Webinar #2: Active Traffic Management Feasibility and Screening Guidance

November 18, 2014
Agenda

- Housekeeping
- Introductions
- Overview of Active Transportation and Demand Management (ATDM)
- ATM Feasibility and Screening Guidance
- Case Study: Caltrans ATM Feasibility Study for Los Angeles Region
HOUSEKEEPING
INTRODUCTION and TODAY'S SPEAKERS

James Colyar
Today’s Speakers

James Colyar, P.E.
Transportation Specialist
FHWA Office of Operations

Lou Neudorff, P.E.
Principal Technologist - ITS
CH2M HILL

Marco Ruano, P.E.
Chief, Office of Traffic Engineering
Caltrans District 7
ATDM Webinar Series

- This is the second in a series of ATDM webinars
- Topics based on **what matters most to you!**
- Upcoming ATDM webinars:
  - Ramp Metering (Dec 2014)
  - Traffic Management Capability Maturity Framework (Jan 2015)
  - Active Demand Management - Part II (Feb 2015)
Purpose of Today’s Webinar

Provide an overview of a recently-developed feasibility and screening process by which agencies can assess Active Traffic Management (ATM) in their regions. Topics include:

- Context of ATM screening relative to Regional Planning and Project Development processes
- Overview of ATM concepts and strategies
- Overview of the steps and activities included in the ATM screening and feasibility guidance
- Experiences from a recent ATM Feasibility Study conducted in Caltrans District 7 (Los Angeles region)
OVERVIEW OF ATDM

James Colyar
What is Active Management?

The fundamental concept of taking a dynamic approach to a performance based process.
Goal of ATDM Concept

- Attain the capability to dynamically monitor, control, and influence travel, traffic, and facility demand of the entire transportation system and over a traveler's entire trip chain.
ATDM Throughout the Trip Chain

ATDM approaches provide travelers with choices throughout the trip chain leading to network performance optimization and increased efficiency.

Key Takeaway: Active management occurs before, during, and at the end of the trip chain
What does ATDM include?

**Active Demand Management (ADM):** A suite of strategies intended to reduce or redistribute travel demand to alternate modes or routes. Incentivizes drivers by providing rewards for travelling during off-peak hours with less traffic congestion.

**Active Traffic Management (ATM):** A suite of strategies that actively manage traffic on a facility.

**Active Parking Management (APM):** A suite of strategies designed to affect the demand on parking capacity.

### Examples of ATDM Implementation Strategies

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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>ADM</td>
<td>Comparative multi-modal travel times, dynamic ride-sharing, pricing, and incentive approaches.</td>
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<tr>
<td>ATM</td>
<td>Dynamic speed limits, dynamic shoulder use, queue warning, dynamic lane assignment, others.</td>
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<tr>
<td>APM</td>
<td>Parking pricing, real-time parking availability and reservation systems.</td>
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</table>
Active Traffic Management Example: Washington State DOT

Seattle “Smarter Highways”

- Deployed on 3 freeways between 2010-2012
- Dynamic speed limits, Dynamic lane control, Queue warning/Traveler information
- Full overhead gantries spaced roughly every ½ mile
- I-5 ATM 3-yr before and after safety evaluation: Collisions down 4.1% (while collisions increased 4.4% on a nearby non-ATM freeway)

http://www.wsdot.wa.gov/smarterhighways/
FHWA’s ATDM Program

- Increase awareness and understanding of ATDM.
- Develop, test, and evaluate strategies.
- Provide tools and methods for performance analyses.
- Provide tools and methods for benefit/cost analyses.
- Train agencies to deploy effective ATDM systems.
Summary

- ATDM represents next evolutionary step in TSM&O in operations.
- Based on real time and predicted information and dynamic actions.
- Performance driven.
- Demand management much more prominent than historical ITS and Operations.
- Several National program activities underway.
OVERVIEW OF FHWA ATM FEASIBILITY & SCREENING GUIDE

Lou Neudorff
ATM Project Background & Overview

- Frequent question during FHWA Workshops on ATDM
  - ATM looks great. How do I get started?
- Guidance developed to assist transportation agencies in making informed investment decisions regarding ATM concepts and strategies. Answer the following questions:
  - What roadway networks and facilities would be best suited for ATM in my region?
  - What specific or combination of ATM strategies would work best?
  - What would be the range of expected benefits?
  - What would be the expected costs (capital and ongoing)?

- Determine feasibility of ATM prior to committing significant resources – **MAKE A BUSINESS CASE FOR ATM**
“Objectives-driven, performance-based approach to planning for operations”
Guidance Context – Systems Engineering
Active Traffic Management (ATM)

“The ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions. Focusing on trip reliability, it maximizes the effectiveness and efficiency of the facility. It increases throughput and safety through the use of integrated systems with new technology, including the automation of dynamic deployment to optimize performance quickly and without delay that occurs when operators must deploy operational strategies manually. ATM approaches focus on influencing travel behavior with respect to lane/facility choices and operations.”

http://ops.fhwa.dot.gov/atdm/approaches/atm.htm
ATM Strategies Addressed

Dynamic Speed Limits (DSpL):
• Adjust speed displays based on real-time traffic, roadway, and/or weather conditions.
• May be enforceable (legal “limits”) or advisories

Dynamic Lane Use Control / Dynamic Lane Assignment (DLA)
• Closing / opening individual traffic lanes as warranted, providing advance warning
• Often installed in conjunction with dynamic speed limits
# ATM Strategies Addressed

<table>
<thead>
<tr>
<th><strong>Queue Warning (QW):</strong></th>
<th>![Queue Warning Sign]</th>
</tr>
</thead>
</table>
| • Real-time displays of warning messages to alert motorists that queues or significant slowdowns are ahead | **CONGESTION AHEAD**
**WB 435 TRAFFIC**
**USE EXIT 69** |
| • May be included as part of DSL / DLA strategies. | |

<table>
<thead>
<tr>
<th><strong>Dynamic Shoulder Lane (DShL):</strong></th>
<th>![Dynamic Shoulder Lane Signs]</th>
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</thead>
</table>
| • Use of the shoulder as a travel lane(s) based on congestion levels / in response to incidents, events, or other conditions | **USE THIS LANE**
**5:30 - 11:00 AM MON-FRI**
**ONLY** |
| • May also be used as a managed lane (e.g., bus-only lane) | |
ATM Strategies Addressed

**Dynamic Junction Control:**
- Allocate lane access on mainline and ramp lanes in interchange areas
- Make lanes through only / exit & entry / combination
- Can be a form of dynamic shoulder lanes

**Adaptive Ramp Metering**
- Ramp metering using system or segment-wide traffic responsive or adaptive algorithms to set metering rates
### ATM Strategies Addressed

<table>
<thead>
<tr>
<th><strong>Transit Signal Priority (TSP):</strong></th>
<th><img src="image1" alt="Transit Signal Priority" /></th>
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</thead>
<tbody>
<tr>
<td>• Manage traffic signals by detecting when a bus nears a signal controlled intersection</td>
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<tr>
<td>• Turn the traffic signals to green sooner or extend the green phase for bus</td>
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<table>
<thead>
<tr>
<th><strong>Adaptive Traffic Signal Control:</strong></th>
<th><img src="image2" alt="Adaptive Traffic Signal Control" /></th>
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<tbody>
<tr>
<td>• Continuously monitor arterial traffic conditions and the queuing at intersections</td>
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<tr>
<td>• Adjust the signal timing to smooth the flow of traffic along coordinated routes</td>
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<tr>
<td><strong>ATM Strategies Addressed</strong></td>
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<td><strong>Dynamic Lane Reversal:</strong></td>
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<tr>
<td>• Reversal of lanes in order to dynamically allocate the capacity of congested roads</td>
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<td>• Allowing capacity to better match traffic demand throughout the day</td>
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<tr>
<td><strong>Dynamic Merge Control:</strong></td>
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<tr>
<td>• Manage the entry of vehicles into merge areas with a series of advisory messages</td>
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<tr>
<td>• Prepare motorists for an upcoming merge; encourage or direct a consistent merging behavior (early / late merge)</td>
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## Guidance Activities / Steps

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
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</tr>
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## Step 1. Getting Started - Preparation

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Getting Started – Preparation: Activities

- Ensure ATM supports regional goals
- Identify relevant objectives
- Identify network
- Collaborate with stakeholders
- Commence data collection
- Review recent literature

Potential ATM Strategies

L = Dynamic Speed Limits
D = Dynamic Lane Control
Q = Queue Warning
S = Dynamic Shoulder Running
R = Ramp Metering
T = Transit Signal Priority
A = Adaptive Signal Control
J = Junction Control
ATM in Support of Regional Goals

Typical Regional Goals
- Safety
- Mobility
- Reliability
- Environment
- Climate Change Adaptation
- Livability / Accessibility
- Preservation

Several Tools To Assist
- Matrix format
- Active Management Screening Tool
- Turbo Architecture Planning Tool

Project that is consistent with regional goals and objectives (and documented) is an “easier sell”
Identify Relevant Outcome Objectives for ATM

“SMART” Objectives

- **Specific**
- **Measurable**
- **Agreed**
- **Realistic**
- **Time-bound**

Examples (From “Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations”)

- Reduce the percentage of facility miles experiencing recurring peak period congestion by X percent by year Y
- Reduce the crash rate by X percent in Y years.
- Reduce the average planning time index (for specific routes by X over Y years.)
Examples of ATM Benefits in US

I-5 Seattle (DSpL / DLA)
- 4.1% reduction in crashes
- 4.4% increase in crashes on SB segment of I-5 (no ATM)

Minneapolis (DSpL / DLA / DShL)
- 20+ % decrease in PDO crashes
- 17% less congestion during AM peak

LA Junction Control
- NB SR-110 to NB I-5
- Average ramp delay decreased from 20 minutes to 5 minutes
- 30% decrease in crashes

Chicago Bus on Shoulder
- On-time performance from 68% to 92%
- No adverse impact on safety
Common ATM Stakeholders

- State and Local DOTs
  - Senior Management
  - Operators
  - Planning
  - Maintenance
  - Design
- Transit
- MPO
- Enforcement
- FHWA

Engagement Activities

- Workshops
- Peer Reviews
- FHWA

Public outreach and education very important; but comes later.
(Not part of screening)
## Step 2. Assess Agency Policies and Capabilities for ATM

1. Getting Started - Preparation
2. Assess Agency Policies and Capabilities for ATM
3. Identify Major Roadway Segments for Potential ATM
4. Analyze Individual Links and ATM Strategies
5. Estimate Benefits and Costs; Finalize Preliminary ATM Recommendations
Assess Agency Policies & Capabilities for ATM: Activities

- Identify applicable ATM strategies in terms of network features, agency policies and legal considerations
- Ensure supporting institutional framework is in place (CMM).

Graphic: Signal–based strategies not applicable to freeway network. DOT has “policy” against ramp metering
Legal and Policy Considerations

- Speed limits or advisories
  - Maximum allowable spacing
  - Opinion of enforcement agencies
  - “Chain of evidence” for enforcement

- Use of shoulder as travel way
  - Passing on shoulder
  - Lane restrictions for trucks

- Can impact estimated costs; time required for new legislation
Traffic Management Capability Maturity (CM) Framework – Level 4 (Optimized) for the “Systems and Technology” Dimension:

“Automation of traffic management processes is based on historical, current, and predicted data. New and emerging technologies are deployed on a continuous basis to improve system efficiency.”

Most helpful if agency wishing to pursue ATM is moving towards Level 2 or Level 3 for several of the other dimensions in the Traffic Management CM Framework
Workforce & Staffing

- Critical to understand changes to operator roles & responsibilities and impact to workload
  - Operators as “Stakeholders”
- Workforce and staffing needs vary by ATM strategy

**Examples of Workforce and Staffing Needs Based on ATM Strategy**

<table>
<thead>
<tr>
<th>Operator-Driven</th>
<th>Operator-Monitored</th>
</tr>
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<tbody>
<tr>
<td>Less Automation</td>
<td>More Automation</td>
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</table>

- Lane Control (Decision Support)
- Dynamic Shoulder Lanes
- Dynamic Speed Limits
- Adaptive Signal
Step 3. Identify Major Roadway Segments for Potential ATM

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Identify Major Roadway Segments for Potential ATM: Activities

- Determine level of TSM&O deployment along segments.
- Analyze segments based on congestion, crash rates, bottlenecks, and other considerations.

Graphic: “Blue dot” segments are less likely to benefit from ATM relative to others.
Identifying Major Roadway Segments

- Identify individual roadway segments where ATM strategies would likely provide the greatest benefit
  - Major interchange to major interchange / spur

- Primarily a **qualitative** effort
  - Local knowledge / available data
  - Reduce the size of project area for detailed analyses in next steps

- Can be combined with detailed analysis depending on project area / data availability
Importance of Having Some TSM&O and ITS Already in Place

- ATM as the “Next Step in Congestion Management”

A continuum – not a “quantum leap”

- Incident Management
- Traveler Info (DMS)
- Traffic Signal Control
- Ramp Metering

- Connected Vehicle
- Automated Vehicles
- Cloud Computing

- Traveler Info (social media)
- Active Traffic Management (ATM)
- Adaptive Signal Control
- Bus Rapid Transit (BRT)
- Adaptive Metering
### Example – Washington State DOT

#### Corridors Evaluation Criteria

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>I-5 (Corson to 128th)</th>
<th>I-405 (I-5 to I-5)</th>
<th>SR 167 (Full Length)</th>
<th>I-90 (I-5 to SR 18)</th>
<th>SR 520 (Full Length)</th>
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<tbody>
<tr>
<td>Data Availability</td>
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<td>Infrastructure</td>
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<td>Traffic Conditions</td>
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<td>1.5</td>
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<tr>
<td>Near-term Construction</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Long-term Construction</td>
<td>1.5</td>
<td>2</td>
<td>1.5</td>
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#### Corridors Active Traffic Management Strategy

<table>
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<tr>
<th>Active Traffic Management Strategy</th>
<th>I-5 (Corson to 128th)</th>
<th>I-405 (I-5 to I-5)</th>
<th>SR 167 (Full Length)</th>
<th>I-90 (I-5 to SR 18)</th>
<th>SR 520 (Full Length)</th>
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<tbody>
<tr>
<td>Speed Harmonization &amp; Queue Warning</td>
<td>2</td>
<td>2</td>
<td>1</td>
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<td>Junction Control</td>
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<td>Hard Shoulder Running</td>
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<td>Traveler Info &amp; Dynamic Re-Routing</td>
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<td>Construction Mitigation</td>
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<td>HOT Lane Interaction</td>
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#### Summary

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<th>Corridors</th>
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<tr>
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<td>18</td>
<td>20.5</td>
<td>16</td>
<td>17</td>
<td>15.5</td>
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</table>

#### Ranking Legend

- **0 = No Potential**
- **1 = Moderate Potential**
- **2 = High Potential**

#### Implementation Feasibility Legend

- **Very Likely**
- **Some Issues**
- **Not Likely**
# Example – New Jersey DOT

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<tr>
<td>EXISTING ITS / TSMO</td>
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<td>Incident Management / Service Patrols</td>
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<td>Traveler Info (DMS / Transmit)</td>
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<td>Other (Detection / Communication Conduit)</td>
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<td>TRAFFIC FLOW CONSIDERATIONS</td>
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<td>Safety Issues / High Crash Rates</td>
<td>15</td>
<td>10</td>
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<td>5</td>
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<td>20</td>
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<td>Recurring Congestion Problems</td>
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<td>Interchange Bottlenecks</td>
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<td>Composite Recurring Congestion Score</td>
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<td>20</td>
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<td>OTHER USE CONSIDERATIONS</td>
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<td>Special Event Traffic</td>
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<td>Commercial Traffic / Serves Truck Terminus</td>
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<td>Severe Weather Issues / Evacuation Route</td>
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<td>Potential ICM Corridor</td>
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<td>Planned Major Construction Along Route</td>
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<td>0</td>
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<td>Within Smart Growth Area</td>
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<td>55</td>
<td>65</td>
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**Priority Segment (congestion / safety)**

**Potential Priority Segment**

**NOT a Priority Segment**
Step 4. Analyze and Prioritize Individual Roadway Links and ATM Strategies

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Analyze Individual Links and ATM Strategies:

Activities

- Analyze & prioritize individual links for ATM deployment
- Identify ATM strategies for each prioritized link
- Combine strategies for each link; provide consistency across the network

Graphic: Strategies L, D, and Q are recommended for “green” links with strategy S also included for “red arrow” links.
Detailed Quantitative Analysis of “Links” and Specific ATM Strategies

- Simulation (not included in Guidance)
- Enhanced version of segment screening
  - Shorter segments / directional
  - Scoring based on actual data (pro-rated)

Scoring Approach
- Safety score
- Congestion score
- “Other Considerations” score
- Combined score (weighting of the other scores based on stakeholder values and needs)
Example Scoring: PennDOT I-95

Southbound corridor assessment

Direction of travel
Dynamic Speed Limits & Dynamic Lane Assignment

- **High Priority Link for ATM**
- **Does link experience high crash rate?**
  - **NO**
  - **YES**

**Does link experience recurring reductions/ variations in speed?**

- **NO**
- **YES**

**Will link be impacted by major reconstruction?**

- **NO**
- **YES**

- **Consider other safety improvements.**
- **Link may benefit from DSpl/DLA.**
Dynamic Speed Limits

DSpL can be installed without DLA

- Recurring weather conditions (fog, wind, ice)
- Sideswipe crashes are not an issue
- In support of dynamic shoulder lanes
Queue Warning

Often installed with DSpL / DLA
Dynamic Shoulder Lanes
Shoulder Lane Issues

- **Width**
  - Minimum of 10 feet; more if used for trucks and buses

- **Ability of shoulder to handle traffic ("hardened")**

- **Treatment at / through interchanges**

- **Safety concerns**
  - Refuge areas
  - Access to incident scenes by first responders
Transit
Signal
Priority

- Do buses experience delays at traffic signals? [YES / NO]
  - Do these delays significantly impact schedule adherence? [YES / NO]
    - Is there frequent bus service (headways) along the route? [YES / NO]
      - Do buses have AVL capability (or soon will)? [YES / NO]
        - Can most of the bus stops be relocated to far side? [YES / NO]
          - TSP not appropriate.
        - Are most of the bus stops far side? [YES / NO]
          - Link may benefit from TSP.
Integrating Selected ATM Strategies Together

- Group the multiple ATM strategies that may have been defined for each link.
- Consider synergistic benefits and cost savings
  - Queue warning with DSpL / DLA
  - DSpL and DLA with shoulder lanes (making it truly dynamic)
- Fill in the “gaps” – taking a strategic approach to ATM deployment providing a continuity of strategies and a more consistent driving experience
### Step 5. Estimate Benefits and Costs

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Getting Started - Preparation</td>
</tr>
<tr>
<td>2</td>
<td>Assess Agency Policies and Capabilities for ATM</td>
</tr>
<tr>
<td>3</td>
<td>Identify Major Roadway Segments for Potential ATM</td>
</tr>
<tr>
<td>4</td>
<td>Analyze Individual Links and ATM Strategies</td>
</tr>
<tr>
<td>5</td>
<td>Estimate Benefits and Costs; Finalize Preliminary ATM Recommendations</td>
</tr>
</tbody>
</table>
Estimate Benefits & Costs: Activities

- Consider key ATM cost factors
- Perform high-level estimates of benefits and costs using available tools
  - Life-cycle
- Refine priorities & recommendations

Graphic: Segments outlined in yellow provide the greatest estimated B/C ratio
Cost Considerations

- Gantries and signs
  - Need to make assumptions on spacing and layout
- Widening, refuge areas, shoulder treatments
  - Environmental issues
- Ramp treatments
- Traffic signal controllers
- Detection
- Communications / power
- New software
  - Automated algorithms / decision support
- Systems engineering activities
- Public outreach
- On-going operations and maintenance
  - Training
- Contingency
Assumptions on Gantry Spacing and Layout

- Concerns with costs of frequent full gantries
- MUTCD requirements on guide sign distances – 600 to 800 feet
- Significant testing in UK of different spacing / layouts – Driver simulations – Visualization / response monitoring software

Moving towards more of a HYBRID approach
- Longer spacings between full gantries (e.g., after on ramps)
- Use of side-mounted signs in-between
- Significant reduction in costs
Hybrid Approach Examples
Tools for Estimating Benefits / Costs

- Review results of prior deployments
  - Washington, Minnesota, Northern Virginia

- Sketch / spreadsheet tools
  - FHWA TOPS–BC Tool

- Highway Capacity Manual Procedures
  - New Chapter 35 (ATDM)
  - HCM Software under development
  - Multi-scenario approach

- Combination
Final Chapter: “Next Steps”

- Continue regional planning / systems engineering activities
- Continue stakeholder involvement
  - Public outreach
- Develop performance measures
- Conformance with Regional ITS Architecture
  - New Service Packages for ATM in Version 7
- Regulations and MUTCD
  - MUTCD does not explicitly address DSpL or DLA
  - NEPA requirements for shoulder lanes
CASE STUDY: CALTRANS ATM FEASIBILITY STUDY FOR LOS ANGELES REGION
ACTIVE TRAFFIC MANAGEMENT
In Los Angeles: Past, Present & Future

MARCO RUANO
CHIEF, OFFICE OF TRAFFIC ENGINEERING
CALTRANS D-7 DIVISION OF OPERATIONS
November 18, 2014
District 7 Profile

- Counties: Los Angeles and Ventura
- Population: 10,793,527 (28% of Statewide)
- Approx. 1200 centerline freeway miles
- 514 operating miles of HOV/managed lanes (36%)
- Vehicle Miles of Travel- 34.9 Billion miles (30%)
- Total Annual Delay- 40.8 Million VHD (44%)
- Average Weekday Delay- 145,132 VHD (44%)
- Lane Miles w/Detection- 1,096 (18% of statewide)
- Lost Lane Miles- 489 miles (40% of Statewide)
As speeds drop, flow rates diminish significantly.
District 7 ATM Experience

- SR-14  Part-time HOV
- SR-118  Part-time use of shoulder as HOV lane
- Freeway to Freeway connector metering
- Adaptive Traffic Signal Control
- System Wide Adaptive Ramp Metering (SWARM) on 210 Corridor
- Dynamic Lane Management Project (Junction Control) at I-110/5 I/C
Northbound SR-110 connector to NB I-5
Re-stripe connector to two-lanes
Extinguishable Message Signs
Implement ‘through only’ lane using In-Pavement (smartstud)Lights

LEFT 2 LANES
DO NOT CROSS
LANE LIGHTS
WHEN ON
District 7 ATM Feasibility Study Objectives

- Develop a methodology for performing a sketch planning analysis of the safety and operational impacts of ATM strategies
- Develop basic guidelines for application, i.e., site conditions required for a particular ATM strategy to be effective.
- Develop a methodology for conducting a more detailed simulation analysis of the impacts of an ATM strategy (modeling tools, assumption criteria, desired outputs, etc)
- Establish a process to select and prioritize candidate corridors for further evaluation
- Develop an implementation plan for deployment on one pilot corridor
- Establish guidelines for ongoing monitoring and assessment of the safety and operational benefits of ATM deployment
- Ensure the guidance from this study can be applied in any freeway corridor for a wide range traffic conditions and facility types
District 7 ATM Feasibility Study Tasks

- Literature Review
- Qualitative Screening of Freeway corridors
- Quantitative Evaluation of ATM Strategies
- Detailed analysis of candidate ATM corridor
- Develop Implementation Plan
Task 4- ATM Assessment Framework

**Objective**- develop a framework that can provide practitioners with a better understanding of when and where ATM strategies may be beneficial

- Proposed use of spreadsheet-based framework with hyperlinked information
- Screening of capabilities for ATM and conditions supporting ATM deployment
Basic Structure

- Deficiency mapping to ATM strategies
- Detail Sheets
  - One-page summaries: Description, Relevant Deployment Conditions, Range of Potential Benefits, Conditions Supporting Success, Conditions Inhibiting Success, Relative Costs
- Compatibility with other ATM strategies
## ATM Assessment Framework – Deficiency Mapping (Partial Representation)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Observed Deficiency</th>
<th>Potential Mitigation Strategies</th>
<th>Typical Cost¹</th>
<th>Typical Benefit²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway</td>
<td>Safety/Crashes</td>
<td>Mainline Metering</td>
<td></td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improved Dynamic Corridor Ramp Metering Algorithms</td>
<td></td>
<td>32.50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Queue Warning</td>
<td>$1,565,000</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Speed Harmonization/Variable Speed Limits</td>
<td>$1,450,000</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lane Use Signals/Dynamic Lane Management</td>
<td>$2,800,000</td>
<td>16.50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dynamic Junction Control</td>
<td></td>
<td>41.50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard Shoulder Running</td>
<td>$2,244,400</td>
<td>26.70%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improved Decision Support Systems (DSS)/Response Plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Recurring Congestion</td>
<td>Safety/Crashes</td>
<td>Mainline Metering</td>
<td></td>
<td>48%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improved Dynamic Corridor Ramp Metering Algorithms</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Speed Harmonization/Variable Speed Limits</td>
<td>$1,450,000</td>
<td>13.70%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lane Use Signals/Dynamic Lane Management</td>
<td>$2,800,000</td>
<td></td>
</tr>
</tbody>
</table>
What it is:
Differences in speed tend to cause vehicle conflicts and can lead to abrupt stopping and slowing leading to increased congestion and the potential for collisions. Queue warning’s basic principle is to inform travelers of the presence of downstream stop-and-go traffic (based on real-time traffic detection) using warning signs and flashing lights. Drivers can anticipate an upcoming situation of emergency braking and slow down, avoid erratic behavior, and reduce queuing-related collisions. Dynamic message signs (DMS) show a symbol or word when stop-and-go traffic is near. Variable speed limits and lane control signals that provide incident management capabilities can be combined with queue warning. The system can be automated or controlled by a traffic management center operator. Work zones also benefit from queue warning with portable dynamic message sign units placed upstream of expected queue points.

Relevant Deployment Conditions:
- Frequently congested freeways or roads.
- Facilities with frequent queues in predictable locations.
- Facilities with sight distance restricted by vertical grades, horizontal curves, or poor illumination.
- Power must be available to site or able to be installed at cost-effective rate.
- Right of way to install QWS signs and/or overhead sign gantries must be available.
- Communications to TOC must be available.
- CCTV monitoring of the site should be present to monitor system performance.
- Signs should be placed to contain end of queuing fully at site.
- Sensors to support QWS operation must be installed at close spacings. Sensors should be located before and after ramp entrances.

Range of Potential Benefits:
- Primary incident reductions ranging from 4% to 42%.
- Secondary incident reductions ranging from 40% to 50%.
- Decrease in speed variability in the traffic stream, particularly at the onset of congestion.
- In the United Kingdom, safety improvements were valued at $220,000 per mile, and delay savings were valued at $12,900 per mile.

Conditions Supporting Success:
## ATM Corridor Assessment - Overview

<table>
<thead>
<tr>
<th>Evaluation Criterion</th>
<th>I-210 (A) 12mi SR-134 to I-605</th>
<th>I-210 (B) 15mi I-605 to Padua Ave</th>
<th>I-710 21mi Long Beach to Alhambra</th>
<th>I-105 17mi Sepulveda Blvd to I-605</th>
<th>I-405 south 13mi I-605 to I-110</th>
<th>I-405 mid 8mi I-110 to I-105</th>
<th>I-405 north 18mi I-105 to US-101</th>
<th>I-5 10mi I-605 to SR-60</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Congestion and Safety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak period congestion levels</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
<td>High</td>
<td>Very High</td>
<td>Oversaturated</td>
<td>Oversaturated</td>
</tr>
<tr>
<td>Accident rate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Congestion variability</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck traffic</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Diversion potential</td>
<td>Very Good</td>
<td>Very Good</td>
<td>Good</td>
<td>Very Good</td>
<td>Moderate</td>
<td>Poor</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Shoulders available?</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Poor</td>
<td>Good</td>
<td>Moderate</td>
<td>Poor</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>HOV/Managed lanes available?</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Ramp/arterial storage</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
<td>Good</td>
<td>Moderate</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>ITS Infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highway detection/surveillance</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Arterial detection/surveillance</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Ramp metering</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Traveler information dissemination</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Institutional Coordination</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency coordination required</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Moderate</td>
<td>Torrance unsupportive?</td>
<td>Low</td>
</tr>
<tr>
<td>Availability of ATM Champion</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>LA or Inglewood?</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Available Analysis Tools</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesoscopic Simulation</td>
<td>No</td>
<td>No</td>
<td>AIMSUN-soon</td>
<td>AIMSUN-soon</td>
<td>No</td>
<td>AIMSUN-soon</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Microscopic Simulation</td>
<td>VISSIM</td>
<td>VISSIM</td>
<td>AIMSUN-soon</td>
<td>AIMSUN-soon</td>
<td>Paramics</td>
<td>AIMSUN-soon</td>
<td>Paramics</td>
<td>Paramics</td>
</tr>
<tr>
<td><strong>Overall Potential Opportunity</strong></td>
<td>✚</td>
<td>✚</td>
<td>✚</td>
<td>✚</td>
<td>✚</td>
<td>✚</td>
<td>✚</td>
<td>✚</td>
</tr>
</tbody>
</table>
**I-105 Corridor (Sepulveda Blvd to I-605)**

**Issue:** Significant peak period demand; bottlenecks due to frequent lane drops

<table>
<thead>
<tr>
<th>ATM Strategy</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp-Arterial Signal Coordination</td>
<td>Metered ramps; good ramp storage and parallel arterials. Ramp metering/arterial signal coordination ConOps is currently being developed as part of DCCM project. Imperial Hwy and El Segundo in the western part of the corridor are viable diversion routes; Imperial Hwy and Rosecrans Ave on the east.</td>
</tr>
<tr>
<td>Dynamic Pricing</td>
<td>Would require converting GP lanes to HOT lanes. This type of analysis may be too early for this project.</td>
</tr>
<tr>
<td>Dynamic HOV</td>
<td>Varying demand in HOV 2+ lanes (saturated in peak) would benefit from dynamic control of the HOV/managed lanes</td>
</tr>
<tr>
<td>Dynamic Routing</td>
<td>Good arterial grid to support new routes (major parallel arterials include Imperial Hwy, El Segundo Blvd, Rosecrans Ave)</td>
</tr>
<tr>
<td>Adaptive Ramp Metering</td>
<td>All ramps and fwy to fwy connector are metered; existing system is local-responsive. Can support adaptive corridor metering – DCCM project will be developing adaptive ramp metering algorithm. If adaptive algorithm is delayed, analysis can use San Diego adaptive algorithm. D7 Ramp Metering group to send existing metering algorithm to CS.</td>
</tr>
<tr>
<td>Queue Warning</td>
<td>Would help address the safety issues resulting from the corridor’s various lane drops, bottlenecks, and ramp spillback locations. A candidate location is at interchange with I-710.</td>
</tr>
<tr>
<td>Speed Harmonization (Variable Speed Limits)</td>
<td>Would help delay onset of flow breakdown due to increased demand, incidents, and downstream bottlenecks. Comparatively more expensive solution.</td>
</tr>
</tbody>
</table>
### Issue: Significant peak period demand; bottlenecks due to frequent lane drops (Cont.)

<table>
<thead>
<tr>
<th>ATM Strategy</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dynamic Lane Reversal</strong></td>
<td>Facility not conducive to reversible lanes (median-running LRT)</td>
</tr>
<tr>
<td><strong>Hard Shoulder Running</strong></td>
<td>Consistently wide shoulders offer good opportunity for expansion, especially around lane drop locations (like WB Crenshaw Blvd, WB Vermont Ave, EB Central Ave off-ramps)</td>
</tr>
<tr>
<td><strong>Dynamic Junction Control</strong></td>
<td>Potentially around I-405 interchange, I-710 interchange, and major ramps</td>
</tr>
<tr>
<td><strong>Adaptive Traffic Signals</strong></td>
<td>Major parallel arterials would benefit from traffic responsive signal systems. Under DCCM project there will be discussions with Cities re: improvements to signal systems</td>
</tr>
<tr>
<td><strong>Predictive Traveler Info</strong></td>
<td>Multi-modal choices available along corridor; travelers would benefit from predictive info. Hard to simulate mode-shift but an assessment will be made of mode shift potential using other tools.</td>
</tr>
<tr>
<td><strong>Transit Signal Priority</strong></td>
<td>Grade-separated Green Line LRT is main transit option, TSP N/A</td>
</tr>
<tr>
<td><strong>Active Parking Management</strong></td>
<td>Better manage park-and-ride lots for median-running Green Line with dynamic parking reservations, pricing, overflow lot management</td>
</tr>
</tbody>
</table>
ATM Strategies Modeled

- Dynamic shoulder lanes (hard shoulder running)
- Queue warning system
- Dynamic routing
- Predictive traveler information
- Adaptive ramp metering
- Coordination of ramp meters and arterial signals
- Adaptive traffic signal control on arterials
AM Peak Westbound Congestion is Addressed by Implementing ATM
## AM Performance Measures – Typical Day

<table>
<thead>
<tr>
<th>Metric</th>
<th>Without ATM</th>
<th>Percent Change from Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ATM Package</td>
</tr>
<tr>
<td>VMT (vehicle miles)</td>
<td>1,400,468</td>
<td>1.51%</td>
</tr>
<tr>
<td>VHT (vehicle hours)</td>
<td>44,832</td>
<td>-26.74%</td>
</tr>
<tr>
<td>Vehicle Hours of Delay (vehicle hours)</td>
<td>20,451</td>
<td>-59.59%</td>
</tr>
<tr>
<td>Person-Miles Traveled (passenger miles)</td>
<td>1,953,167</td>
<td>1.35%</td>
</tr>
<tr>
<td>Person-Hours Traveled (passenger hours)</td>
<td>60,453</td>
<td>-25.06%</td>
</tr>
<tr>
<td>Person-Hours of Delay (passenger hours)</td>
<td>26,677</td>
<td>-57.68%</td>
</tr>
<tr>
<td>Average Travel Time (seconds per mile)</td>
<td>115.24</td>
<td>-27.83%</td>
</tr>
<tr>
<td>Average Trip Time (minutes per trip)</td>
<td>6.34</td>
<td>-27.31%</td>
</tr>
</tbody>
</table>
## AM Fuel Consumption and Emissions

**System wide — typical day**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Without ATM</th>
<th>Percent Change from Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ATM Package</td>
</tr>
<tr>
<td>CO (kg)</td>
<td>4,742</td>
<td>-3.73%</td>
</tr>
<tr>
<td>CO₂ (kg)</td>
<td>662,382</td>
<td>-4.52%</td>
</tr>
<tr>
<td>NOₓ (kg)</td>
<td>1,113</td>
<td>-0.73%</td>
</tr>
<tr>
<td>PM₁₀ (g)</td>
<td>75,260</td>
<td>-6.84%</td>
</tr>
<tr>
<td>SOₓ (g)</td>
<td>6,658</td>
<td>-4.25%</td>
</tr>
<tr>
<td>VOC (kg)</td>
<td>442</td>
<td>-6.93%</td>
</tr>
<tr>
<td>Fuel Consumption (gal)</td>
<td>76,670</td>
<td>-4.32%</td>
</tr>
</tbody>
</table>
# Total Monetized Benefits Per Year

*ATM Package* scenario, for entire network

<table>
<thead>
<tr>
<th>Benefit Category</th>
<th>AM</th>
<th>PM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person-Hours of Delay Saved <em>(recurring congestion)</em></td>
<td>$47,704,841</td>
<td>$41,150,592</td>
<td>$88,855,433</td>
</tr>
<tr>
<td>Emissions Reductions</td>
<td>$1,021,968</td>
<td>$1,167,221</td>
<td>$2,189,189</td>
</tr>
<tr>
<td>Fuel Savings</td>
<td>$3,087,749</td>
<td>$3,218,556</td>
<td>$6,306,305</td>
</tr>
<tr>
<td>Collision Reductions</td>
<td>$5,350,762</td>
<td>$5,235,395</td>
<td>$10,586,157</td>
</tr>
<tr>
<td>Improved Travel Time Reliability</td>
<td>$8,123,244</td>
<td>$7,173,161</td>
<td>$15,296,405</td>
</tr>
<tr>
<td><strong>Total Monetary Benefits</strong></td>
<td><strong>$65,288,564</strong></td>
<td><strong>$57,944,925</strong></td>
<td><strong>$123,233,489</strong></td>
</tr>
</tbody>
</table>
Total Monetized Benefits Per Year

**HSR-Only scenario, for entire network**

<table>
<thead>
<tr>
<th>Benefit Category</th>
<th>AM</th>
<th>PM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person-Hours of Delay Saved (recurrent congestion)</td>
<td>$39,289,778</td>
<td>$28,924,059</td>
<td>$68,213,837</td>
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<tr>
<td>Emissions Reductions</td>
<td>$1,159,503</td>
<td>$957,835</td>
<td>$2,117,338</td>
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<tr>
<td>Fuel Savings</td>
<td>$3,317,569</td>
<td>$2,719,907</td>
<td>$6,037,476</td>
</tr>
<tr>
<td>Collision Reductions</td>
<td>$3,879,836</td>
<td>$3,879,836</td>
<td>$7,759,672</td>
</tr>
<tr>
<td>Improved Travel Time Reliability</td>
<td>$8,006,476</td>
<td>$7,235,368</td>
<td>$15,241,844</td>
</tr>
<tr>
<td><strong>Total Monetary Benefits</strong></td>
<td><strong>$55,653,162</strong></td>
<td><strong>$43,717,005</strong></td>
<td><strong>$99,370,167</strong></td>
</tr>
</tbody>
</table>
## Benefit-Cost Analysis

<table>
<thead>
<tr>
<th></th>
<th>Full ATM Package</th>
<th>HSR-Only Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Costs</td>
<td>$80,194,824</td>
<td>$39,479,304</td>
</tr>
<tr>
<td>(from implementation plan)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations and Maintenance Annual Costs</td>
<td>$2,543,000</td>
<td>$1,347,000</td>
</tr>
<tr>
<td>Net Present Value of Costs over 10-year period</td>
<td>$104,190,673</td>
<td>$52,189,649</td>
</tr>
<tr>
<td>Net Present Value of Benefits over 10-year period</td>
<td>$1,039,515,345</td>
<td>$838,220,311</td>
</tr>
<tr>
<td>Benefit/Cost Ratio</td>
<td>10.0 to 1</td>
<td>16.1 to 1</td>
</tr>
</tbody>
</table>
Conceptual Layout for Dynamic Shoulder Lanes and Speed Limits

Dual variable speed limit signs (on each side of roadway)
I-105 Deployment Contract Deliverables

- Concept Level Design Document
- Implementation Plan
- Deployment Cost Estimates
- Operations & Maintenance Plan
NEXT STEPS

- Engage Local partners!
- Explore Design issues
- Environmental/statutory considerations
- Engage enforcement
- Project Study Report (I-105 mobility improvements, including Express Lanes)
Related Efforts

- Connected Corridors Pilot- I-210 Integrated Corridor Management
- Dynamic Corridor Congestion Management (DCCM)- South Bay COG; integration of freeway ramp operations with arterial street operations
- Regional Express Lane Network implementation (MPO)
- FHWA Feasibility & Screening Guidance (Summer 2014)
- NCHRP 03-114- “Planning and Evaluating Active Traffic Management Strategies”
- Arroyo Seco Safety study – potential use of “Flex Lane”
Question and Answer Session
Knowledge and Technology Transfer

- Website: [http://ops.fhwa.dot.gov/atdm/index.htm](http://ops.fhwa.dot.gov/atdm/index.htm)
- Lessons Learned
- Informational Briefs
- Research and Publications

Welcome to Active Transportation and Demand Management

The Active Transportation and Demand Management (ATDM) program is intended to support agencies and regions considering moving towards an active management approach. Through customized workshops, tools, guidance documents, resources, and peer exchanges, the program can assist with technical support to implement ATDM strategies. Importantly, ATDM is not an exclusive program restricted to specific agencies. Every agency that is considering moving towards active and dynamic capabilities can benefit from the ATDM program’s efforts.

WHAT’S NEW

- Guide for Highway Capacity and Operations Analysis of Active Transportation and Demand Management Strategies (FHWA-HOP-13-042)
- ATDM Analysis Brief: Example Application (HOV to HOT) of ATDM Capacity and Operations Analysis (FHWA-HOP-13-036)
- ATDM Analysis Brief: Example Application (Ramp Metering and Demand Management) of ATDM Capacity and Operations Analysis (FHWA-HOP-13-037)
- ATDM Analysis Brief: Methodology for Capacity and Operations Analysis of ATDM (FHWA-HOP-13-035)
ATM Guidance and Resources Coming Soon

- ATM Feasibility and Screening Guide
- Freeway Management & Operations Handbook update
- Shoulder Guidance
- Traffic Management Capability Maturity Framework
- Ramp Metering Primer

Will be posted at: http://ops.fhwa.dot.gov/atdm/index.htm
# Points of Contact

## Follow Up Questions

<table>
<thead>
<tr>
<th>Name</th>
<th>Org.</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
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<td>(646)345-5971</td>
</tr>
<tr>
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<td>Caltrans</td>
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<td>(213)897-9863</td>
</tr>
</tbody>
</table>
Thanks for joining us!

We hope to see you at our next ATDM Webinar in December!

– Topic: Ramp Metering Benefits, Opportunities, and Keys for Overcoming Common Challenges
– Date Placeholder: December 10th, 1-3pm EST