Webinar: Active Traffic Management (ATM) Implementation and Operations Guidance

October 17, 2017
Agenda

- Housekeeping
- Introductions
- Overview of Active Transportation and Demand Management (ATDM)
- ATM Implementation and Operations Guidance
- Question and answer
Housekeeping

- Participants’ phone lines will be muted during the webinar.
- If you have any questions enter them in the “Questions” pane at any time during the presentation.
- Contact information for the presenters will be provided at the conclusion of the webinar.
Introduction

- This webinar was developed as part of a project funded by the Federal Highway Administration.
- Thanks to the National Operations Center of Excellence for hosting today’s event.
- Thank you for your participation in today’s webinar.
Today’s Speakers

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

Beverly Kuhn, Ph.D., P.E., PMP
Senior Research Engineer
Texas A&M Transportation Institute

Vinh Dang, P.E.
Freeway Operations
Washington State Department of Transportation
Purpose of Today’s Webinar

Provide an overview of a recently-developed implementation and operations guidance which agencies can use to deploy Active Traffic Management (ATM) in their regions. Topics include:

- Context of ATM implementation and operations and use by agencies.
- Overview of ATM concepts and strategies.
- Overview of the critical issues included in the ATM implementation and operations guidance.
- Experiences from a recent ATM deployment.
Overview of Active Transportation and Demand Management

- What is Active Management?
- Goal of the ATDM Concept
- ATDM Throughout the Trip Chain
- What does ATDM include?
- FHWA’s ATDM Program
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 that 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

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ADM</td>
<td>Comparative multi-modal travel times, dynamic ride-sharing, pricing, and incentive approaches.</td>
</tr>
<tr>
<td>ATM</td>
<td>Dynamic speed limits, dynamic shoulder use, queue warning, dynamic lane assignment, others.</td>
</tr>
<tr>
<td>APM</td>
<td>Parking pricing, real-time parking availability and reservation systems.</td>
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</tbody>
</table>
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.
Overview of FHWA ATM Implementation and Operations Guidance

- FHWA Team, Contractor Project Team, and External Advisory Panel.
- Project objectives and activities.
- ATM Guide context and objectives.
- Overview of ATM Guide chapters and content.
FHWA Team

- James Colyar (GTM)
- Jim Hunt
- Jimmy Chu
- Greg Jones
Contractor Project Team

- Battelle
  - Bill Perez, PM
- Texas A&M Transportation Institute (TTI)
  - Beverly Kuhn
  - Nick Wood
  - Kevin Balke
  - Jerry Ullman
External Advisory Panel

- Vinh Dang, Washington State Department of Transportation
- Paul Keltner, Wisconsin Department of Transportation
- Michael Marsico, New York City Department of Transportation
- Shital Patel, Regional Transportation Commission of Southern Nevada
- Kamal Suliman, Virginia Department of Transportation
- Raj Ponnaluri, Florida Department of Transportation
Project Objectives and Activities

Produce a Guide for agencies interested in implementing ATM in their region, as well as for agencies that have implemented ATM and are interested in guidance on operating their ATM systems and strategies.

- Prepare the ATM Implementation and Operations Guide.
- Prepare an informational brief to create broad awareness of the ATM Implementation and Operations Guide.
- Prepare and conduct a national webinar.
The ATM I&O Guide Context

Scope

Multi-Strategy Resources

Active Traffic Management Feasibility and Screening Guide

NCHRP 3-114: Planning and Evaluating Active Traffic Management Strategies

Use of Freeway Shoulders for Travel — Guide for Planning, Evaluating, and Designing Part-Time Shoulder Use as a Traffic Management Strategy

Ramp Metering: A Proven, Cost-Effective Operational Strategy

Single Strategy Resources

Active Transportation Management Implementation and Operations Guide

Guidelines for the Use of Variable Speed Limit Systems in Wet Weather

Phase

Planning  Design  Implementation  Operations and Maintenance
ATM Guide Objectives

- Develop Guide to enable agencies to make informed and sound engineering decisions regarding implementing and operating ATM systems and strategies.
- Intended for agencies interested in implementing ATM in their region, as well as for agencies that have implemented ATM and are interested in guidance on operating their ATM systems and strategies.
ATM Guide Objectives

- Highlight best practices, lessons learned, and case studies as well as guiding principles, resources, key questions, and issues to consider when implementing ATM.

- The guidelines are not intended to focus on how to plan for ATM deployment, but rather to focus on the next phase of implementing ATM and subsequently operating ATM systems and strategies.
Use of Guide

- Implementing ATM in a region.
- Operating ATM systems more effectively.
- Incorporate ATM into overall TSMO program.
- Variety of potential benefits.
ATM Guide Chapters

- 1 – Introduction
- 2 – Planning and Organizational Considerations
- 3 – Design Considerations
- 4 – Implementation and Deployment
- 5 – Operations and Maintenance
- 6 – Final Remarks
- 7 – References
Chapter 1 – Introduction

- 1.1 – Overview, Goals, Intent, and Audience
- 1.2 – Overview of ATM Strategies
- 1.3 – ATDM, ATM, and TSMO
- 1.4 – Systems Engineering
- 1.5 – Chapters at a Glance
ATM Strategies In Guide

Active Traffic Management

Dynamic Merge Control
Dynamic Speed Limit
Queue Warning
Dynamic Shoulder Lane
Dynamic Lane Use Control
Dynamic Lane Reversal
Dynamic Junction Control
Adaptive Traffic Signal Control
Adaptive Ramp Metering

Source: Adapted from NCHRP 03-114
Early Adopter – WSDOT

- Seattle, Washington
  - I-5
  - SR 520
  - I-90
- Branded “Smarter Highways.”
- Variable speed limits.
- Dynamic lane use control.

Source: Texas A&M Transportation Institute
Early Adopter – WY DOT

- I-80 between Laramie and Rawlins.
- Address weather-related closures.
  - Severe weather.
  - High winds.
- Rural application.
- Monitoring road conditions, wind, surface and atmospheric conditions, speeds.

Source: Wyoming Department of Transportation
ATM Strategy Details

- Name
- Acronym
- Definition
- Operational scenarios (e.g., recurring congestion, work zones, incidents, directional shift, etc.).
- Application geography
  - Limited access facilities
  - Arterials
  - Interchanges and ramps
- Examples and links to resources.
ATDM, ATM, and TSMO

- **ATDM**
  - Active Demand Management
  - Active Traffic Management
  - Active Parking Management

- **Active Management Cycle**

- **TSMO**
  - Includes strategies that are dynamic, predictive, proactive, performance-driven, continuously monitored, and supply and demand oriented.
Systems Engineering
Chapter 2 – Planning and Organizational Considerations

- 2.1 – Planning for ATM Operations
- 2.2 – Organizational Capability for ATM Operations
- 2.3 – Setting Objectives and Performance Measures for ATM
- 2.4 – Analysis, Modeling, and Simulation
- 2.5 – Programming and Budgeting
Objectives-Driven, Performance-Based Approach

Regional Goals

Monitoring and Evaluation

Operations Objectives

Investment and Implementation

Performance Measures

Management and Operations Strategies
Organizational Capability for ATM Operations

**Performed (Level 1)**
- Activities and relationships ad hoc
- Champion-driven

**Managed (Level 2)**
- Process developing
- Staff training
- Limited accountability

**Integrated (Level 3)**
- Process documented
- Performance measured
- Organization/partners aligned
- Program budgeted

**Optimized (Level 4)**
- Performance-based improvement
- Formal program
- Formal partnerships
Setting Objectives and Performance Measures for ATM

- Objectives and performance measures for each strategy.
- SMART: Specific, measurable, attainable, realistic, and time-bound.
- Travel time reliability.
- Congestion management.
- Safety.
- Sustainability and livability.
Additional Planning

- Analysis, Modeling, and Simulation
  - Mobility
  - Safety
  - Environmental
  - Benefit-Cost

- Programming and Budgeting
Chapter 3 – Design Considerations

- 3.1 – Concept of Operations
- 3.2 – Requirements
- 3.3 – Design Elements
- 3.4 – Performance-Based Practical Design
- 3.5 – Technology, Procurement, and Testing
Concept of Operations

- Scope
- Reference Resources
- User-Oriented Operation Description
- Operational Needs
- System Overview
- Operational and Support Environments
- Operational Scenarios
- Summary of Impacts
Requirements

- Functional requirements
- Performance requirements
- Scope of the system
- Reference documents
- Requirements for ATM system
- Verification methods for requirements
- Supporting documentation
- Traceability matrix
- Glossary of terms, acronyms, and definitions
Design Elements

- Civil Design Elements
  - Traffic Control Devices
  - Geometrics
  - Emergency Pull-Offs
- Technology Elements
  - Controllers and Software
  - Detection and CCTV
  - Communications
  - Control Signals, DMS, and Beacons
Infrastructure Design

- Shoulder Pavement
- Fixed Objects
- Vertical Clearance
- Drainage Treatment
- Rumble Strips
- Design Exception Process
- Traffic Control Design
- MUTCD Experimental Approval Process

Source: Washington State Department of Transportation
ITS Design

- Hardware
- Connectivity
- Data
- Software design and integration

Source: Washington State Department of Transportation
Procurement and Testing

- Software Delivery Models
  - In-House
  - External Developer
  - Interface with Existing Software

- Testing of equipment

Source: Washington State Department of Transportation
Procurement Lessons Learned

- ATM requires more precision and skill to implement.
- Critical to have durable, high-quality signs.
- ATM should supplement traffic management.
- Continuous communication between project managers and software developers.
- Establish requirement traceability matrix at the onset.
- Advance design beyond 30% during development of design-build procurement documents.
Chapter 4 – Implementation and Deployment

- 4.1 – Construction and Scheduling
- 4.2 – Legal Issues
- 4.3 – Stakeholder Engagement, Public Outreach, and Involvement
Construction and Scheduling

- Design-Build
- Design-Bid-Build
- Construction Management at Risk
- Public-Private Partnership
- Advantages vs. Disadvantages
- Coordination
- Schedule
Legal Issues

- Legality of Strategies: Shoulder use, dynamic speed limits.
- Enforcement strategies.
- Operating policies related to operator validation.
- Need for additional staffing and/or equipment.
Stakeholder Engagement, Public Outreach, and Involvement

- Identifying stakeholders and team.
- Engagement, outreach, and involvement.
- Lessons Learned.
  - Provide information on whether strategy is worthwhile.
  - Consider travelers as allies and advocates.
  - Use a broad range of dissemination tools and mechanism.
  - Share successes.
  - Consistent messages across all levels of an organization.
  - Communication early and often.
Stakeholder Engagement, Public Outreach, and Involvement

Never drive in a red X lane

Driving under a red X sign could endanger your life and the lives of others, and you could be caught.

Source: Virginia Department of Transportation

Source: Highways England

Source: Washington State Department of Transportation
Chapter 5 – Operations and Maintenance

- 5.1 – Activation Thresholds and Performance Monitoring
- 5.2 – Performance Evaluation
- 5.3 – Maintenance
- 5.4 – Incident Management
- 5.5 – Enforcement
- 5.6 – Costs
Thresholds and Performance Monitoring

- Active management process
- Automated systems
- Manual systems
- Hybrid
- Thresholds and data sets required
- Typical measures by strategy
- Use performance monitoring to drive active management.
Performance Evaluation

- Collect performance data over an extended period of time to determine overall benefits.

Source: Texas Department of Transportation
Maintenance

- Understand elements and relative cost range.
- Some strategies may have unique maintenance considerations.
  - Amount of field equipment.
  - Detection issues.
  - Equipment and proximity to traveled way.
  - Supporting signage.
Incident Management and Enforcement

- Incident Management Activities
  - Dedicated service patrols.
  - Stationed tow trucks.
  - Utilize dynamic shoulder use in incident management.
  - Emergency refuge areas.

- Enforcement
  - Engage law enforcement early in the implementation process.
  - Process for enforcement.
  - Adjudication support.
Costs

- Accessibility to federal funding programs.
- Incorporation of strategies and operational costs in capital projects.
  - System integration.
  - Telecommunications.
  - Reconstruction of buildings or structures housing components.
  - Control/management center and system hardware/software.
  - Infrastructure-based ITS improvements.
  - Signage and signals.
Chapter 6 – Final Remarks

- 6.1 – Impact of Connected and Automated Vehicles on ATM
- 6.2 – Uses of Guide by Transportation Agencies
Impact of Connected and Automated Vehicles on ATM

- CV and AV can provide data to support operational strategies.
- Successful demonstration at the intelligent network flow optimization (INFLO) prototype system can deliver queue warning and speed harmonization messages in-vehicle.
- Simulation showed that dynamic speed harmonization and queue warning has positive impact on system operations in reducing magnitude of shockwaves.
- Data may impact algorithms.
ATM in Washington State

Vinh Q. Dang, P.E.
Freeway Ops Eng., NW Region Freeway Ops
Traffic management

• Ramp metering – Peak hours operation, bottle neck algorithm
• Reversible/express lane operation on I-5 – manual operation and on fixed schedule.
• Reversible lane operation using lane control signal \( \times \) and \( \downarrow \) on I-90
• TMC and staffing for system monitoring.
Capacity enhancement

- Complete I-90 connection to downtown Seattle – comm. system
- HOV / managed lane program - increased person throughput.
- Incident response program – capacity recovery.
- Interagency coordinated operation – foundation for ICM.
- Open up shoulder as storage lane during ramp metering operation.
- Expand hour of TMC operation
Responsive management

- Variable speed limit on I-90 – weather responsive.
- Enhance ramp metering – Fuzzy logic.
- Further deployment of Variable speed late 90 – traffic responsive.
- Pilot HOV/HOT lane on SR 167 – begin of the congestion pricing era.
- Expand hour of TMC operation.
Proactive management

• Full ATM on I-5, I-90, SR 520
  - Queue detection/warning
  - Speed transitioning
  - Junction warning
  - Lane control signaling
• Automation of ramp metering
• Remote/automated EL operation
• More ICM strategies deployed
• Congestion pricing – variable toll
  - SR 16, SR 520 Bridge crossing
  - SR 167 HOT lane
  - I-405 Express /Toll lane
Full ATM corridors

- I-5 NB only – 8/10/10
  - 7 mi / 15 gantries / 97 signs
  - $23 mil – AWT mitigation

- SR 520 – 11/16/11
  - 8 mi / 19 gantries / 70 signs
  - $20 mil – UPA fund

- I-90 – 6/8/11 & 5/18/12
  - 11 mi / 25 gantries / signs
  - $22 mil – UPA fund
Typical gantry and sign layout

• Gantry over one direction
  - Exclusively on I-5
  - Some locations on I-90 and SR 520 where cross sections are wide
• Gantry over both direction
  - Mostly on compact cross section on SR 520
• Bridge over crossing as gantry
• Why ½ mile spacing?
Typical sign graphics

SPEED LIMIT (Displayed between 30 to 60 in multiples of 5, 30mph only used during a major weather event or disaster)

SPEED LIMIT 35

HOV 2+ (or 3+)
ONLY

OPEN TO ALL

LANE CONTROL SIGNS

X Y MILES

X

MERGE LEFT, RIGHT OR AROUND, CAUTION IN LANE

MERGE

MERGE

MERGE

CAUTION
Comprehension and Compliance

Under normal operating condition

- No violation of red X.
- Initial confusion on the posted speed limits. Operating speed is within the 85th percentile speed in the speed range 35+ MPH
- Drivers vacated the lane approaching the merge sign or the junction warning sign.
Maintenance and Operation staffing

- Expanded hour of operation – added 3 FTE to the TMC.
- VMS Inventory increased from 70 to 360 – added 2 FTE and 1 boom truck to Maintenance.
- Re-organization - transitioning maintenance staff into operation. Union challenges.
- Low learning curve – operator participated throughout the entire software development.
Automatic algorithms

• Running in the background 24/7.
• Monitor flow and detect congestion.
• Activate junction warning.
• Activate ramp metering.
• Activate speed transitioning.
• Activate routing VMS
• Different speed limit between HOV and GP.
Enhanced merging

I-90 Eastbound at Eastgate: Increased throughput:

- Automatic on when ramp demand is high and freeway is congested.
- Mainline traffic vacate lane 1 to leave room for ramp demand.
- Approaching traffic accept shorter gap thus increase through put.
ATMS in TMC operation

- System in auto mode
ATMS in TMC operation

- System in auto mode
- Operator opens the ATM control panel.
ATMS in TMC operation

- System in auto mode
- Operator opens the ATM control panel.
- Clicks on the two lane control signs over the blocked lane just upstream from blockage.
ATMS in TMC operation

- System in auto mode
- Operator opens the ATM control panel.
- Clicks on the two lane control signs over the blocked lane just upstream from blockage.
- Clicks preview.
ATMS in TMC operation

- System in auto mode.
- Operator opens the ATM control panel.
- Clicks on the two lane control signs over the blocked lane just upstream from blockage.
- Clicks preview.
- Clicks confirm.
- LCS segments override 3 gantries. The remaining gantries are available for all other automatic processes.
- Incident occurred in the add/drop lane.
- Vehicles start merging as they see the yellow merge arrow.
- Speed is stop and go – travel time is a minute or two between gantry - vehicles continues to inch past the red X until they find gap to merge.
- Empty lane syndrome
Results?

• Good compliance - people are following the signs.
• Reduced speed differential across lanes.
• Reduced stop and go.
• Reduced abrupt evasive maneuvers.
• Reduced collision frequency and severity.
• Increased throughput approaching on-ramp.
### Frequency of Collisions, Before and After Comparison per I-5 ATM Section and Other Similar Roadways

(Officer-reported collisions 5a-8p; 3 Yr B/A: 7/07-6/10, 10/10-9/13; 2 Yr B/A: 7/08-6/10, 10/10-9/12)

<table>
<thead>
<tr>
<th></th>
<th>ATM Corridor</th>
<th>Shoreline - CBD</th>
<th>Comparison Segments</th>
<th>King County Freeways</th>
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<tbody>
<tr>
<td>2 Year, Weekday</td>
<td>-7.5%</td>
<td>-3.3%</td>
<td>-27.0%</td>
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<td>2 Year, Weekend</td>
<td>0.3%</td>
<td>2.1%</td>
<td>-11.0%</td>
<td>-0.7%</td>
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<td>3 Year, Weekday</td>
<td>5.4%</td>
<td>6.1%</td>
<td>3.7%</td>
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<tr>
<td>3 Year, Weekend</td>
<td>3.5%</td>
<td>2.2%</td>
<td>3.7%</td>
<td>6.5%</td>
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Extents: ATM Corridor: NB I-5 MP 157.20-165.49; Shoreline-CBD: SB I-5 MP 166.29-174.59; Comparison Segments: NB I-5 MP 165.50-180.60, SB I-5 MP 157.20-180.60; King Co Fwys: fwy segments of I-5, I-90, I-405, SR 167, and SR 520 in King County
Hard Shoulder Running

Static approach: Restripe to narrower lane and wider shoulder. Open shoulder up as travel lane during congestion – low speed.
Hard Shoulder Running

- ATM-lite 😊
- Q-detection algorithm
- Transition interval
- Ready for automation
Hard Shoulder Running

BEFORE
February-April 2017

AFTER
First 3 months
Operation scenario

- Disable vehicle in shoulder
- Segment closure
- Disable vehicle in emergency pull-out
- Open with caution
(re)Design for operation - Practical

<table>
<thead>
<tr>
<th>Current standard</th>
<th>Lt shoulder</th>
<th>4’-6’</th>
<th></th>
<th>rest in Red X</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-section: 50’-52’</td>
<td>lane 3</td>
<td>lane 2</td>
<td>lane 1</td>
<td>Rt shoulder</td>
</tr>
<tr>
<td>12’</td>
<td>12’</td>
<td>12’</td>
<td>10’</td>
<td></td>
</tr>
</tbody>
</table>

| Proposed new | Lt shoulder | 2’-4’ |  |  |
| X-section: 48’-52’ | In 3 | In 2 | In 1 | Rt shoulder |
| 11’ | 11’ | 11’ | 13’-15’ |

Using a Signal Type Mast Arm

Washington State Department of Transportation
ICM effort - Load balancing

- Route choice and diversion.
- Most effective for major incident.
- Network junctions – constraints as well as opportunities.
- Coordinated ramp metering and arterial signal operation.
Where are we heading

• Design for operation – Practical
  - Flexible lane and shoulder combination.
  - Dual queue lines storage on-ramp.
  - Freeway/arterial integration at network junction.
  - Ramp meter ready – from data station to metering.

• Explore deployment or delivering ATM strategies via emerging technologies and initiatives – apps, crowdsourcing, in-vehicle devices, connected vehicles

• Continue the proven steps: plant the seed for demand management and integrated corridor management.
Question and Answer Session
Knowledge and Technology Transfer

Website: http://ops.fhwa.dot.gov/atdm/index.htm

- Lessons Learned
- Informational Briefs
- Research and Publications
# Points of Contact for Follow Up Questions

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<tr>
<th>Name</th>
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Thanks for joining us!