Arterial Performance Measurement Efforts in Washington

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Background

• Arterial performance is a key attribute to overall urban roadway system performance
  – Quality of life / attractiveness of urban area
  – Traveler information
  – Air quality improvement through delay reduction
  – Public perception of agency job performance
Background

• Traditionally arterial signal systems are “timed and forgotten”

• Little funding exists for signal timing, let alone data collection for performance monitoring
Background

• Because funding is not available to track roadway performance
  – Feedback mechanisms are not present to inform an agency when timing patterns need revision
  – Timing plan revisions are done infrequently
  • If you don’t know they are needed, how do you justify spending the resources?
Background

• Most modern traffic signals have vehicle detection in order to run actuated timing plans

• Advanced Traffic Signal Controllers have the processing and communications capabilities to transmit these data from the intersection
Basic Concept

• Use existing traffic detection to measure intersection performance
  – Supplemented by other signal information
    • Actual green times,
    • Cause of changes in phase lengths

• Poor performance results in:
  – Changes in traveler information provided
  – Notification that timing plan changes are needed
Basic Concept

- Rather than pay to collect ‘extra’ travel time (or other) data, use existing sensor data to monitor the performance of individual intersection approaches.

- To learn arterial performance, combine consecutive intersection performance values.
Basic Concept

• Measure whether each signal (approach) is working as intended:
  – Are excessive delays occurring?
  – Has an approach failed?
  – Is available capacity being used effectively?
Problems

- Older traffic signal systems are very limited in communications capabilities
- Traffic detection (number, location, style) even of new systems is non-uniform
  - Stop bar detection (single lane, multi-lane, long loops)
  - Queue detection
  - Dilemma zone detection
  - Downstream detection
  - Mid-block detection
Problems

• Volume and occupancy from these detectors often cannot be used as on a freeway:
  – Volume at stop bars is often under-counted
  – Speeds at mid-block often do not reflect delays at signals
  – Occupancy upstream of signals is affected by the red phase
  – Downstream detection says little about queuing
Possible Solutions

• Require specific detector locations / types
  – Wang - video for use in detecting signal cycle failure
  – Perrin & Martin - upstream detection used to compute congestion LOS
Our Hope

• Use a combination of available detection data and signal timing/status data to determine performance
Problems

• Fixed time volume and occupancy reporting (i.e., every x minutes) has significant limitations in determining the performance of specific signal phases / cycles
Idea

• Obtain stop bar traffic data only during those times when a non-red phase is currently occurring
EB SR 522 at 68th Ave NE

FIELD DATA

Vehicles per minute vs. Occupancy %

- 6AM-12 midnight
- AM/PM Peak
EB SR 522 at 68th Ave NE

(1 min green samples)

FIELD DATA

- Vehicles per minute
- Occupancy %

Symbols:
- 6 AM - 12 midnight
- AM/PM Peaks
Problems

• The time period of volume and occupancy data must be matched against the actual timing of the signals
  
  – Especially when the signal phases are constantly changing to match observed demand
Idea

• Use signal controller data as a second input to the performance criteria
  – What is causing the signal to change phases?
    • Max green reached?
    • Forced off (coordination, other need, e.g., peds.)?
    • Gap out?
Arterial and Sensor Layout SR 522 @ 68th
Frequency Plot of Max Out, Gap Out and Force Off
Issues: Coordinated Phases, Mainline vs. Side Street
Congestion on mainline is persistent except during midday from about 10 AM to 2 PM.

AM congestion peaks on side streets but amount of Gap Out events suggests that congestion is not severe.

Congestion on side streets is only apparent during PM peak between 4 PM and 6 PM.
Data byproducts from i2TMS: HCM model
Data byproducts from i2TMS: CCM model

CCA Volume Capacity
SR522 & 68th AVE NE

Volume Capacity Ratio

Time

00:00 02:00 04:00 06:00 08:00 10:00 12:00 14:00 16:00 18:00

Phase 2  Phase 8  Phase 7  Phase 6
Current Conclusions

- If very precise data can be gathered
  - Volumes / occupancies during green & yellow phases
  - Controller information
- We believe we can measure current approach performance - without requiring additional detection
Current Conclusions

• However, we have not yet worked through all of the complexity