Traffic Signal
Performance Measures

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Signal Timing Procedure

I. Define Objectives, Assess and Prioritize Activities

II. Assemble relevant data to support timing and documentation objectives

III. Software Modeling

IV. Timing Design and Documentation

V. Deployment

VI. Evaluation

Options:
1. Engineer / Synchro
2. Adaptive Signal Control
3. Data Driven Performance Measures
Implementation

The software developed by UDOT has been shared freely with multiple agencies and companies around the country. Several cities and DOTs, including a few in Canada, have shown interest in it. Currently, five locations are using SPMs and at least four are in the process of implementing the system.
State-wide Traffic Signal Management
AASHTO Technology Implementation Group  http://tig.transportation.org
Signal Performance Metrics

Selected Signal: No Signal Selected

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

Map

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

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: 6/2/2016
- End Date: 6/2/2016
- Reset Date: 6/2/2016
- Start Time: 12:00 AM
- End Time: 11:59 PM

Create Metrics
What is the new traffic data and how does it work?

HOW THIS APPROACH WORKS
Using Traffic Signal Data
Consider this “mini-corridor” for the Diamond at I-20/59 @ McFarland

Intersection 1
WB Ramp

Need Feedback!

Intersection 2
EB Ramp
Example: Internal Progression
Not just for the left-turns, but how is traffic progressing through the interchange

For this SB thru movement, we can use a Purdue Coordination Diagram to monitor
Purdue Coordination Diagram
C:\Users\Alex\Desktop\pcd.mp4

https://www.youtube.com/embed/YhrtTuhcjMw
I-465 @ SR-37
Diamond Interchange w/Advanced Loops

Advanced Detection
Ring Displacement
Offset Between Coordinated Phases

RD = 42s
Ring Structure
From the HiRes Data, Plot the Rings
Ring Displacement

How is this parameter set?
SB Thru Detectors

Consider one of the four internal movements

North INT

Detector

South INT

Arrival on Green?

Plot the green status of the overlap
Project the Detector Data

295’ upstream ≈ 5 seconds @ 40 MPH

The engineer who set the ring displacement did a fantastic job at arrivals on green for this movement!
Adjusting the ring displacement

What effect would it have?
Ring Displacement +10 Seconds

What effect would it have?
Ring Displacement  +20 Seconds
Vehicles from upstream arrive later
By moving the ring displacement 20 seconds forward, the lagging WBL from the north ramp movement arrives at the south intersection on OL-D red while the EBL at the south ramp is served… Not Good!
Optimization Curves

Let’s Look at the Southbound Thru (Our +0, +10, +20 example)

Percent on Green vs. Ring Displacement Adjustment
Optimization Curves

Southbound Thru +10

Percent on Green vs Ring Displacement Adjustment
Optimization Curves

Southbound Thru +20

Percent on Green vs. Ring Displacement Adjustment
Optimization Curves

Southbound Thru for the Full Sweep

-40  -30  -20  -10  0  10  20  30  40

Percent on Green

Ring Displacement Adjustment

SB Thru
Consider All Four Movements Simultaneously

NBL, NBT, SBL, SBT
Composite Interchange Sweep

This is where all four movements are considered simultaneously.
Purdue Coordination Diagram
Also Useful to Visualize Arrivals on Green

Start of Green

Start of Red

Time of Day

Time in Cycle (Seconds)
Purdue Coordination Diagram
Looking at an entire plan (0900-1400)
24HR PCD: Sequence for 0900-1400

First is Ø6 SBT, then Ø7 WBL from the ramp
A Brief 2-Slide Explanation and Cool Results Video

SEQUENCE OPTIMIZATION
I-69 / 96th Street Diamond Interchange

How to handle the left-turn phasing?

Based on the arriving platoons, should the left turn lead or lag?
I-69 / 96th Street

WB Thru

BEFORE  AOG = 5,866

AFTER  AOG = 7,315  (+1,449)
WBT After Video
C:\Users\Alex\Desktop\sequence.mp4

https://www.youtube.com/embed/B4qGZo2_0q4
Tuscaloosa Signals
85 Signals covering 7 Corridors
This was very effective to show executive staff the benefits and improvements.
What do we need for this?

Implementation of Data-Driven Performance Measures

• Detection
  – Advanced, by-lane detection with crisp arrival information
  – Need to capture each vehicle

• Communication
  – Fiber is great, especially if existing
  – Cellular is fine too. Also, radio can fill in the gaps

• Data-Logging Traffic Controllers
  – Most modern controllers feature built-in data logging
  – Siemens M54 & M60, Econolite ASC/3 & Cobalt, Peek ATC1000
Conclusion: These Graphics are Useful!
Can they be included on newer generation traffic controllers?
Conclusion: These Graphics are Useful!

Can they be included on newer generation traffic controllers?
Conclusion: High-Resolution Event-Based Data
Powerful New Way to Monitor, Operate, and Optimize Signals

Siemens M52 Data Logging Controller

alexhainen.com
Programming Lots of Equipment
Advanced Detection Installation – Wireless Setup

One detector in each lane, in each direction, 5 seconds upstream
Advanced Detection Installation

Contractor coring a 4” hole in AL-69S SB (just south of Skyland)
Advanced Detection Installation

Completed Sensor Install. Will be almost invisible.
Installing Lots of Equipment