<table>
<thead>
<tr>
<th>Name</th>
<th>Jamie Mackey</th>
</tr>
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<tr>
<td>Date</td>
<td>1/17/2017 11:07:05 AM</td>
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<tr>
<td>Signal</td>
<td>7220 - Foothill Drive 1300 South</td>
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<tr>
<td>Agency</td>
<td>State Government</td>
</tr>
<tr>
<td>Actions</td>
<td>Actuated Coord, All-Red Interval, Coord On/Off, Modeling, Cycle Length, Traffic Study, Detector Issue, Yellow Interval, Offset, Force Off Type, Sequence, Split Adjustment, Time Of Day, Manual Command, Other</td>
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<td>MetricTypes</td>
<td>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</td>
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<tr>
<td>Comment</td>
<td>Identified broken detector and adjuste</td>
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[Create button]
Review Action and Metric Use

Chart Usage
- 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

Agency Usage
- Academics
- City Government
- Consultant
- County Government
- Federal Government
- MPO
- State Government
- Other

Split Monitor
- Detector Issue
- # of Actions: 49

# of Actions
- Audited Coord.
- Coord Only
- Cycle Length
- Detector Issue
- Other
- Sequence
- Time of Day
- Other
- All-Red Internal
- Modeling
- Traffic Study
- Yellow Interval
- Force Off Time
- Split Adjustment
- Manual Command
Review Metric Use

Collected by automatic logger

# of Reports Run

- 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 Alternations
- Purdue Split Failure