Topics

Traffic Signals and Safety

- TSAMS (Traffic Signal Asset Management System)
- GLG-Green Light Go Program
- Traffic Signal Remote Communication Policy
- Automated Signal Performance Measures
- Unified Command and Control Signal System Software
- HSIP (Highway Safety Improvement Program)
- Consultant Support Contracts
### PENNDOT District 6-0 Traffic Unit

**Signal Asset Management System**

**General Information**
- **ID #**: M06-008XG
- **HOP #**: M06-008XG
- **Design Firm/Contact for 30 Day Test**: TPO - Anthony Dougherty
- **Phone**: 610-326-3100

**Current Review Information**
- **Received Date**: 11/10/2008
- **Assigned Date**: 12/1/2008
- **Closed Date**: 12/1/2008
- **Days**: 0
- **Follow Up Action**: No
- **Tickle Date**: 3/16/2016

**Revision**
- **Field Imp. Date**: 3/19/2016
- **Inspection Date**: 3/16/2016
- **Inspected By**: [Name]

**Intersecting Roadways**

<table>
<thead>
<tr>
<th>Street Name</th>
<th>SR</th>
<th>Seg</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEKALB PIKE</td>
<td>0202</td>
<td>0040</td>
<td>0000</td>
</tr>
<tr>
<td>GULPH RD</td>
<td>3039</td>
<td>0064</td>
<td>0275</td>
</tr>
</tbody>
</table>

**Overall Comments**

[Webpage content]

---

[山东师范大学] Department of Transportation
Login Screen

Traffic Signal Asset Management System

**WELCOME** to PennDOT’s Traffic Signal Asset Management System (TSAMS).

TSAMS is a web-based application featuring...

- Signal and Non-Signal Asset Inventories
  - Traffic Signals
  - Emergency Traffic Signals
  - Electronic Signs
  - Flashing Warning Devices
  - In-Roadway Warning Lights
  - Intersection Control Beacons
  - Ramp Meters
  - Rectangular Rapid Flashing Beacons
  - Roundabouts
  - School Zone Speed Limit Signs
- GIS Integration
- Maintenance Activity Tracking
- Signal and Non-Signal Systems Identification
- Approved Products Database
- Reporting & Advance Search

It is available FREE of cost to all stakeholders.

Login

For TSAMS users only.

User ID
befiana

Password
********

Login

Forgot Your Password?

Quick Links

- Traffic Signal Portal
- PennDOT Publications
- Traffic Engineering Forms (TE-Forms)
- 511PA

Release: 1.1
Copyright © 2015 Pennsylvania Department of Transportation. All Rights Reserved.

PennDOT Privacy Policy
Your session will expire in 30 minutes.
Statewide Data Collection

Stakeholder Outreach & Collaboration: 50%
Document Scanning & Collection: 80%
LiDAR (Light Detection and Ranging): 85%
Field Collection: 0%

Project Completion Date: June 30th, 2016
LiDAR Ex. 2
**Development Status**

**STAGE 1**
- 100%
- Completed (Aug-2015)
- Available to Central Office Users
- Basic Functionality

**STAGE 2**
- 70%
- Planned Completion (July-2016)
- Available to all Users
- Basic GIS
- Maintenance

**STAGE 3**
- 0%
- Planned Completion (Late 2016)
- Inspection
- Projects
- Enhanced GIS

**STAGE 4**
- 0%
- Planned Completion (2017+)
- System requirements currently being established.

**TSAMS**

[Department of Transportation Logo]
Local Grant Element
- Act 89 Identified requiring 50% municipal or private cash match
- Municipal Managed Projects

PennDOT Project Element
- Equivalent program for Critical Corridors created by Secretary
- 50% match is still required
- PennDOT Project Management through ECMS

PennDOT Management
- Program created by Secretary to consider & implement ownership on super-critical corridors
- Updates to existing legislation and regulations required

Other Statewide Signal Improvements
- Systematic statewide and regional improvements benefiting all traffic signal stakeholders
- Implement technology and innovation that meet objectives

Objectives:
- Improve Maintenance and Operations
- Financial Responsibility and Transparency
- Promote Multi-municipal cooperation
Year 1 (SFY 2014-2015) [Up to $10 Million]
• Awarded 12/20/2014
• 46 Projects (39 Municipalities) received $1.8 Million
• TSAMS data collection on state highways (8,700 Signals)

Year 2 (SFY 2015-2016) [Up to $25 Million]
• Award TBD
• 146 Applications (119 Municipalities) requesting $13.6 Million

Year 3 (SFY 2016-2017) [Up to $40 Million]
• Application period to be 1-month after Year 2 Awards
### Prioritization Phases

| Super-Critical Corridors (AADT > 25,000) or (AADT > 7,500 per lane) |
|-------------------------|-------------------------|-------------------------|
| # of Corridors | # of Municipalities | # of Signals |
| 1 | 8 | 9 | 88 |
| 2 | 8 | 13 | 78 |
| 3 | 12 | 22 | 51 |
| 4 | 19 | 27 | 139 |
| 5 | 45 | 79 | 520 |
| 6 | 95 | 159 | 1,371 |
| 8 | 74 | 110 | 640 |
| 9 | 8 | 11 | 61 |
| 10 | 11 | 18 | 82 |
| 11 | 31 | 66 | 316 |
| 12 | 10 | 17 | 94 |
| Philadelphia | 43 | 1 | 791 |
| Pittsburgh | 18 | 1 | 76 |

**TOTAL**: 382 Corridors, 533 Municipalities, 4,307 Signals

### Prioritization Criteria
- Average AADT
- Average AADT per Lane
- Maximum AADT
- Number of Signals
- Signal Density
- Number of Signal Owners

### PennDOT Management
- Program created by Secretary to consider & implement ownership on super-critical corridors
- Updates to existing legislation and regulations required

### Prioritization Phases

<table>
<thead>
<tr>
<th>Prioritization Phases</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematic Evaluation</td>
<td>The use of existing data/information to objectively and consistently identify supercritical corridors across Pennsylvania</td>
</tr>
<tr>
<td>District Evaluation</td>
<td>The application of local knowledge from Engineering Districts along with their Planning Partners</td>
</tr>
<tr>
<td>Asset Evaluation</td>
<td>The use of TSAMS data to enable asset maintenance and operations considerations</td>
</tr>
</tbody>
</table>

### Systematic Evaluation

- District:
  - Super-Critical Corridors (AADT > 25,000)
  - or (AADT > 7,500 per lane)

<table>
<thead>
<tr>
<th>District</th>
<th>Super-Critical Corridors (AADT &gt; 25,000) or (AADT &gt; 7,500 per lane)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td>6</td>
<td>95</td>
</tr>
<tr>
<td>8</td>
<td>74</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>11</td>
<td>31</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>43</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>18</td>
</tr>
</tbody>
</table>

**TOTAL**: 382 Corridors, 533 Municipalities, 4,307 Signals
<table>
<thead>
<tr>
<th>ID #</th>
<th>Corridor Identification</th>
<th>Corridor Beginning Point</th>
<th>Corridor Ending Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>23002</td>
<td>US 1/State Rd/Twp Line Rd/City Ave</td>
<td>I-476</td>
<td>Ridge Ave</td>
</tr>
<tr>
<td>09003</td>
<td>PA 132/Street Rd</td>
<td>PA 611/Easton Rd</td>
<td>I-95</td>
</tr>
<tr>
<td>46012</td>
<td>PA 309/Bethlehem Pk</td>
<td>PA 63/Welsh Rd</td>
<td>Sellersville Bypass</td>
</tr>
<tr>
<td>65004</td>
<td>US 30/Loucks Rd &amp; Arsenal Rd</td>
<td>Wills Run</td>
<td>North Hills Rd</td>
</tr>
<tr>
<td>23007</td>
<td>US 202/Wilmington Pk</td>
<td>Delaware Line</td>
<td>Railroad N of Matlack St</td>
</tr>
<tr>
<td>23003</td>
<td>PA 3/West Chester Pk</td>
<td>High St</td>
<td>Cobbs Creek Pkwy/63rd St</td>
</tr>
</tbody>
</table>

**Corridor Data**

<table>
<thead>
<tr>
<th>Corridor Length (miles)</th>
<th>Signal Density (signals per mile)</th>
<th>Average AADT (per lane)</th>
<th>Maximum AADT</th>
<th># of Municipal Signal Owners</th>
<th>Avg Signals per Municipality</th>
<th>Avg AADT Rank</th>
<th>Avg AADT per Lane Rank</th>
<th>Max AADT Rank</th>
<th># Signals Rank</th>
<th>Signal Density Rank</th>
<th># Signal Owners Rank</th>
<th>Avg Score</th>
<th>Legislation Req.</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>10.00</td>
<td>35268</td>
<td>8616</td>
<td>5</td>
<td>8.00</td>
<td>18</td>
<td>101</td>
<td>8</td>
<td>11</td>
<td>82</td>
<td>32</td>
<td>42</td>
<td>TRUE</td>
</tr>
<tr>
<td>49</td>
<td>15.15</td>
<td>33965</td>
<td>8423</td>
<td>5</td>
<td>9.80</td>
<td>24</td>
<td>117</td>
<td>13</td>
<td>8</td>
<td>114</td>
<td>32</td>
<td>51</td>
<td>FALSE</td>
</tr>
<tr>
<td>23</td>
<td>7.99</td>
<td>35240</td>
<td>8688</td>
<td>6</td>
<td>3.83</td>
<td>19</td>
<td>93</td>
<td>36</td>
<td>40</td>
<td>143</td>
<td>20</td>
<td>59</td>
<td>FALSE</td>
</tr>
<tr>
<td>11</td>
<td>4.16</td>
<td>56989</td>
<td>11096</td>
<td>4</td>
<td>2.75</td>
<td>3</td>
<td>19</td>
<td>3</td>
<td>123</td>
<td>164</td>
<td>53</td>
<td>61</td>
<td>FALSE</td>
</tr>
<tr>
<td>16</td>
<td>8.64</td>
<td>48553</td>
<td>1520</td>
<td>6</td>
<td>2.67</td>
<td>4</td>
<td>12</td>
<td>7</td>
<td>81</td>
<td>249</td>
<td>20</td>
<td>62</td>
<td>FALSE</td>
</tr>
<tr>
<td>76</td>
<td>19.73</td>
<td>32033</td>
<td>7492</td>
<td>11</td>
<td>6.91</td>
<td>36</td>
<td>243</td>
<td>15</td>
<td>3</td>
<td>86</td>
<td>4</td>
<td>65</td>
<td>FALSE</td>
</tr>
</tbody>
</table>
Automated Traffic Signal Performance Measures

What are Automated Traffic Signal Performance Measures?
Provides real-time and historical functionality at signalized intersections by using traffic signal controllers with data loggers, detection systems, remote communication back from traffic signal, and vehicle probe data allowing engineers to accurately measure what could only previously be modeled.

What are the Benefits?
- Real-Time and achieved traffic count and intersection operational information.
- Improved planning by prioritizing and justifying investments.
- Executive Reporting that is accurate, accountable, and transparent.
- Identifying, evaluating, and addressing complaints.
- Reduction of data collection and high engineering costs to traffic signal updates.
- Reducing Delay and Congestion making improvements to travel time, gas consumption, and green house gas emissions.
- Improving corridor reliability providing potential economic benefits.
- Improving Maintenance Contractor accountability.
- Improving Safety and Driver Behavior by reviewing and making appropriate adjustments.
- Verification that a traffic signal is operating to Permit.
- Addressing equipment issues.
- Low cost per intersection ($7,500 over 10-years) compared to Adaptive Signal Systems ($45,000 per intersection).
- Providing this industry to allow appropriate applications for connected and automated vehicles moving forward.
- Example: UDOT’s system was implemented in January 2013, and in the first twelve months of use they proactively found and fixed more than 100 detector problems, 35 time-of-day errors and 40 incorrect traffic offsets for better progression. Today, UDOT claims that only one in four vehicles encounter a red light on UDOT roads.


<table>
<thead>
<tr>
<th>National Traffic Signal Report Card 2012</th>
<th>National</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Traffic Signal Operations</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Signal Timing Practices</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Traffic Monitoring and Data Collection</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Overall</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td># of Signals</td>
<td>1118</td>
<td>13577</td>
</tr>
<tr>
<td># of Municipalities</td>
<td>1118</td>
<td>13577</td>
</tr>
<tr>
<td>% of Municipalities</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Provides a facts based approach to addressing traffic signal maintenance, and operational issues identified in the National Report Card and other state Transportation Advisory Committee (TAC) studies. Through this proven method and with enhancements to the Green Light-Go Program, significant statewide improvements to the management, maintenance, and operation of traffic signals can be completed and sustained.

Who does this Benefit?
- Public — improved maintenance and operations provides for reliable and efficient highway
- PennDOT — allows the Department to better manage, monitor, evaluate, and accurately implement solutions that can have a significant impact to the safety and mobility of the motoring public.
- Municipal Governments to use the data in a similar manner to PennDOT and the ability to identify and resolve maintenance issues prior to calling out there maintenance provider.
- Maintenance signal technicians — provides the ability to remotely identify, investigate, and sometimes remotely resolve issues.
- Consultants — significantly improves traffic data accuracy and allows for real-world monitoring and adjustments to be made without performing very detailed evaluations.
- Planning Organizations — Provides real-world planning, prioritization, and appropriate calibration of regional traffic models.
- Academia — Provides real-world data to conduct various research studies.
How does Automated Traffic Signal Performance Measures work?

This involves a combination of modern signal controllers and vehicle detection systems to collect and archive operational data with tenth-of-a-second timestamps, referred to as “high resolution data.” With communication from each signal to the central computer server, the data can be stored and archived for further analysis and reporting. ATSPM does not require a central traffic management or traffic adaptive system, and the data storage and reporting are achieved with open-source software developed by the Utah Department of Transportation (UDOT).

Key Elements

- Vehicle Detection
- High resolution controller
- Communications

Effective Signal Operations

- Advanced Control
- Efficient Coordination
- Efficient Local Control
- Operations
- Detector Health
- Maintenance
- Working Communications

Technical Details

<table>
<thead>
<tr>
<th>Controllers</th>
<th>High-Resolution Controller (current support by 4 vendors)</th>
<th>0.1 second resolution data logger</th>
<th>Controller Upgrade (if needed) $2,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection</td>
<td>Any detection technology can be used (as long as it works)</td>
<td>Existing detection often adequate</td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>Need IP-based communication from signal to data center</td>
<td>Allows active monitoring</td>
<td>Ideal: fiber interconnect (not required)</td>
</tr>
<tr>
<td>Server</td>
<td>Translate raw log files</td>
<td>Store in database</td>
<td>11 MB per intersection per day</td>
</tr>
<tr>
<td>Website</td>
<td>Query database</td>
<td>Display graphics</td>
<td>UDOT software available for free</td>
</tr>
</tbody>
</table>

How it Works

- Each traffic event can be tracked to the nearest 0.1 second
- Enables detailed analysis of signal operations
- Parameter Changes
- Time Event Parameter Description
- SQL Database
Automated Traffic Signal Performance Measures

How does ATSPM change the traffic engineering process for signals?

Traditional traffic signal timing involves using sophisticated modeling software with dozens of input parameters, such as estimated speeds, roadway geometrics, and assumed vehicle and driver characteristics. Since manual traffic counts for input into these models is very labor intensive, only a single day of data during the peak traffic periods is used for analysis. Although industry leaders recommend retiming signals every 3-5 years, it’s common for signal timings remain in place for decades due to the cost for traditional data collection and analysis. The traditional traffic signal timing is shown in the red band below.

Historically, assessments of traffic signals were either from systematic scheduling retiming programs, agency experience of problem areas, and user complaints. ATSPM allows real-time monitoring to proactively assess traffic signal performance across all traffic signals, allowing the cycle of assessment and operational improvements to occur more rapidly and within increased frequency. Enhancements to the process using ATSPM are shown in the green band below.

Why are thorough performance measures needed?

Where has ATSPM been implemented?
**Automated Traffic Signal Performance Measures**

**How does ATSPM identify operational and safety issues?**

Using high resolution log data collected and stored by modern traffic signal controllers, ATSPM provides graphical tools to identify operational and safety issues. The graphics shown below are examples from actual intersections in Pennsylvania where ATSPM was implemented with existing controllers and detection. These examples demonstrate specific uses of ATSPM to identify and resolve operational issues.

- Malfunctioning pedestrian push buttons were identified based on movements operating for the maximum time in the middle of the night (bars represent green time in each cycle; pink represents a phase terminating due to max out).

![Side Street max out 3:30-6:00 AM](image)

- Identifying malfunctioning vehicular detection based on movements operating for the maximum time at off-peak times (such as shadows at a certain time of day affecting video detection).

![Side Street max out 8:45-9:30 AM](image)

- Modifying offsets to reduce corridor travel time and increase reliability (before offset adjustment on left below, after on right). Green shading represents the probability of the signal being green at any point during the cycle based on actual green times. Black bars represent the proportion of vehicles arriving at that time in the cycle.

**Before**

![Platoon arrives on red](image)

**After**

![Platoon arrives on green](image)
Automated Signal Performance Metrics

Signal Performance Metrics

Selected Signal: 7055 Bangerter Hwy (SR-154) SR-201 DDI

Signals
Region: All
Metric Type: All
Filter: Signal Id

Signal List

Map

Metric Settings
Metric Type:
- Approach Delay
- Approach Volume
- Arrivals On Red
- Speed
- Perund Coordination Diagram
- Split Monitor
- Turning Movement Counts

Y Axis Maximum
Percentile Split: 85

Show Plan Stripes
Show % Max Out/ Force Off
Show Ped Activity
Show Percent Gap Outs
Show Average Split
Show Percent Skip

Dates
Start Date: 9/4/2014 12:00 AM
End Date: 9/4/2014 11:59 PM

Create Metrics

Pennsylvania Department of Transportation
Traffic Signal Command and Control
The purposes of this document is to:

• Describe the operations of remote traffic signal communications

• Establish a formal process to request access to the Commonwealth network

• Identify the roles and responsibilities in establishing the remote communication

• Provide guidelines to develop requirements for the remote communication

• Provide guidelines to design remote communication

• Establish a formal process/procedure for establishing the remote communication using the Commonwealth network

• Establish a formal process to access the Commonwealth network, which in turn will allow anyone with proper access rights to access traffic signals remotely
Safety Programs

Highway Safety Improvement Program (HSIP)

- HSIP Program funds can be used for medium to high cost roadway safety improvements/countermeasures to address areas and locations that have high instances of fatalities and serious injuries. HSIP funds can also be used to supplement LCSIP projects.

- HSIP projects can also utilize the following systematic proven countermeasures, based on problem identification, in the following priority:
  - Centerline Rumble Strips
  - Edgeline/Shoulder Rumble Strips
  - Intersection Safety Implementation Plan
  - Roadway Departure Safety Implementation Plan

Low Cost Safety Improvement Program (LCSIP)

- Provides low cost roadway safety improvements/countermeasures to address areas and locations that have high instances of crashes.

- Includes, but is not limited to, the following countermeasures:
  - Centerline/Edgeline Rumble Strips
  - Intersection Improvements
  - Curve Safety Improvements
  - Removal of Frequently Hit Trees
  - Utility Pole Relocation
  - Pedestrian Safety Improvements
    - Pedestrian Countdown Signals
    - Yield To Pedestrian Channelizing Devices
Traffic Safety

Funding

HSIP Statewide ($92M Yearly)
  - MPO/RPO Allocation ($57M)
  - Statewide Set-aside ($35M)

DVRPC-District 6-0 HSIP Program
  - Regional Line Item ($12M/Year)
  - Dist 6-0 Allocation from Statewide Set-aside
    (Average $6.53M/Year)

Low Cost Safety Program
Statewide $10M/Year
Dist 6-0 Allocation $1.7M/Year
District 6-0 Cluster lists

High Crash Location Lists
  * 2010 > 166 locations out of 322 Statewide
  * 2012 > 224 locations out of 332 Statewide
  * 2015 > 225 locations out of 364 Statewide

Intersection Safety Implementation Plan (ISIP)
  * 2326 intersections in the District

Roadway Departure Implementation Plan (RDIP)
  * 1227 locations in the District

Other Cluster lists
  * Wet pavement Cluster Lists
    On an average district has over 60 locations above
    50% select ratio
ArcGIS Online Map - Pennshare

http://pennshare.maps.arcgis.com/home/
LiDAR Pilot

Signs and Pavement Marking Asset Management

CADD Plans for signs and pavement marking in Micro station format
ArcGIS online maps for signs and pavement markings along with feature attribute data (database)
LiDAR Pilot
Signs and Pavement Marking Asset Management

ESRI field data collector (ArcGIS) app to add/modify the signs feature attribute data
LiDAR Pilot
Signs and Pavement Marking Asset Management

Signing plan in straight line format using ESRI straight line Tool (ArcGIS)
Consultant Support Contracts
Engineering Agreements

- Traffic Signals and Safety Open End
  McMahon Asso. (Exp. 09/2018)
- Traffic Signal Retiming Initiatives
  TWT (Exp. 05/2018)
- Traffic Safety HSIP Project Delivery
  HNTB (Exp. 06/2020)
- Traffic Signal Management Program-
  Operation and maintenance
  Jacobs (Exp. 02/2021)