UDOT Freeway and Traffic Signal Performance Metrics
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UDOT
Keeping Utah Moving
Utah Demographics
Speed Report – Benefit of Past Projects

Average Speed BEFORE Project

Average Speed AFTER Project
Speed Report – Identify Need for Future Projects

- Average Speed 2014
- Average Speed 2016

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Estimated Cost</th>
<th>Status</th>
<th>Construction Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 North to South Layton Pkwy Aux Lane and Ramp Meters</td>
<td>$6.5M</td>
<td>FY 2016</td>
<td>April 2016</td>
</tr>
<tr>
<td>Aux Lane Extension; Farmington to 200 North</td>
<td>$5M</td>
<td>FY 2017</td>
<td>July 2016</td>
</tr>
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</table>
Delay
The Buffer Time Index (BTI) represents the **additional time** drivers need to add to their average travel time to ensure that they arrive at their destination on time 95% of the time.

### Median Speed (5-6 pm)

- **Non-recurring Congestion**
  - 50 mph
  - Reliable Fast Speeds
  - Unreliable Fast Speeds

- **Recurring Congestion**
  - Reliable Slow Speeds
  - Unreliable Slow Speeds

- **BTI**
  - Less variability
  - High variability
  - 0.6
Reliability

Annual I-15 SB in SL County (Weekdays 5-6 PM)
Reliability

PERCENT OF I-15 SB ROADWAY IN SL COUNTY

2014

- Unreliable Slow Speeds
- Reliable Slow Speeds
- Unreliable Fast Speeds
- Reliable Fast Speeds
Reliability

Reliability
Annual I-15 SB (Weekdays 5-6 PM)
2016 Data to 8/1/16

PERCENT OF I-15 NB ROADWAY IN SL COUNTY

Davis-Weber  Salt Lake 2013  Utah
Davis-Weber  Salt Lake 2014  Utah
Davis-Weber  Salt Lake 2015  Utah
Davis-Weber  Salt Lake 2016  Utah

Unreliable Slow Speeds  Reliable Slow Speeds  Unreliable Fast Speeds  Reliable Fast Speeds
UDOT’s Freeway Detection System

3,070 Detectors
94% Operational

Transsuite
UDOT Traffic map, travel times, ramp meters

Iteris PeMS (Performance Management System)
Data cleaning, historical data aggregation & analysis

Center to Center Feed
Freeway Performance Metrics Website

http://udottraffic.utah.gov/freewayperformancemetrics/
Building Freeway Performance Measures

- Brainstorm –
  - What is needed
  - What are we trying to measure
  - What actions can we take from this metric
- Create a prototype
- Present to senior leadership
- Make adjustments
- Document process
- Allow in-house software developers to use their creativity
Automated Speed Report

Map showing West Valley City and adjacent areas with start milepost 307.24 and end milepost 277.71.

Speed Graph:
- Speed Report: I-15
- Dates: 12/1/2015 - 12/31/2015
- Time: 5:00 PM - 6:00 PM
- Days: Tuesday, Wednesday, Thursday
- Direction: Southbound

Graph displaying speed data with green for 85th percentile, blue for 50th percentile, and orange for 15th percentile.
Mobility Cake

- Show the delay that can be attributed to the incidents, construction, and weather.
- Show where the delay is occurring on a corridor.
- Make assumptions that can be easily understood - don’t be a black box algorithm.
- Leverage existing databases and ITS infrastructure.
Mobility Cake

![Map and Graph](image-url)
Mobility Cake Report: I-15 SB

Dates: 12/1/2013 - 12/31/2013
Days: Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday

Graph showing data for different categories such as Capacity, Queue, Incident, and Weather across various mileposts.

Mileposts:
- Milepost 283
- Milepost 288
- Milepost 293
- Milepost 298
- Milepost 303

Delay Hours:
- 4500
- 4000
- 3500
- 3000
- 2500
- 2000
- 1500
- 1000
- 500
- 0

Weather categories and their respective colors are shown in the legend on the right side of the graph.
UDOT Traffic Signal Performance Metrics

- Traffic Signal Performance Metrics – Standard for Performance Measures
  - Make specific decisions from performance measure
  - Performance measures developed by the staff that will manage the network
- UDOT thanks GDOT for being a strong partner in providing open source code to all agencies!
Traffic Signal System Benefits

1. Increased Capacity
2. Increased Safety
3. Boost Public Image

Signal Performance Measures

Available at all traffic signals

<table>
<thead>
<tr>
<th>Metric Type</th>
<th>Available at all traffic signals</th>
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<tbody>
<tr>
<td>Purdue Phase Termination</td>
<td></td>
</tr>
<tr>
<td>Split Monitor</td>
<td></td>
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<tr>
<td>Pedestrian Delay</td>
<td></td>
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<tr>
<td>Preemption Details</td>
<td></td>
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<tr>
<td>Turning Movement Counts</td>
<td></td>
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<tr>
<td>Purdue Coordination Diagram</td>
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Require extra sensors or configuration

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<td>Approach Volume</td>
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<tr>
<td>Approach Delay</td>
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</tr>
<tr>
<td>Arrivals On Red</td>
<td></td>
</tr>
<tr>
<td>Approach Speed</td>
<td></td>
</tr>
<tr>
<td>Yellow and Red Actuations</td>
<td></td>
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<tr>
<td>Purdue Split Failure</td>
<td></td>
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Actions Resulting from
Signal Performance Metrics
January 1 - June 18, 2014

# Actions Taken

- Detector Issue
- Modeling
- Split Adjustment
- Cycle Length
- Time Of Day
- Offset
- Coord On/Off
- Actuated Coord
- Force Off Type
- Sequence

- Phase Termination
- Split Monitor
- Purdue Coordination Diagram
- Other
How Phases Terminate by Time-of-Day

8-phase signal with working detection

- Gap out
- Max out
- Pedestrian activation (shown above phase line)
- Force off
- Skip

Metric: Purdue Phase Termination
Detection Requirements: None
Maintenance Example: Nighttime detection problem

**BEFORE:** Video detection not working at night

Minor street through & left turn max out at night only

Metric: Purdue Phase Termination
Detection Requirements: None
Maintenance Example: Nighttime detection problem

**After:** Detection repaired

Phases are rarely used at night

Metric: Purdue Phase Termination
Detection Requirements: None
Detection Alert

Phase 4 at 400 E & 800 N, 4/8 & 9/2014

Phase 4 starts constant call

4/8/2014

Alert email sent

SPMs evaluated for % max outs

4/9/2014

Detection Alert

Metric: Purdue Phase Termination

Detection Requirements: None

Gap out
Max out
Force off

Pedestrian activation (shown above phase line)

Skip
Alert Example: 100% Max Out

- Daily email at 7 a.m.
- Uses Purdue Phase Termination chart data
- Flags phases with >90% max-outs on each phase between 1 a.m. and 5 a.m. after 20 occurrences.
- Compare to previous day’s list. Only phases with new flags are sent in the email.

SPM Alerts for 4/9/2014

- SPMWatchDog@utah.gov
- 5092 - SR-126 (1900 W) & Riverdale (5300 S) (Roy) - Phase: 1
- 5105 - Antelope (SR-108/2000 N) & I-15 NB (Layton) - Phase: 4
- 6022 - US-89 & Pacific Dr (American Fork) - Phase: 3
- 6305 - 400 East & 800 North - Phase: 4
- 6310 - Center Street (Orem) & I-15 SPUI - Phase: 8
- 7055 - Bangerter Hwy (SR-154) & SR-201 DDI - Phase: 5
- 7062 - Bangerter Hwy (SR-154) & 4700 South - Phase: 11
- 7613 - 10600 South & 700 West - Phase: 8
- 8114 - Bluff Street & I-15 NB Ramps - Phase: 4

Metric: Purdue Phase Termination Detection Requirements: None
Additional Uses of SPMs

1. Increased traffic simulation modeling accuracy
   - Observe split behavior of intersection
   - See the variation of signal operations over several days
   - Observe the frequency of pedestrian movements
   - Less expensive to gather turning movement counts

2. Arterial Construction Project Closure Schedule
   - More volume count locations allows us to decrease factors of safety when lanes can be closed on arterials.
   - Estimate the capacity of arterial using split monitor

3. Measure Diversion During Construction Projects
   - Determine the effect of public outreach/construction congestion
SO WHAT! – Decisions Made from SPMs

1. Complaint Response
2. Efficient Technician Assignment
3. Progression Optimization
4. Evaluation
5. Tracking Performance
6. Reduced Data Collection
7. Troubleshooting