

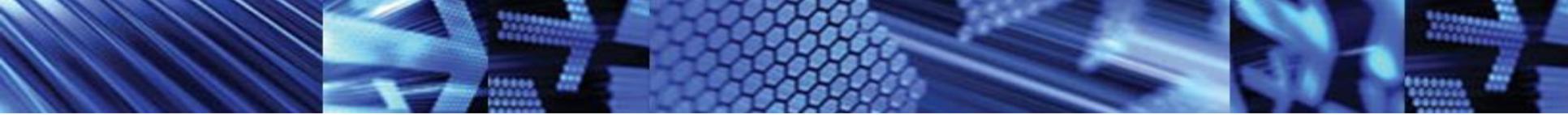
Active Transportation And Demand Management

**ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT
(ATDM) WEBINAR SERIES**

Webinar #5: National ATDM Program Research

March 26, 2015





Agenda

- Introduction and Welcome
- Overview of ATDM and the FHWA ATDM Program
- ATDM Research: Completed, Current, and Future Efforts
- ATDM Research on Part-Time Shoulder Lanes
- ATDM AMS Testbed Project
- ATM Traffic Control Devices Study
- Tools for Predicting Performance and Tactical and Strategic Decision Making Project and Behavioral Study
- Q&A



Today's Speakers



James Colyar

*Transportation Specialist, FHWA
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Management Team*



Balaji Yelchuru

*Senior Associate, Booz Allen
Hamilton*



Greg Jones

*Transportation Specialist, FHWA
Research Center and FHWA
Office of Operations*



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*Sr. Research Psychologist, FHWA
Office Safety R&D Human Factors
Team*



Today's Speakers



Kevin Sylvester

*Transportation Specialist, FHWA
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Control Devices Team*



John Halkias

*Team Leader, FHWA Office of
Operations Systems Management
Team*



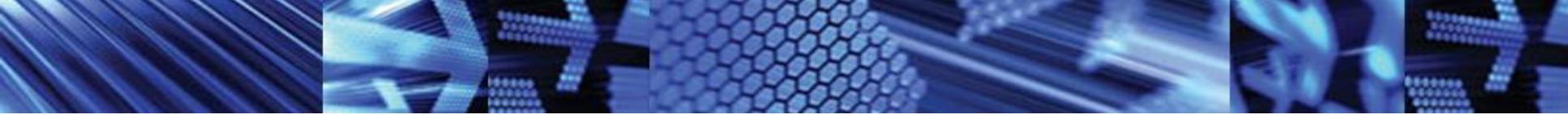
ATDM Webinar Series

- This is the last of a 5-part ATDM webinar series
- Topics are based on **what matters most to you!**
- ATDM webinars previously recorded:
 - Webinar #1: Active Demand Management (Oct 2014)
<https://connectdot.connectsolutions.com/p6byoty6abj/>
 - Webinar #2: Active Traffic Mgmt. Feasibility Screening (Nov 2014)
<https://connectdot.connectsolutions.com/p34emklqwh/>
 - Webinar #3: Ramp Metering (Dec 2014)
<https://connectdot.connectsolutions.com/p53nkrawi1p/>
 - Webinar #4: Traffic Mgmt. Capability Maturity Framework (Jan 2015)
<https://connectdot.connectsolutions.com/p2ot5fxl1ot/>



*Improving the
Performance of
the Transportation
Industry Through
Training*





OVERVIEW OF ATDM AND THE FHWA ATDM PROGRAM



What is Active Management?

The fundamental concept of taking a dynamic approach to a performance based process



Moving Towards Active Management

Transportation Agency Operators:
Moving from Static to Proactive Management

- High complexity, high reward
- Emerging

- Low risk
- Proven

Proactive Management

- Respond to predicted changes in supply & demand
- Ability to delay or eliminate breakdowns

Responsive Management

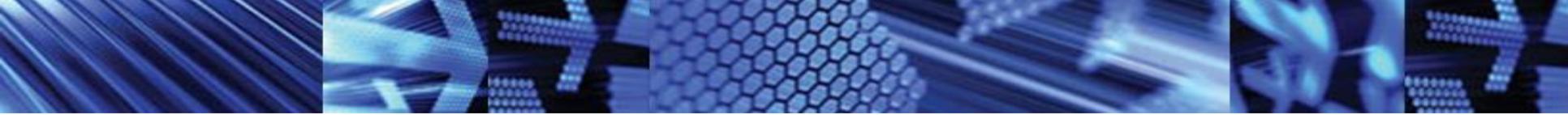
- Respond to current conditions
- Account for traffic impacts due to conditions
- Reduce time of degraded operation

Static Management

- Time of day
- Set-it and forget it
- Will work when there is limited variability

Actively Managing Operations



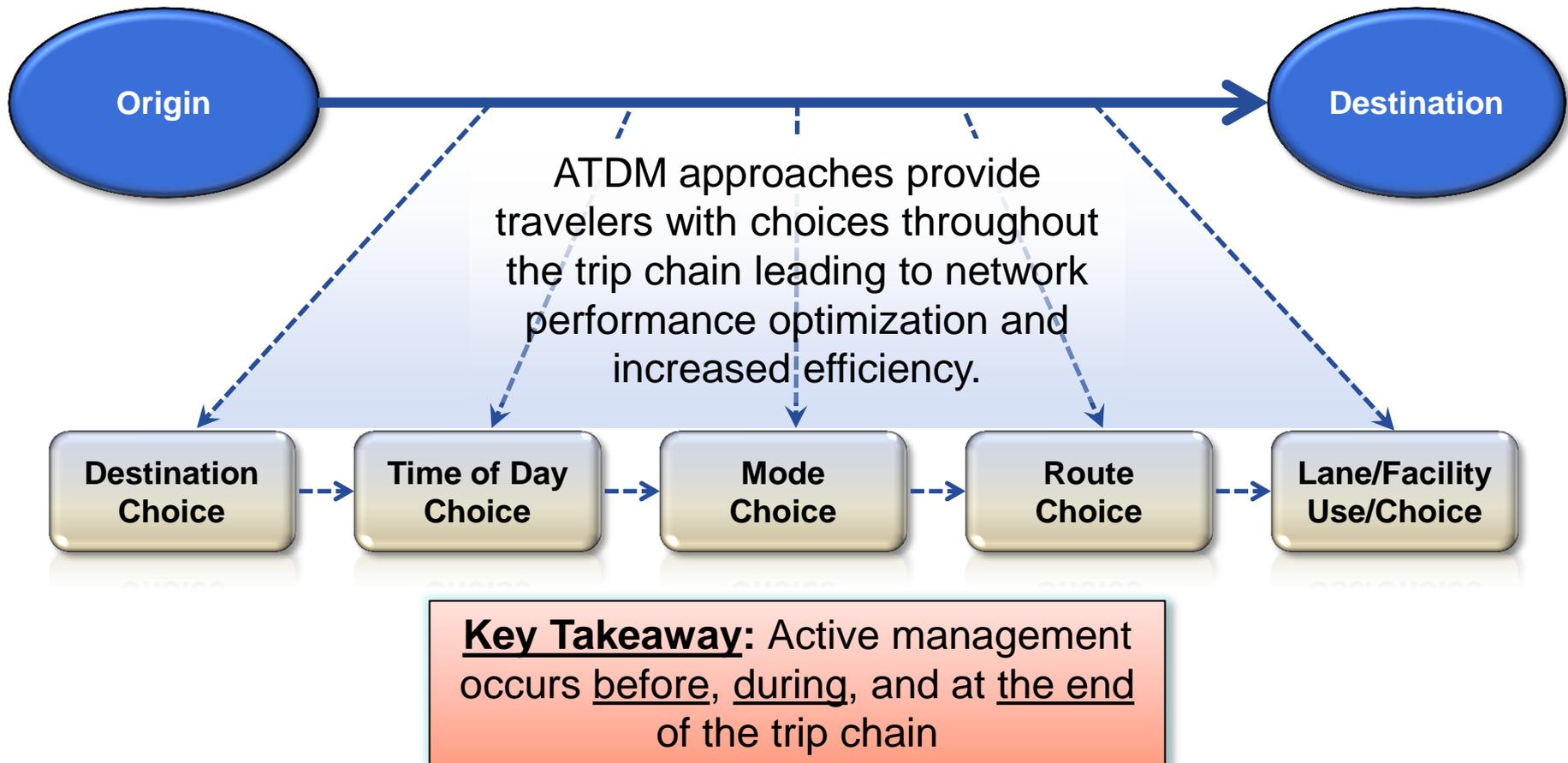


Goal of ATDM Concept

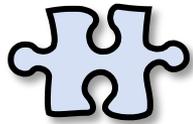
- Attain the capability to dynamically monitor, control, and influence travel, traffic, and facility demand of the entire transportation system and over a traveler's entire trip chain.



ATDM Throughout the Trip Chain



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.

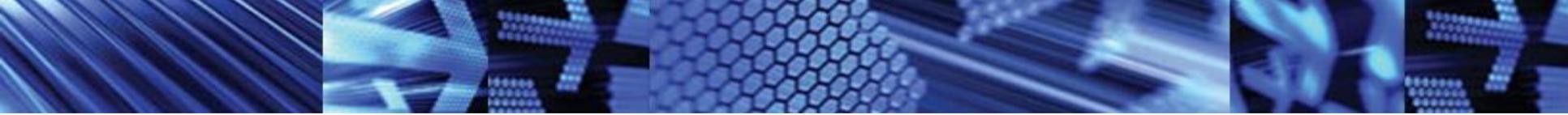


Active Parking Management (APM): A suite of strategies designed to affect the demand on parking capacity.

Examples of ATDM Implementation Strategies

ADM	Comparative multi-modal travel times, dynamic ride-sharing, pricing, and incentive approaches.
ATM	Dynamic speed limits, dynamic shoulder use, queue warning, dynamic lane assignment, others.
APM	Parking pricing, real-time parking availability and reservation systems.



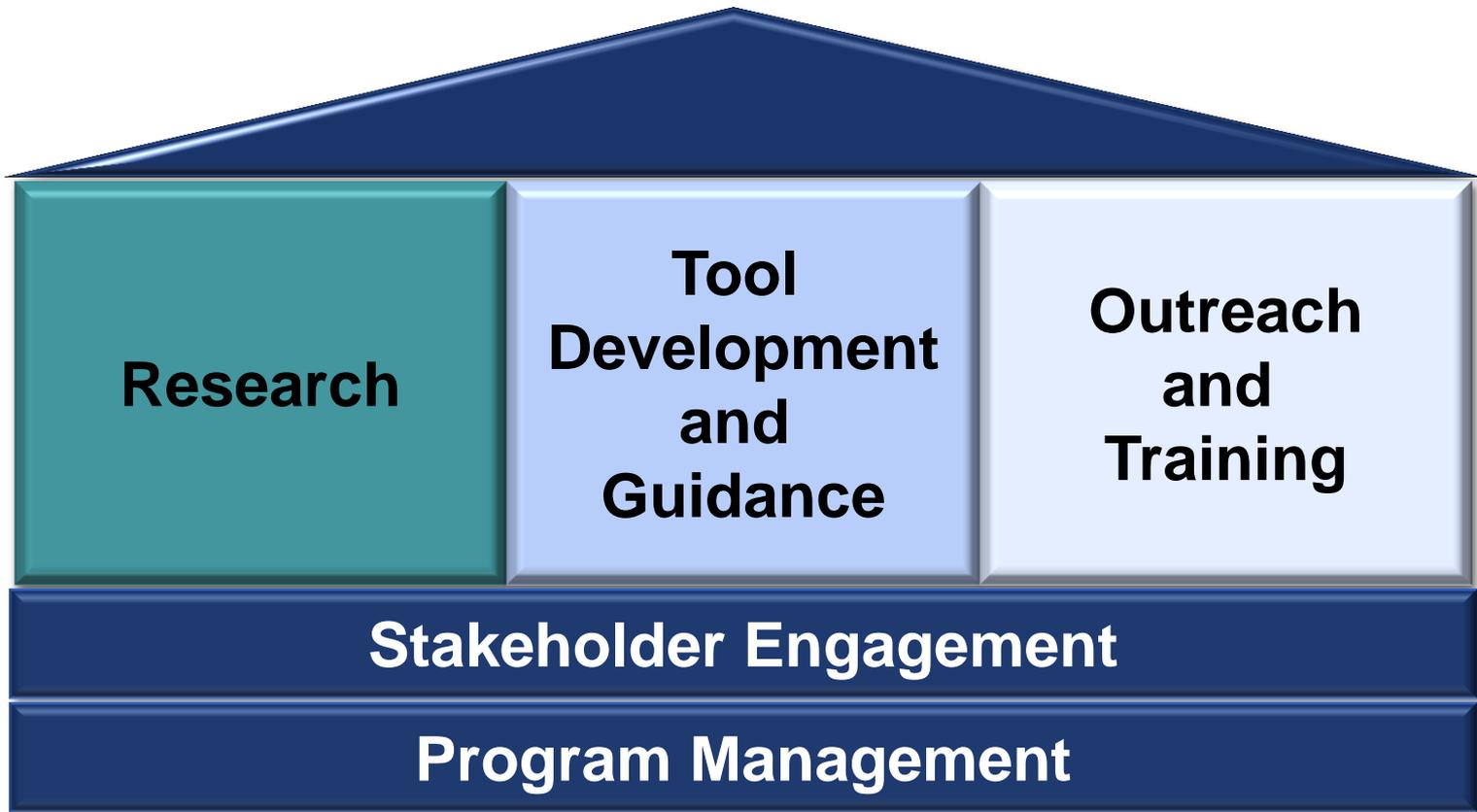


FHWA's ATDM Program

- Increase awareness and understanding of ATDM
- Research, develop, test, and evaluate new methods and strategies
- Provide tools, methods, and guidance for performance and benefit/cost analyses
- Train agencies to plan, deploy, and operate effective ATDM programs and systems



ATDM Program Components



ATDM Program: Guidance and References Available

Guidance, Primers, and Case Studies

- ATM: The Next Step in Congestion Management (FHWA-PL-07-012)
- Synthesis of ATM Experiences in Europe and the United States (FHWA-HOP-10-031)
- Operations Benefit/Cost Analysis Desk Reference (FHWA-HOP-12-028)
- Designing for Transportation Management and Operations: A Primer (FHWA-HOP-13-013)
- Guide for Highway Capacity and Operations Analysis of ATDM Strategies (FHWA-HOP-13-042)
- The ATDM Program: Lessons Learned (FHWA-HOP-13-018)
- Dynamic Parking Pricing Primer (FHWA-HOP-12-026)
- Ramp Metering Primer (FHWA-HOP-14-020)
- Integrating Demand Management into the Transportation Planning Process: A Desk Reference (FHWA-HOP-12-035)



ATDM Program: Outreach and Training

Knowledge and Technology Transfer (KTT) Tools

- Informational Briefs
- Public Relations Resources Guide
- Regional Workshops/Peer Exchanges (19 total from 2011-present)
- NHI ATDM Webinar Series

Watch FHWA's
ATDM Video!

<https://www.youtube.com/watch?v=qd8xy0ozSXI>

Active Transportation and Demand Management

U.S. Department of Transportation
Federal Highway Administration

ATDM Program Brief: An Introduction to Active Transportation and Demand Management

What is Active Transportation and Demand Management (ATDM)?

ATDM is the dynamic management, control, and influence of travel demand, traffic demand, and traffic flow of transportation facilities. Through the use of available tools and assets, traffic flow is managed and traveler behavior is influenced in real-time to achieve operational objectives, such as preventing or delaying breakdown conditions, improving safety, reducing emissions, or maximizing system efficiency.

Under an ATDM approach the transportation system is continuously monitored. Using archived data and/or predictive methods, actions are performed in real-time to achieve or maintain system performance.

What are some examples of ATDM Approaches?

Active management of transportation and demand can include



FHWA ATDM Website

- Clearinghouse for ATDM Knowledge and Technology Transfer
- Publications, Briefs, Lessons Learned, External Resources, etc.

<http://ops.fhwa.dot.gov/atdm/about/program.htm>

The screenshot shows the FHWA ATDM website homepage. At the top, it features the U.S. Department of Transportation Federal Highway Administration logo and navigation links for "FHWA Home" and "Feedback". The main header is "ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT". Below this is a navigation bar with "OFFICE OF OPERATIONS" and "21ST CENTURY OPERATIONS USING 21ST CENTURY TECHNOLOGIES". The main content area includes a search bar for ATDM, a "Go" button, and a sidebar with links: Home, About ATDM, Approaches, Research, Knowledge and Technology Transfer, Resources, and Contact Us. The main text welcomes visitors to the ATDM program, explaining its purpose and providing a list of "WHAT'S NEW" publications. A circular diagram titled "View the ATDM Overview Flyer" illustrates the ATDM process: Implement Dynamic Actions, Monitor System, Assess System Performance, and Dynamic Actions. The source is cited as "Source - U.S. DOT". The footer contains the FHWA logo, navigation links for "US DOT Home", "FHWA Home", "Operations Home", and "Privacy Policy", and the date "Last modified: May 27, 2014".

U.S. Department of Transportation
Federal Highway Administration

FHWA Home | Feedback

ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT

OFFICE OF OPERATIONS 21ST CENTURY OPERATIONS USING 21ST CENTURY TECHNOLOGIES

Search ATDM:

Home
About ATDM
Approaches
Research
Knowledge and Technology Transfer
Resources
Contact Us

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)

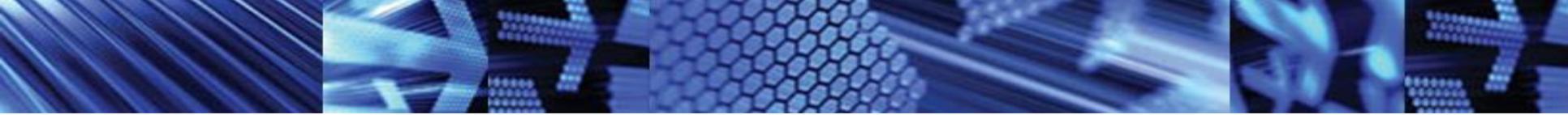
[View the ATDM Overview Flyer](#)

Source - U.S. DOT

U.S. DOT Home | FHWA Home | Operations Home | Privacy Policy

Last modified: May 27, 2014





ATDM RESEARCH: COMPLETED, CURRENT, AND FUTURE EFFORTS



ATDM Research: Completed

- ATDM Foundational Research
 - ATDM Operational Concept and Program Development Workshops
 - Analysis, Modeling, and Simulation (AMS) Concept of Operations, Capabilities Assessment, and Analysis Plan
- AMS Testbed Planning for ATDM and Dynamic Mobility Applications (DMA)
- ATDM HCM Analysis Methodology
 - Guidance for Highway Capacity and Operational Analysis of ATDM
- Shoulder Lane Usage Analysis (Phase 1)
- HOV Managed Use Lane Pooled Fund Study
 - Design and Operational Elements of Dynamic Shoulder Use
 - Evaluation of ATM Lane Control Signage
- NCHRP Synthesis 447, ATM for Arterials



ATDM Research: Current Underway

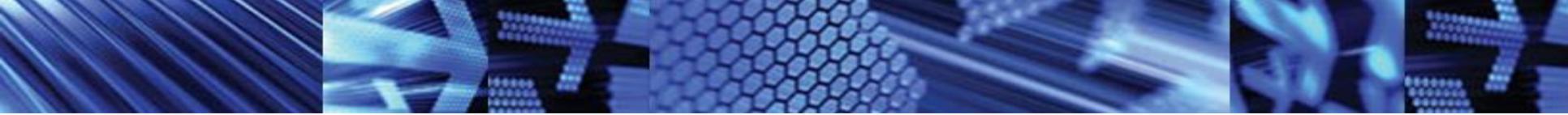
- Covered in this webinar:
 - ATDM AMS Testbed Project
 - Shoulder Research Projects
 - ATM Traffic Control Devices Study
 - ATDM Tools for Tactical and Strategic Decision Making for Operations
 - Tools for Predicting Performance
 - Tools for Tactical and Strategic Decision Making for Operations
- Traffic Management Capability Maturity (covered in Webinar #4)
 - Developing several maturity frameworks to enable advancing capabilities in Operations
- Trajectory Level Validation
 - Collecting data and developing a methodology to enable Simulation tools to be validated based on detailed vehicle trajectory level data
- NCHRP 3-114, ATM Planning and Evaluation
 - Developing a guide to planning and evaluating ATM for recurrent and non-recurrent conditions



ATDM Research: Future Efforts/Ideas

- Synthesis of ATDM evaluation results and methodologies
- Multi-objective trade-off analysis tools
- Influencing behaviors through incentives
- ATDM control algorithms and decision support systems
- HCM ATM Freeway methodology validation and Urban Street methodology development
- TRB Freeway Operations Research Circular
 - Identifies and prioritizes research needs in 8 focus areas (ATM is one)
 - Draft available at:
https://sites.google.com/site/trbfreewayops/sub_committees/research





Greg Jones

FHWA Resource Center/Office of Operations

Atlanta, GA

TOPIC 1: ATDM RESEARCH ON PART-TIME SHOULDER LANES

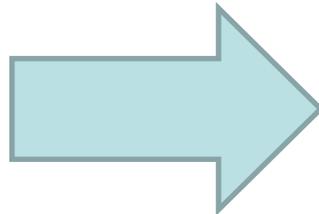


ATDM Subareas

Active Demand Management



Active Traffic Management



Active Parking Management



Active Traffic Management Strategies

- Part-time shoulder lanes (Hard Shoulder Running)
- Variable Speed Limits
- Overhead Lane Control Signals
- Queue Warning
- Dynamic Ramp Metering
- Dynamic Junction Control
- Adaptive Signal Control



Part-time Shoulder Lane Research

- FHWA Report to Congress (Efficient Use of Highway Capacity, FHWA 2010) <http://ops.fhwa.dot.gov/publications/fhwahop10023/index.htm>
- Report provided to Congress in response to the ATM International Scan Report from 2007 (<http://international.fhwa.dot.gov/pubs/pl07012/>)
- Summary of part time shoulder lanes applications in the US as of 2010
- 11 States had implemented at least one application in 2010, 14 as of today
- Most applications are on the Right Shoulder of Freeways



Three Distinct Types of Applications

Bus on Shoulder

- Shoulder lane applications limited only to authorized transit vehicles
- Can either be fixed time or congestion responsive
- Limited number of vehicles
- Operating rules can limit speed differential with GP lanes
- Improved transit reliability
- 13 States



Three Distinct Types of Applications

Fixed/Time of Day

- Part-time shoulder operations allowing general purpose traffic to use the shoulder as a lane during fixed periods of time
- Based on historical periods of recurring congestions
- Typically has static signing
- 7 States have used this

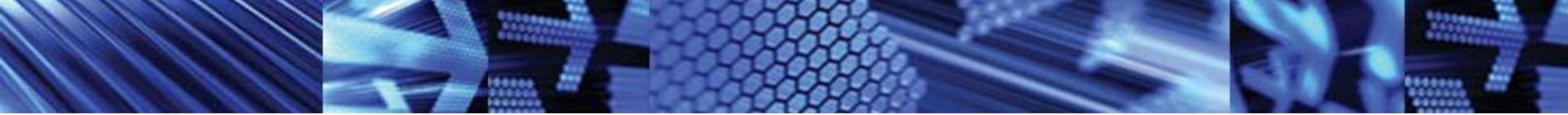


Three Distinct Types of Applications

Dynamic

- Part-time shoulder lanes allowing general purpose traffic to use the shoulder lane as a travel lane as needed based on real time traffic conditions
- The shoulder lane can also be closed when the need to convert back to a safety shoulder arises



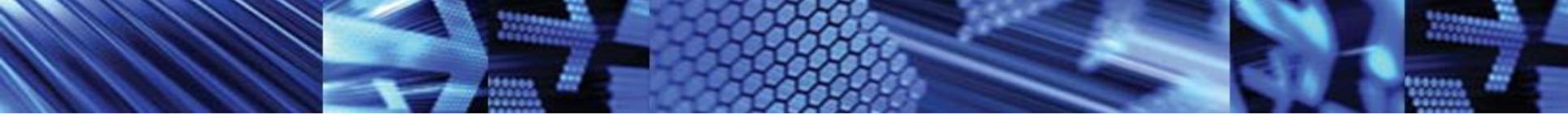


FHWA Research

Evaluation of Operational and Safety Characteristics of Shoulders Used for Part-time Travel Lanes

- Collected Safety and Operational data from existing part time shoulder lane sites across the US.
- Analysis of operational and safety data trends for different types of shoulder lane applications
 - Effective capacity addition approximately 65-75% of adding a new lane
 - Primary operational issue: Right-side applications and conflicts at interchanges (carry thru or drop the lane)
 - Safety results have been neutral



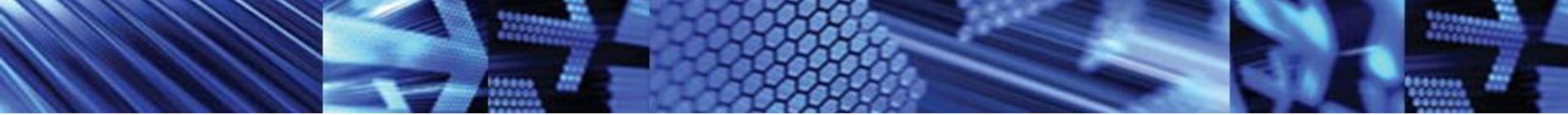


FHWA Research

Development of Modeling Capabilities for Shoulders Used as Part-Time Travel Lanes

- Used previous operational data to develop modeling capabilities for part-time shoulder lane applications
- Adjustment factors developed for type of application used, length, and conflicts
- Ability to develop better benefit vs. cost comparisons for planning and project development



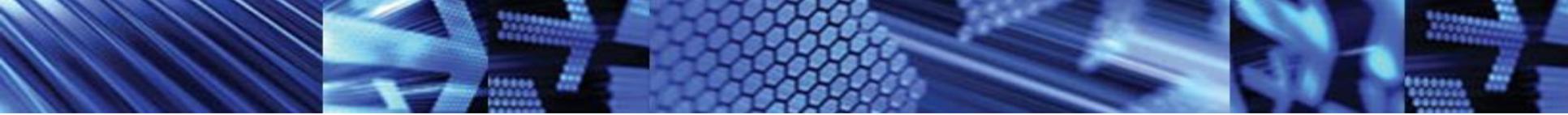


HOV/Managed Use Lane Pooled Fund Study Research

Design and Operations Elements of Dynamic Shoulder Use

- A 2013 synthesis of the domestic and international state of practice for part time shoulder use operations (Update from the 2010 Report)
- Best practice information on design, safety, and operations issues





FHWA Guidance

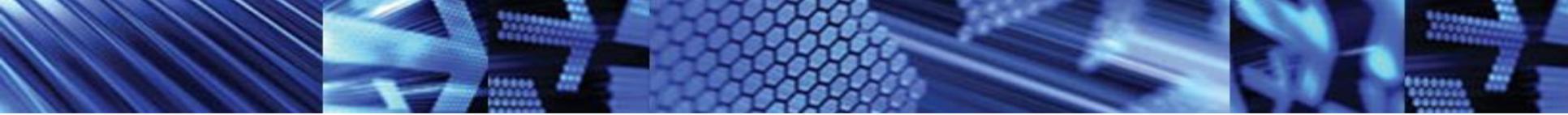
- Currently under development
- Anticipated delivery by the EOY 2015
- Stakeholder input from State DOT volunteer working group
- Stakeholder feedback from interviews with Incident Responders and Enforcement personnel
- Target areas of guidance: Geometric Design, Pavement design, Safety analysis, Operational concepts, Incident response coordination, MUTCD coordination, Environmental considerations, and Maintenance considerations



Future Applications

- I-66 reconstruction in Northern VA
 - Retain shoulder lane, now will be dynamic
 - Incorporate other ATM elements
 - VSL, Overhead Lane Control signals, Queue Warning
- Moving closer to European standards





Future Applications

- I-70 west of Denver
 - Rural mountain freeway
 - Congestion mostly from recreational traffic
 - Potential for Extreme Winter Weather
- Developing a design to incorporate ATM features (including a dynamic shoulder lane) along with Road Weather station/pavement conditions input



For additional information...

- Questions?



Federal Highway Administration

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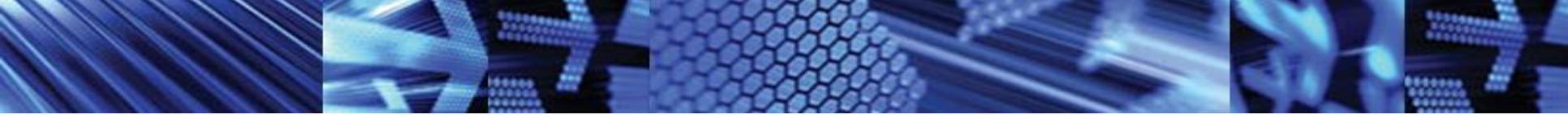


Balaji Yelchuru

Senior Associate, Booz Allen Hamilton

TOPIC 2: ATDM AMS TESTBED PROJECT





DMA / ATDM Introduction

- USDOT has two programs to achieve transformative mobility, safety, and environmental benefits through enhanced, performance-driven operational practices in surface transportation systems management
 - **Active Transportation and Demand Management (ATDM)** - *initiated by Federal Highway Administration (FHWA)*
 - **Dynamic Mobility Applications (DMA) Connected Vehicle Research Program** - *collaborative initiative spanning the Intelligent Transportation Systems Joint Program Office (ITS JPO), Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), the Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA)*



DMA Bundles and Applications

FRATIS

Freight Advanced Traveler Information Systems

Apps: Freight-Specific Dynamic Travel Planning and Performance, Drayage Optimization (DR-OPT)



IDTO

Integrated Dynamic Transit Operations

Apps: Connection Protection (T-CONNECT), Dynamic Transit Operations (T-DISP), Dynamic Ridesharing (D-RIDE)



R.E.S.C.U.M.E.

Response, Emergency Staging and Communications, Uniform Management, and Evacuation

Apps: Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG), Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE), Emergency Communications and Evacuation (EVAC)



DMA Bundles and Applications (cont.)

MMITSS

Multimodal Intelligent Traffic Signal System



Apps: Intelligent Traffic Signal System (I-SIG), Transit and Freight Signal Priority (TSP and FSP)
Mobile Accessible Pedestrian Signal System (PED-SIG), Emergency Vehicle Preemption (PREEMPT)

INFLO

Intelligent Network Flow Optimization



Apps: Dynamic Speed Harmonization (SPD-HARM), Queue Warning (Q-WARN), Cooperative Adaptive Cruise Control

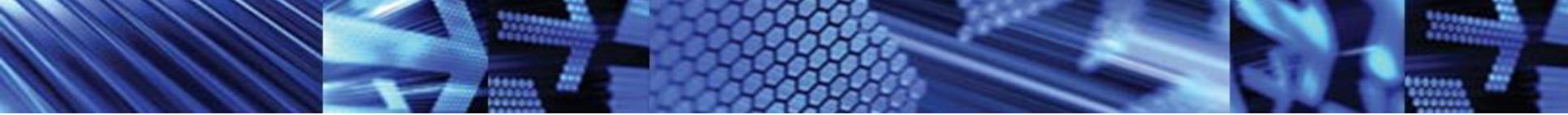
Enable ATIS

Enable Advanced Traveler Information Systems



Apps: EnableATIS (Advanced Traveler Information System 2.0)



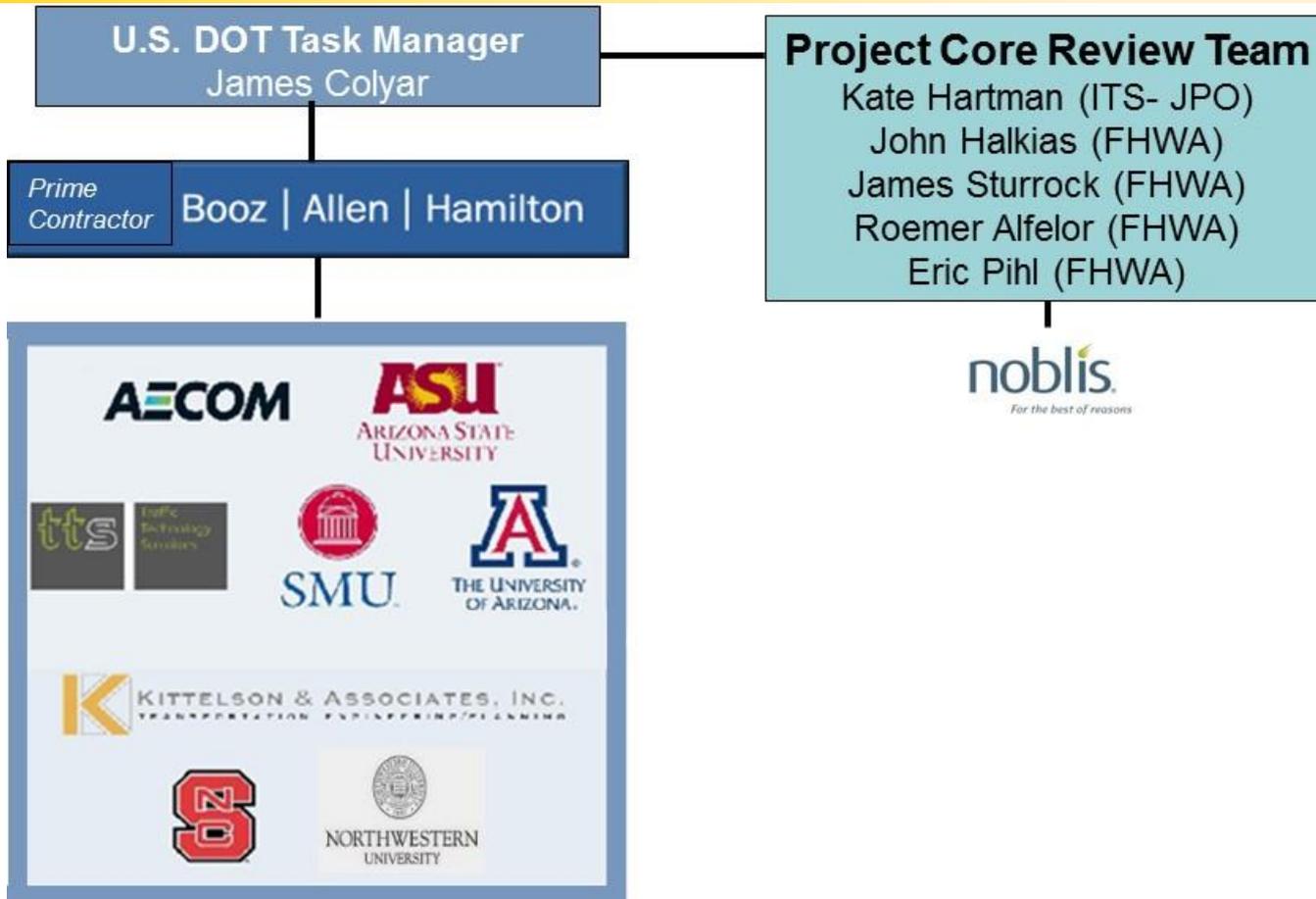


Need for a Joint DMA-ATDM AMS Testbed

- The more active forms of control envisioned by the ATDM Program will rely on new forms of data from vehicles, travelers, and infrastructure to hone predictions and tailor management responses
- Likewise, the transformative applications developed in the DMA Program must be incorporated within current and future dynamic system-wide management practices in order to realize their full potential
- In order to explore potential transformations in transportation systems performance, both programs require an AMS capability
- AMS Testbeds will support a detailed and integrated evaluation of DMA and ATDM concepts before initiating costly large-scale field deployments
- Provide modeling results (i.e., impacts) to the USDOT's DMA National Program and Mobility Impacts Estimation project



AMS Testbed Project Team





AMS Testbed Project - Overview

- AMS Testbeds will be **virtual computer-based environments** in a laboratory setting, to create models/tools that can capture impacts of implementing concepts, bundles, and strategies associated with the **DMA** and **ATDM** programs
 - As close to real-world as possible by modeling an actual metropolitan region's transportation system and transportation demand (e.g., persons, vehicles, transit)
 - Developed by building off existing and previous AMS capabilities and modeling efforts
- The AMS Testbed project
 - Evaluate the system wide impacts of individual and logical combinations of DMA bundles/ATDM strategies, and identify conflicts and synergies in order to maximize benefits
 - Address the DMA/ATDM Research Questions



Top ATDM Research Questions

Rank	ATDM Research Question
1	What will be the impact of increased prediction accuracy, more active management, and improved robust behavioral predictions on mobility, safety, and environmental benefits?
2	Which ATDM strategy or combinations of strategies will have the most impact in influencing short-term behaviors versus long term behaviors and under what operational conditions?
3	Are ATDM strategies more beneficial when implemented in isolation or in combination (e.g., combinations of ATM, ADM, or APM strategies)?
4	Which ATDM strategy or combinations of strategies yield the most benefits for specific operational conditions?



Top ATDM Research Questions (cont.)

Rank	ATDM Research Question
5	Which ATDM strategy or combinations of strategies will be most benefited through reduced latency and under what operational conditions?
6	Which ATDM strategy or combinations of strategies will have the most benefits for individual facilities versus system-wide deployment versus region-wide deployment and under what operational conditions?
7	Which ATDM strategy or combinations of strategies will yield most benefits through changes in short-term behaviors versus long-term behaviors and under what operational conditions?



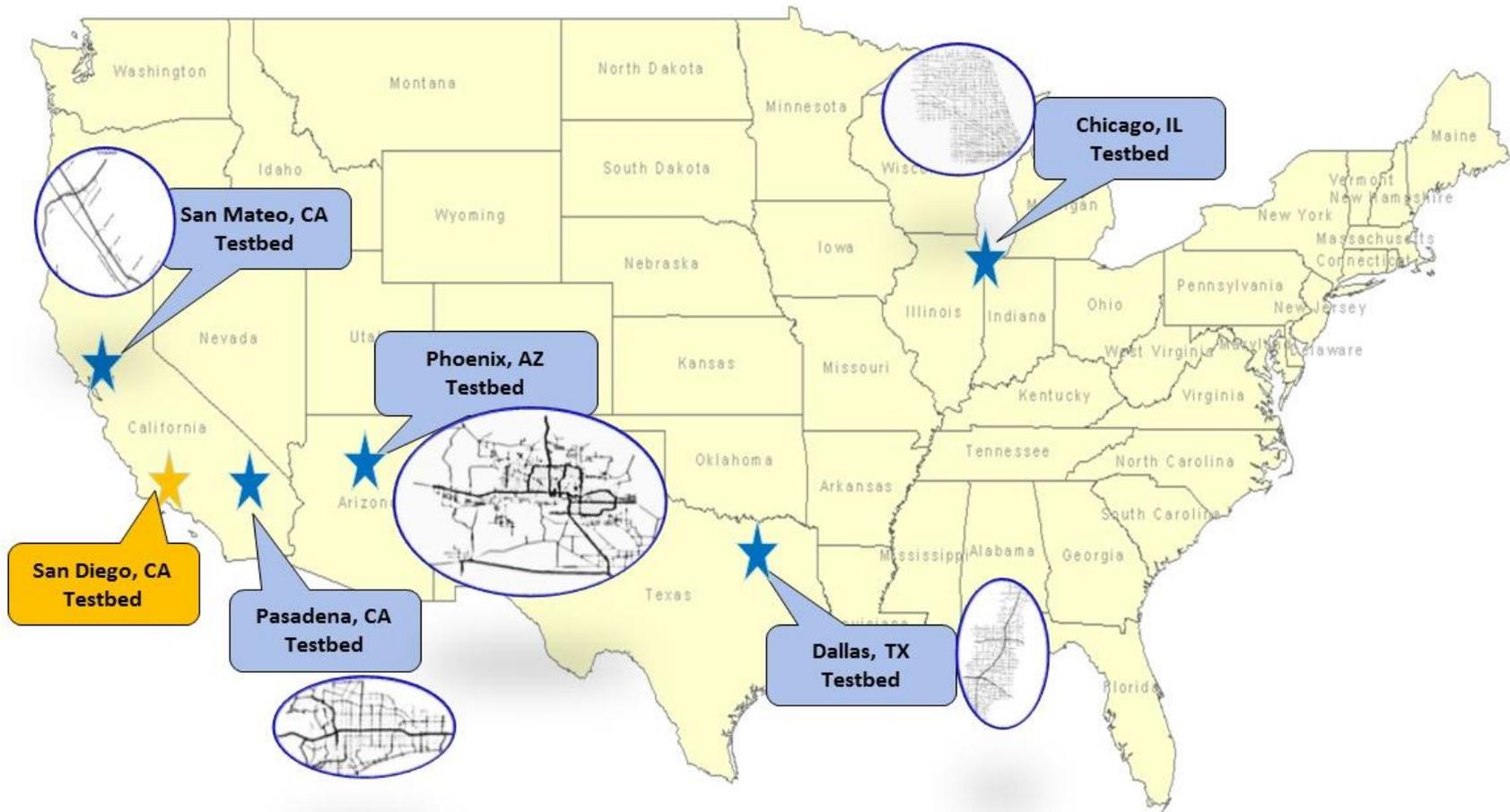
AMS Testbed Project Phases

- **Phase 1: AMS Testbed Selection**
 - Develop Testbed requirements and selection criteria
 - Conduct preliminary and final selection of AMS Testbed
- **Phase 2: Develop Evaluation Methodology**
 - Develop Testbed specific Analysis Plans
 - Combine Testbed specific plans to develop an overarching Evaluation Plan
- **Phase 3: Modeling, Analysis, and Reporting**
 - Develop and calibrate Testbed models, including data collection
 - Evaluate DMA and ATDM strategies using calibrated Testbeds
 - Report the relevant findings, produce documentation, and make them publicly available
 - Recommend further research for continuation of the DMA / ATDM future projects

Ongoing Work



AMS Testbeds Selected



Matching ATDM Applications to Testbeds

ATDM Strategy Type	Application	San Mateo	Phoenix	ICM Dallas	Pasadena	Chicago
Active Traffic Management Strategies	Dynamic Shoulder Lanes	-	-	√	√	√
	Dynamic Lane Use Control	-	-	-	√	√
	Dynamic Speed Limits	-	-	-	√	√
	Queue Warning	-	-	-	√	-
	Adaptive Ramp Metering	-	√	√	√	-
	Dynamic Junction Control	-	-	-	√	-
	Adaptive Traffic Signal Control	-	√	√	√	√
Active Demand Management Strategies	Predictive Traveler Information	-	√	√	-	√
	Dynamic Routing	-	√	√	√	√
Active Parking Management Strategies	Dynamically Priced Parking	-	-	√	-	-



AMS Testbed Cluster Analysis

- Operational conditions define specific combinations of traffic/travel conditions
 - Demand levels and patterns (e.g., low, medium or high demand)
 - Weather (e.g., clear, rain, snow, ice, fog, poor visibility)
 - Incident (e.g., no impact, medium impact, high impact)
 - Other planned disruptions (e.g., work zones, sporting events, etc.)
- **Cluster analysis** uses observed data from each Testbed to identify conditions with similar characteristics and their frequency of occurrence
 - Needed for estimating annualized benefits and reliability statistics
 - Some preference will be given to condition clusters that highlight DMA / ATDM benefits
 - Observed data from the selected condition clusters will be used to calibrate and validate the input demand and traffic performance of the operational condition
- Demand levels and traffic conditions observed in other regions will be used to extrapolate the benefits of DMA / ATDM strategies to other locations



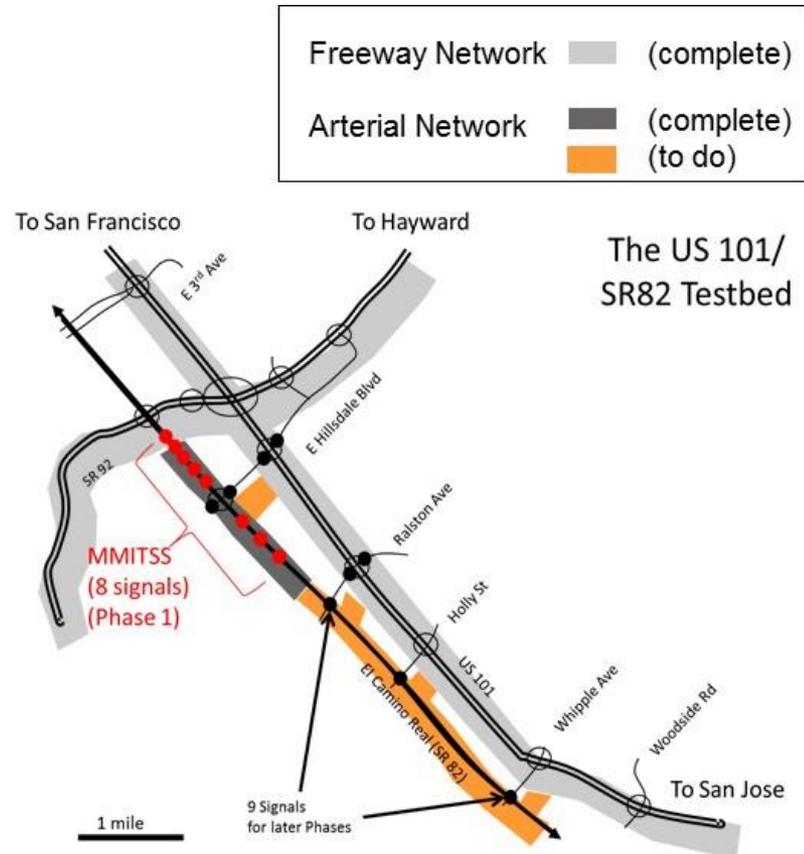
San Mateo Testbed: Overview

- 8.5 mile long stretch of the US 101 freeway and State Route 82 (El Camino Real) in San Mateo County, California

- The US 101 freeway is an 8 lane freeway, transitioning to 6 mixed flow lanes plus 2 peak period HOV 2+ lanes south of Whipple Avenue
- El Camino Real is a 4 to 6 lane signalized divided arterial with a posted 35 mph speed limit

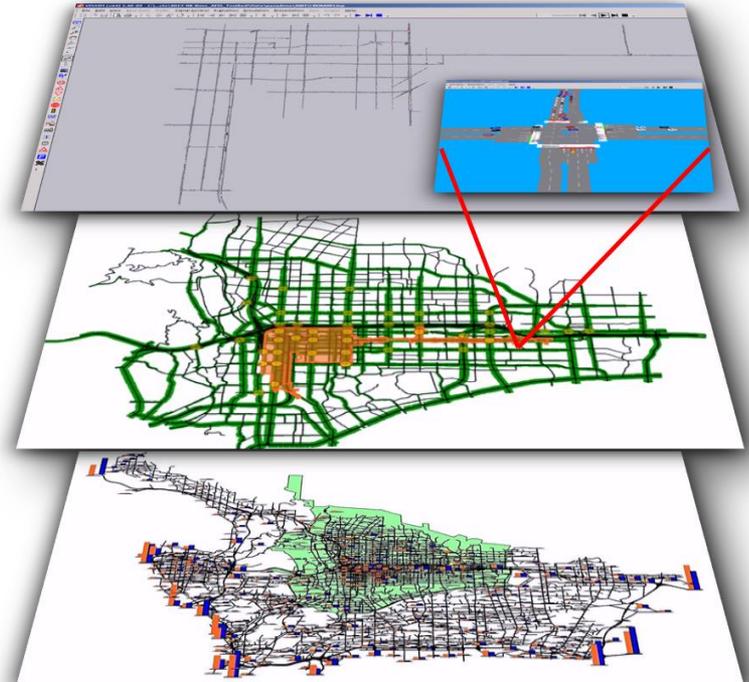
- A microsimulation network coded in VISSIM software

- San Mateo Testbed is used for only DMA program evaluation



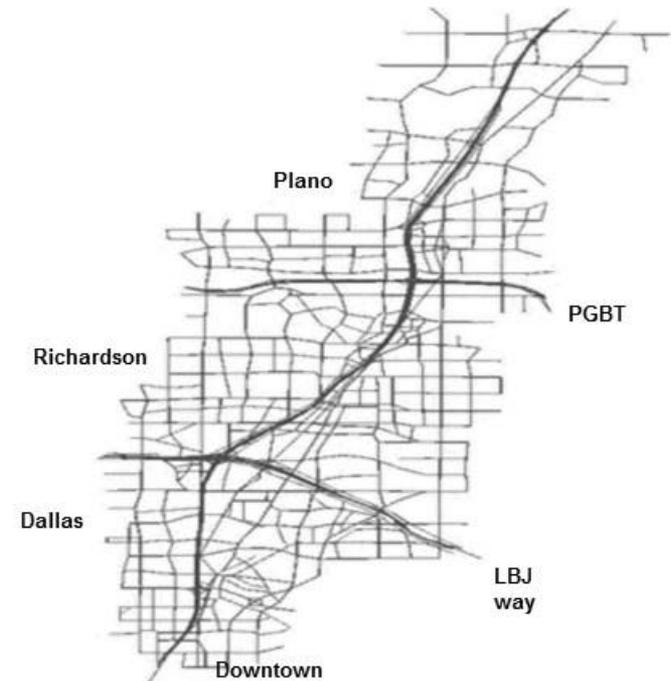
Pasadena Testbed: Overview

- Four major freeway segments in the city of Pasadena: I-210, I-710, CA-134 and CA-110
 - 11 miles of HOV lanes on I-210 and CA-134 for both directions
- Multi-resolution approach using VISSIM microsimulation software and Visum's dynamic traffic assignment (DTA)
- Prediction in the Pasadena Testbed includes two parts: demand prediction tool and network performance prediction by the TRANSIMS simulator



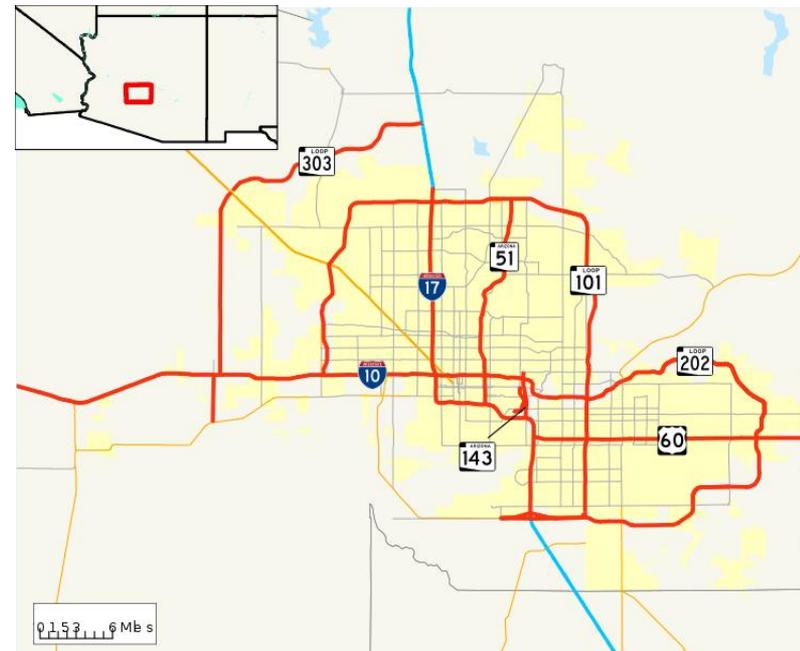
Dallas Testbed: Overview

- US-75 corridor – Dallas
 - A 20-mile long stretch of the US-75 freeway with several parallel and crossing major arterial streets
- Modeled using a mesoscopic dynamic traffic assignment simulation model: *DIRECT* (Dynamic Intermodal Routing Environment for Control and Telematics)
- The DIRECT simulation Testbed adopts a rolling horizon framework, which integrates (1) network state estimation module; (2) a network state prediction module; (3) demand estimation and prediction module; and (4) decision support subsystem



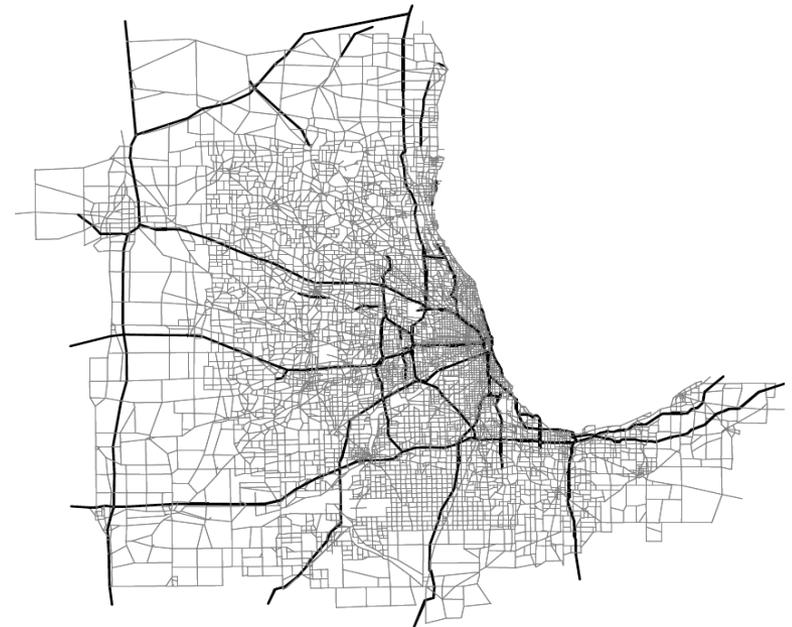
Phoenix Testbed: Overview

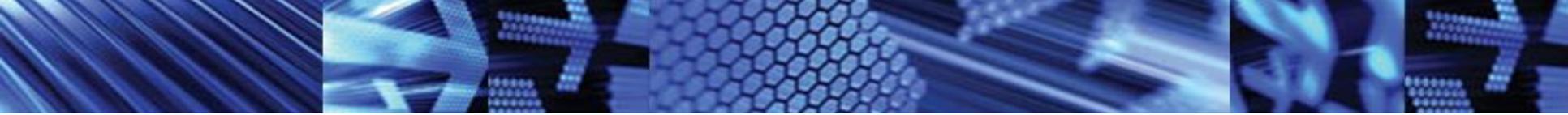
- Includes the Greater Phoenix metropolitan area (MPO boundary)
 - 9,200 square miles
 - 440 Centerline miles of Freeway
- The integrated activity-travel demand and dynamic traffic assignment systems of the Testbed include a series of model components for route choice and simulation of person/vehicle movement
- It is a multi-resolution simulation Testbed that consists of Activity-based travel demand, Dynamic Traffic Assignment, VISSIM microsimulation models



Chicago Testbed: Overview

- The Chicago downtown area
 - Located in the central part of the regional network, Kennedy Expressway (I90), Edens Expressway (I94), Eisenhower Expressway (I290), and Lakeshore Drive
- Developed using the enhanced, weather-sensitive DYNASMART
- Weather Related Applications: Emergency Parking Management, Traffic Signal Preemption for Winter Maintenance Vehicles, Snowplow Routing, Anti-icing and Deicing Operations





Project Next Steps & Outcomes

- Continue Testbed development, calibration, and modeling efforts
- Continue Stakeholder engagement throughout 2015
 - Conferences and webinars
- Several resources will be made available for use by others
 - Draft Testbed specific Analysis Plan
 - Methodology used for evaluating ATDM concept and strategies
 - Algorithms and Tools (e.g. APIs, code)
 - Serve as examples for transportation agencies to set up their own Testbed and evaluate DMA and ATDM strategies/applications





For more information...

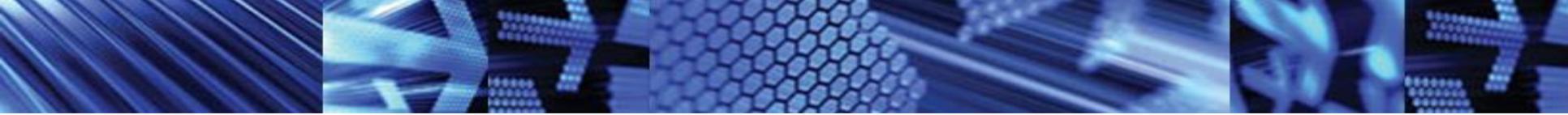
Balaji Yelchuru

Booz Allen Hamilton

AMS Testbed Principal Investigator

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Kevin Sylvester / Brian Philips

FHWA Office of Operations MUTCD Team / FHWA Safety R & D Human Factors Team

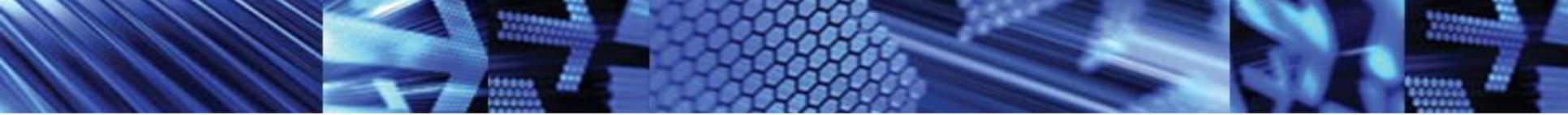
TOPIC 3: TRAFFIC CONTROL DEVICES





ACTIVE TRAFFIC MANAGEMENT PROJECT UPDATE





Presentation Overview

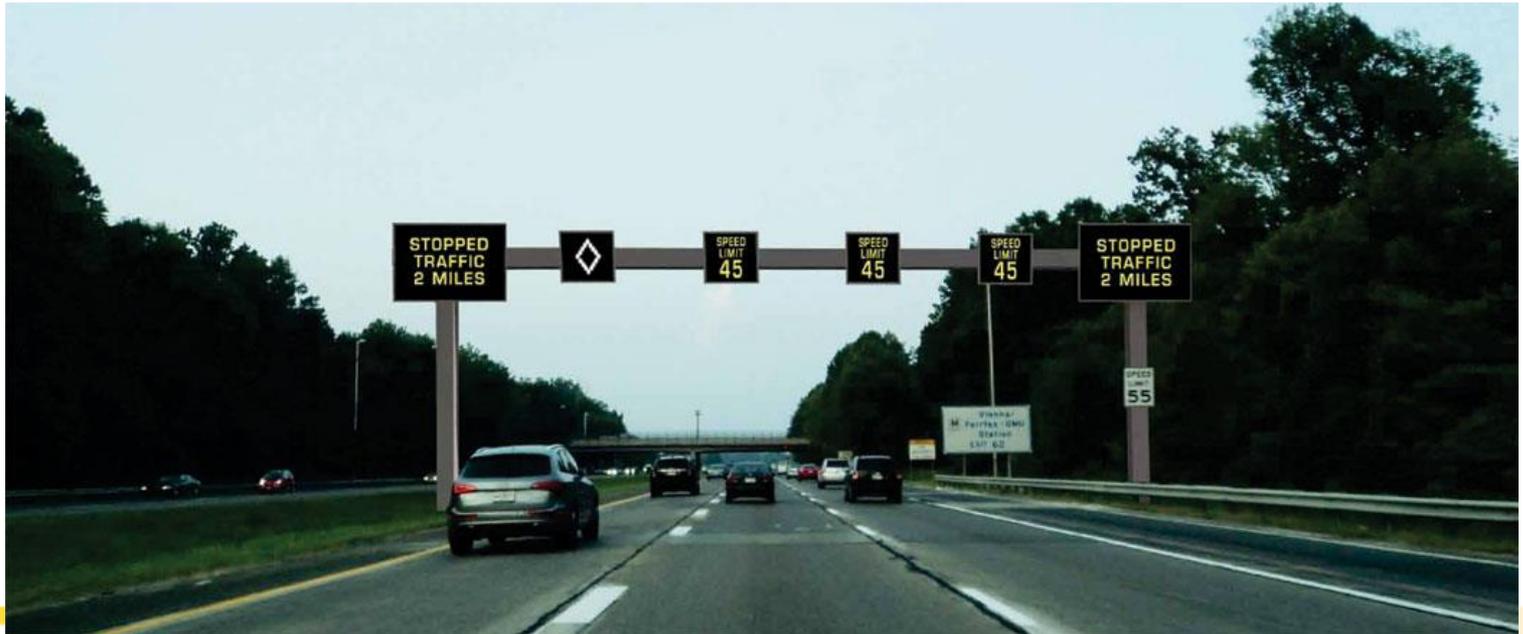
- Introduction
- Study Objectives
- Study Overview
 - Sign Testing
 - Driving Simulator Studies
- Update on research progress
- Discussion



Study Focus

- Variable Speed Limit (VSL) Signs
- Lane Control Signs
- CMS

VA I-66 ATM Concept



ATM Deployments and Tests Underway in the US

- Minnesota – Smart lanes
- Seattle - Active Traffic Management

Smart Lanes. Real Time. Real Choices. Real Safe.



<http://www.dot.state.mn.us/smartlanes/withoutsmartlanes.html>

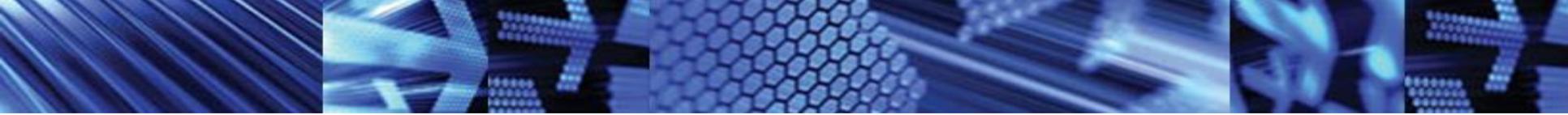


Seattle ATM Deployment



<http://www.wsdot.wa.gov/smarterhighways/>

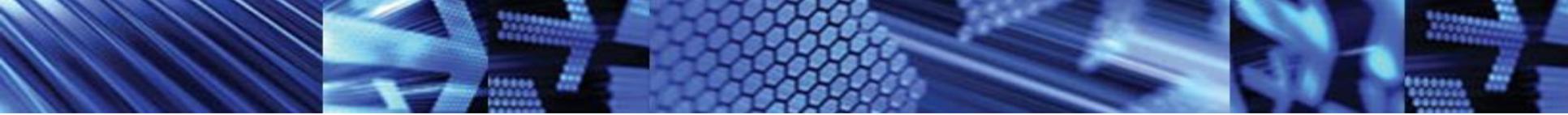




Study Goals

- Determine both the comprehension of the Active Traffic Management (ATM) signs as well as the legibility distance of these signs.
- Determine how motorists respond to these signs in a simulated driving environment.

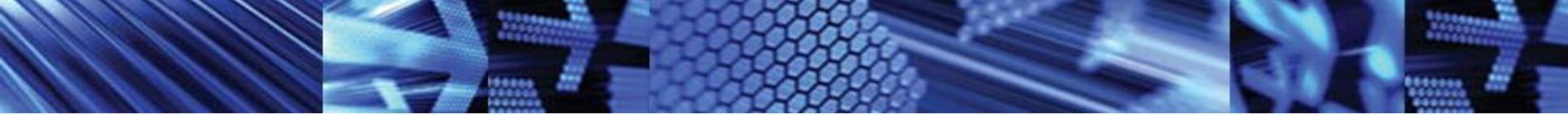




Study Objectives

- Determine motorist comprehension of ATM signs currently undergoing experimental installation in Minnesota and Washington as well as alternative designs.
- Determine legibility distance for these ATM signs.
- Determine speed reduction behaviors in a driving mini-simulator using a variety of sign configurations.





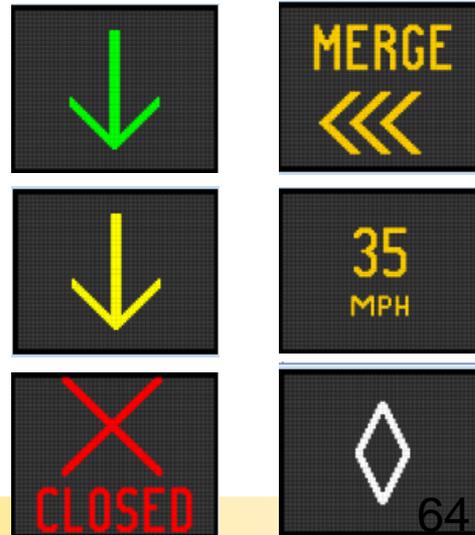
Study Overview

- Phase 1
 - Literature review; Sign Selection & Design; Scenario Development; and Laboratory Testing
- Phase 2
 - Interactive simulator testing. Employ a lower fidelity simulator (mini-Sim)
- Phase 3
 - Interactive simulator testing. Employ high-fidelity simulator (Highway Driving Simulator). Simulator has 6-degree of freedom motion base and eye-tracking system.



Phase 1

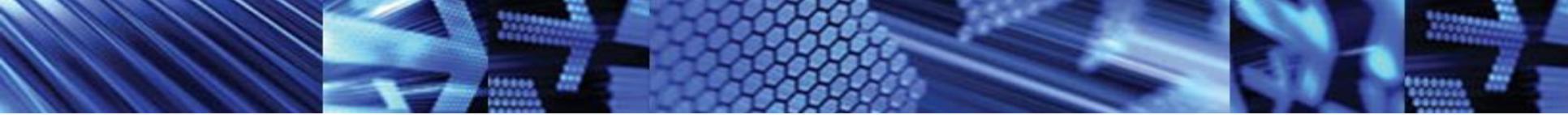
- Laboratory studies to assess drivers
 - Comprehension
 - Legibility distance
 - Decision making
- Develop signs in a systematic manner
 - Model sign elements for VSL and lane control
 - For example:



Phase 1 (cont.)

- Examine alternative sign structure layout
- Present the signs with highway context
 - Traffic
 - Other highway signs

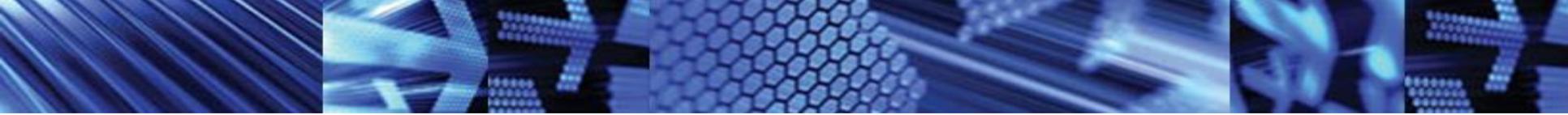




Phase 1 (cont.)

- Products of this phase
 - Literature review and synthesis
 - Alternative sign designs
 - Results from laboratory tests on comprehension and legibility distance
 - Test plan for simulation studies
 - Signs for testing
 - Scenarios
 - Phase 1 Technical Memo





PHASE 1 SCENARIO

INCIDENT – 1 LANE (LEFT-CENTER) CLOSED



 HOV 2+
ONLY
6:30AM-9:30AM
MON-FRI
↓



 WEST
Front Royal
↓ ↓ ↓

40
MPH

40
MPH

40
MPH

 HOV 2+ ONLY
6:30AM-9:30AM
MON-FRI
↓



 WEST
Front Royal
↓ ↓

35
MPH

35
MPH

 50
Arlington
Fairfax
EXIT 2 MILES

35
MPH



 HOV 2+
ONLY
6:30AM-9:30AM
MON-FRI
↓

 WEST
Front Royal
↓ ↓


Arlington
Fairfax
EXIT 1 1/2 MILES

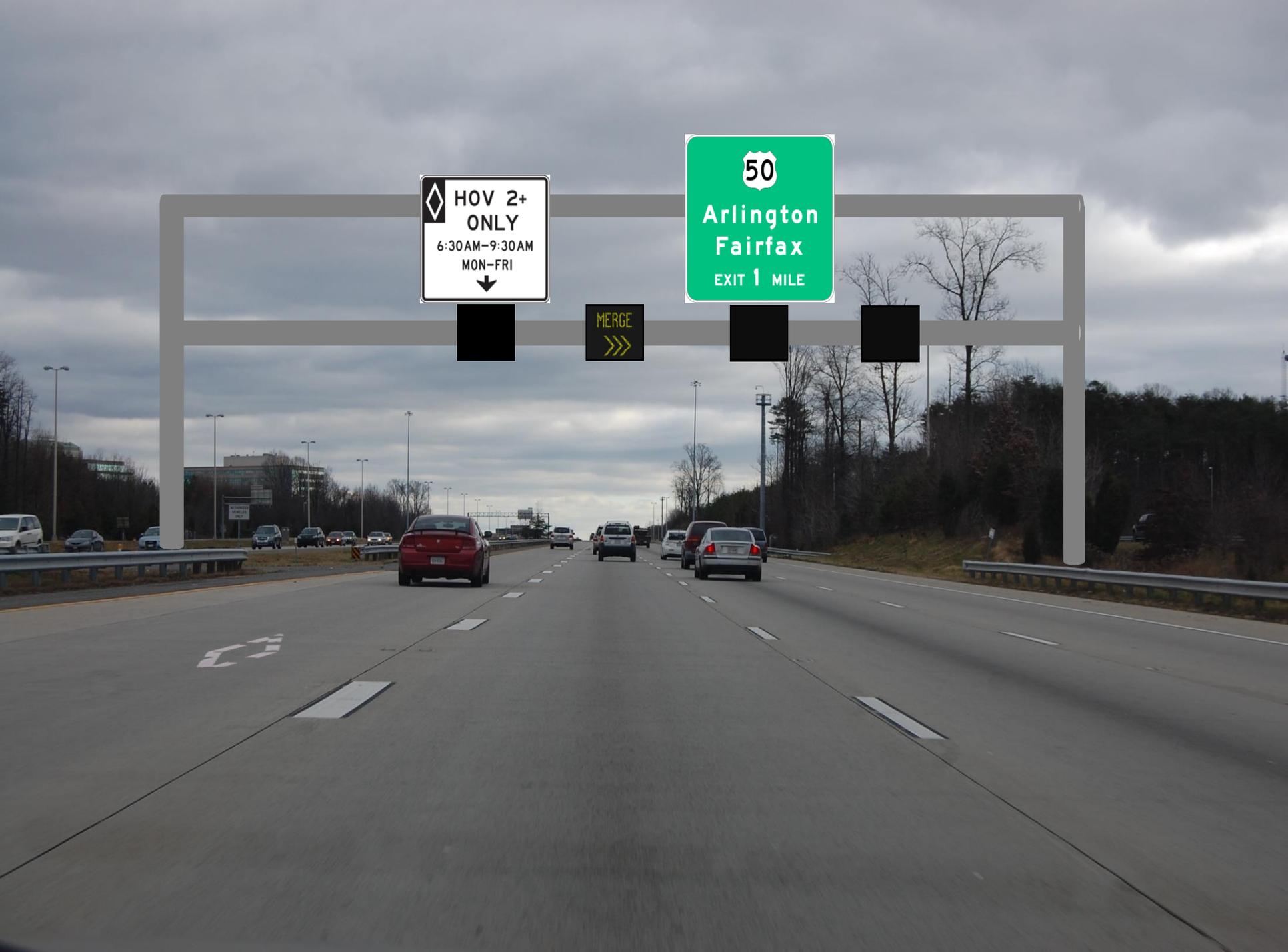

1 MILE



HOV 2+ ONLY
6:30AM-9:30AM
MON-FRI
↓

50
Arlington
Fairfax
EXIT 1 MILE

MERGE
>>>



 HOV 2+
ONLY
6:30AM-9:30AM
MON-FRI
↓

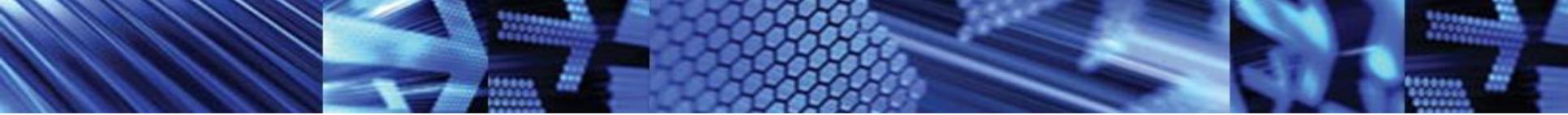


 WEST
Front Royal
↓ ↓



 50
Arlington
Fairfax
EXIT 1/2 MILE
↓





PHASE 1 SCENARIO

INCIDENT – 2 RIGHT LANES CLOSED



 HOV 2+
ONLY
6:30AM-9:30AM
MON-FRI
↓



 WEST
Front Royal
↓ ↓ ↓

40
MPH

40
MPH

40
MPH

 HOV 2+
ONLY
6:30AM-9:30AM
MON-FRI
↓



 WEST
Front Royal
↓ ↓

35
MPH

35
MPH

 50
Arlington
Fairfax
EXIT 2 MILES

X
1 MILE



 HOV 2+
ONLY
6:30AM-9:30AM
MON-FRI
↓

 WEST
Front Royal
↓ ↓

 50
Arlington
Fairfax
EXIT 1 1/2 MILES

 1 MILE

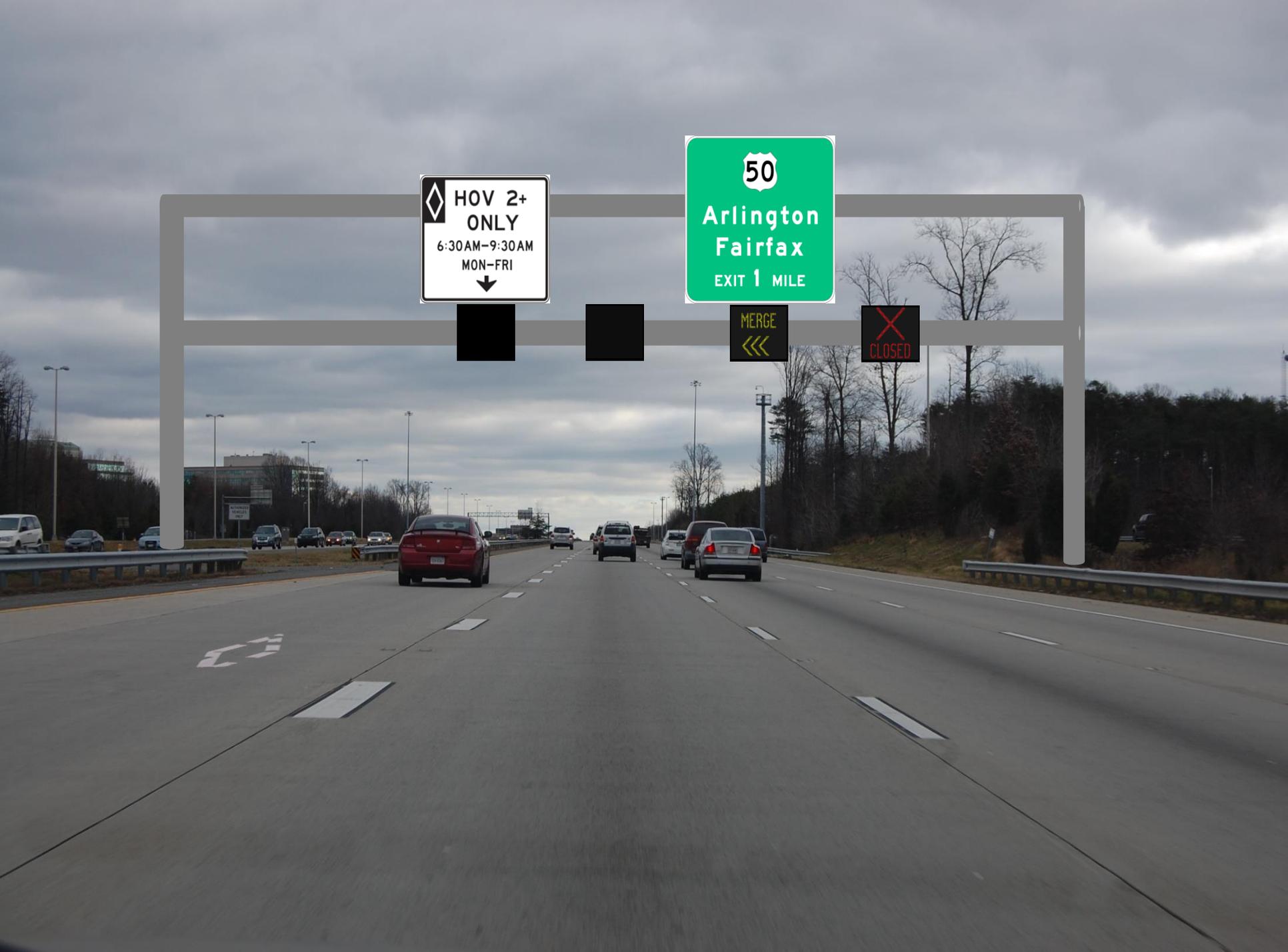
MERGE
←←←

HOV 2+ ONLY
6:30AM-9:30AM
MON-FRI
↓

50
Arlington
Fairfax
EXIT 1 MILE

MERGE
←←

✗
CLOSED



 HOV 2+
ONLY
6:30AM-9:30AM
MON-FRI
↓

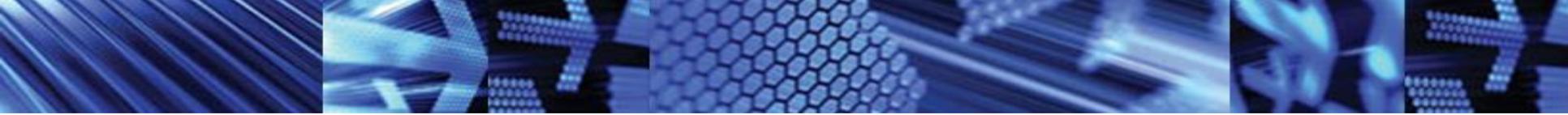


 WEST
Front Royal
↓ ↓



 50
Arlington
Fairfax
EXIT 1/2 MILE

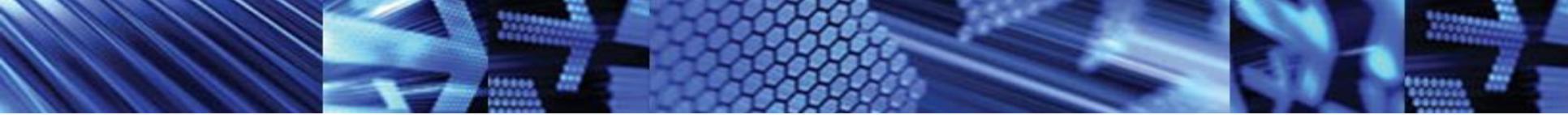




Phase 2

- Test driver decision making in an interactive environment
- Employ a high fidelity driving simulator
- Employ different scenarios. For example,
 - Resting condition for the signs (normal operations for all lanes).
 - Stalled vehicle closing 1 lane (right center lane – lane 3).
 - Vehicle crash closing 2 left lanes (lanes 1 and 2).
 - Vehicle crash closing 2 right lanes (lanes 3 and 4 with exit ramp open).
 - Message in the event of slow moving traffic in all lanes (speed reduction).



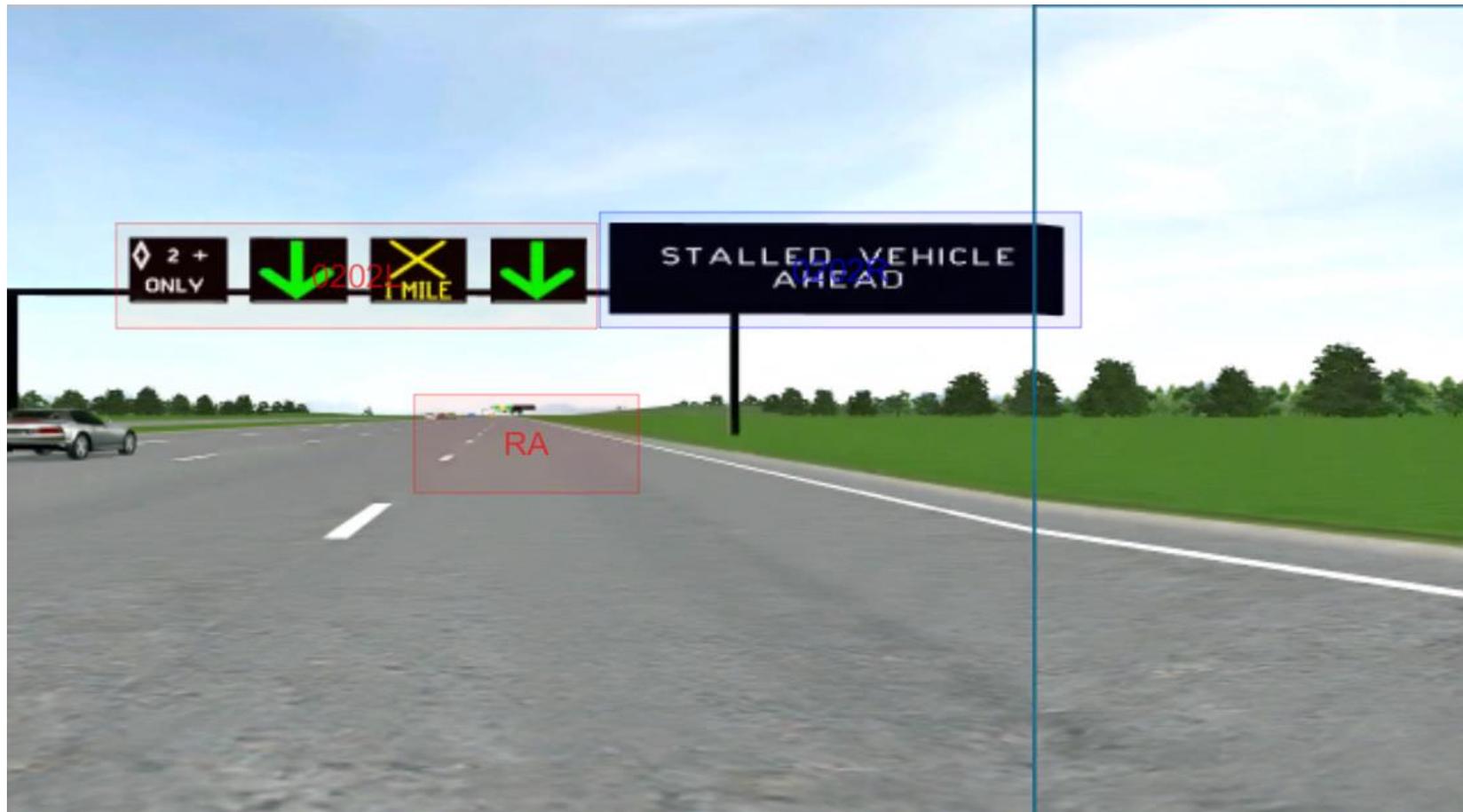


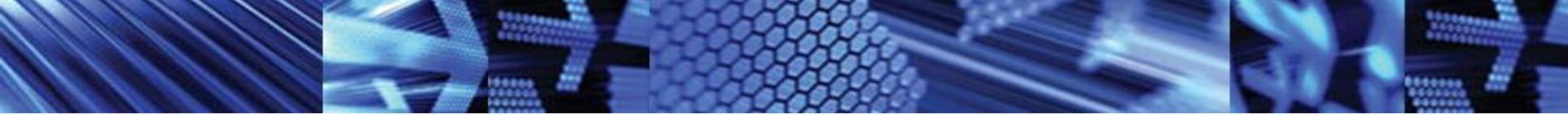
Phase 2 (cont.)

- Collect data on:
 - Eye glance behavior
 - Lane choice
 - Speed behavior
 - Compliance with speed limit signs
- Vary
 - Scenarios
 - ATM signs - best from lab study



Phase 2 (cont.)

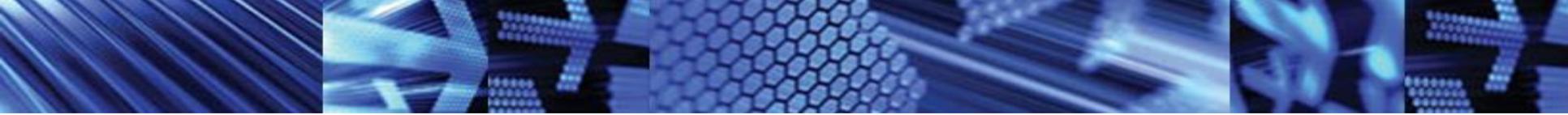




Phase 3

- Examine driver behavior and decision making:
 - under different scenarios, and
 - varying levels of visual clutter

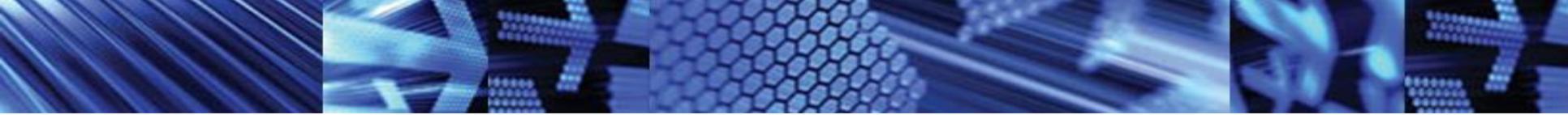




Phase 3

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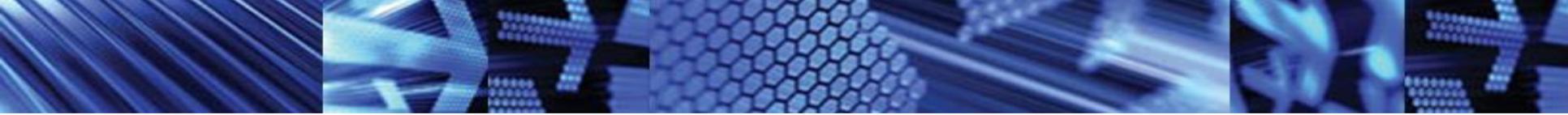




Phase 3 (Continued)

- Collect data on
 - Eye glance behavior
 - Lane choice
 - Speed behavior
 - Compliance with speed limit signs
- Vary
 - Scenarios
 - ATM signs - best from lab study
 - Visual clutter level (low and moderate)

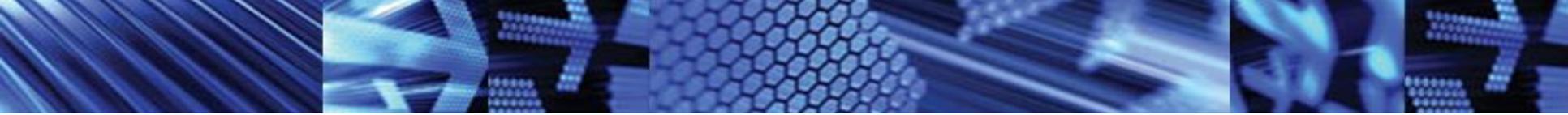




Next Steps

- Data collection and analyses are complete
- Technical report is currently in draft form and being reviewed



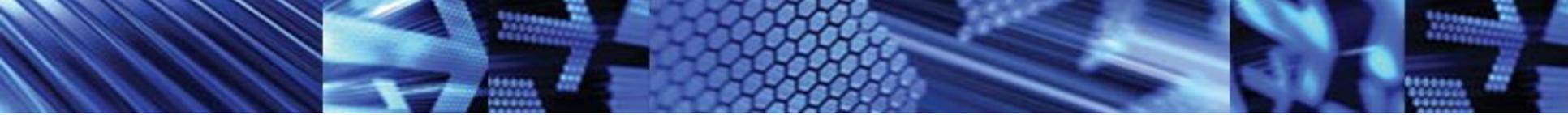


John Halkias

Team Leader, Office of Operations System Management Team

TOPIC 4: TOOLS FOR DECISION-MAKING: ADVANCING METHODS FOR PREDICTING PERFORMANCE

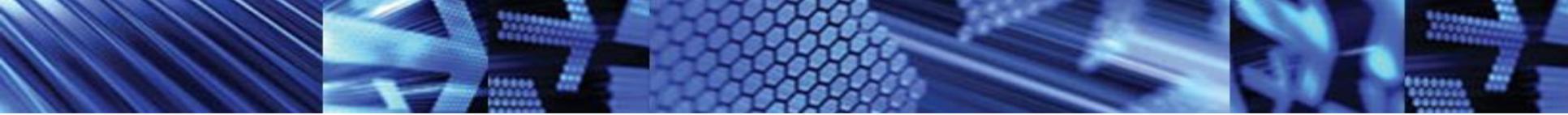




Objectives

- Develop a Guide for Agencies to use predictive methods for both “Playbook” and Proactive “Real-time” Regional Operations
- Develop a state of the practice report highlighting analytical tools for strategic and tactical decision making
- Develop predictive analysis Prototype Framework for “Playbook” and “Real-time” Operations
- Test Prototype Framework with Agency(ies) in a “Real-world” environment and document results

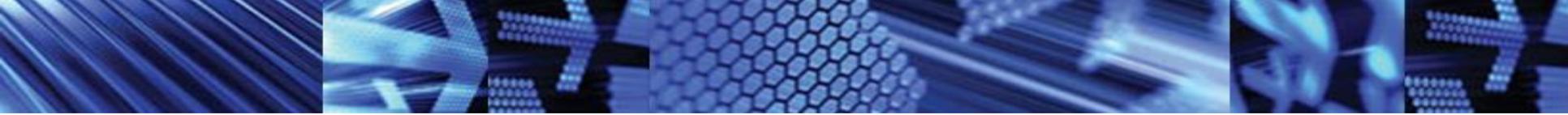




Traffic Prediction Overview

- Predictive approaches have to
 - Predict spatiotemporal changes in traffic states
- In doing so
 - Need to capture the interaction between traveler behavior and state evolution
- This project is concerned with the traveler behavior side in a ‘limited’ fashion
 - Future projects will consider these effects in ‘more detail’

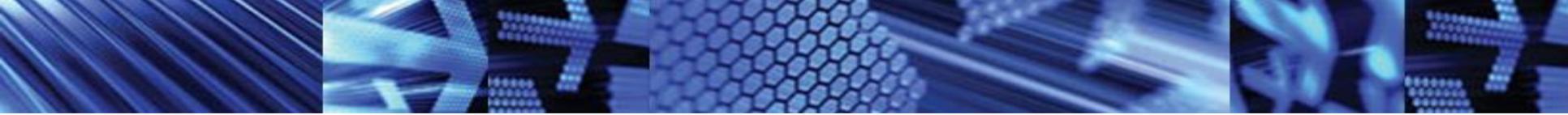




Traveler Behavior Changes

- Possible changes in traveler behavior include:
 - Amount of foregone or induced demand,
 - Extent of peak spreading or recoiling,
 - Possibility to change origin/destination,
 - Chaining of multiple activities into a single trip,
 - Time-dependent mode choices,
 - Persons/Vehicle occupancy changes, and
 - Traffic diversion during congestion.

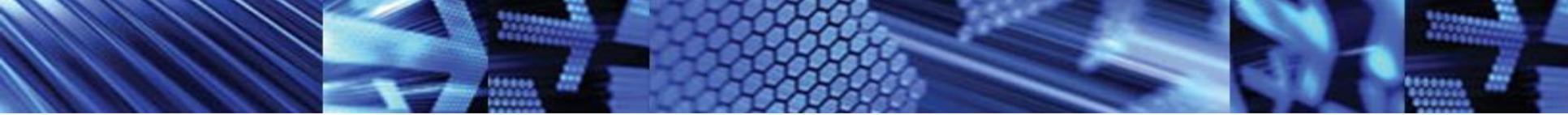




Factors Affecting Traveler Behavior

- Weather
 - Forgone demand
 - Temporal shifts
 - Mode shifts
- Work zones and incidents
- Traveler information
- Changes in the network that result in an enhancement of the transportation system efficiency





Modeling Behavioral Changes

- Key issues that need investigation include:
 - Defining the spatiotemporal extents at which the driver behavior extends
 - Defining how far up the chain of possible changes one should investigate
 - Level of error in the various steps vs. the level of resolution required at the modeling stage





Approaches to Modeling Behavioral Changes

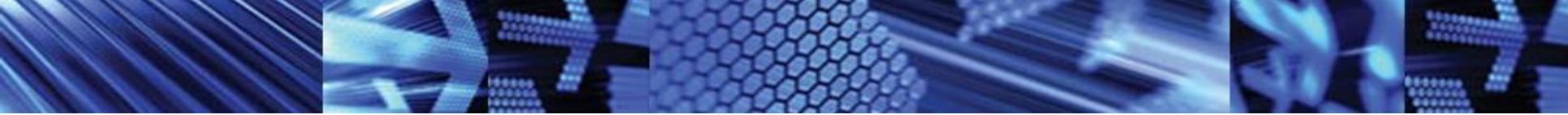
■ Modeling approach

- Pros:
 - Models each component separately
- Cons:
 - Based on many assumptions in each component resulting in accumulation of error across the different models

■ Data mining approach

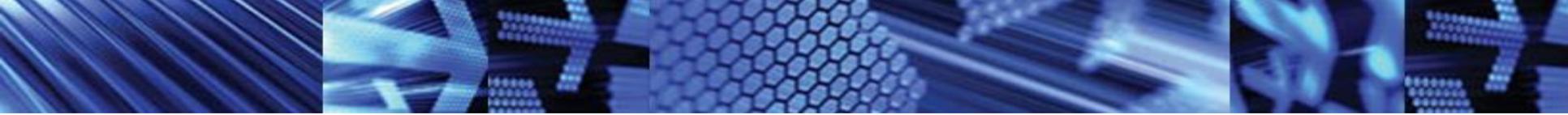
- Pros:
 - Does not require the modeling of each of the seven possible changes, instead models the overall change
- Cons:
 - Requires the implementation of a strategy before its outcome can be established





ATDM Application of Tools for Tactical and Strategic Decision Making for Operations

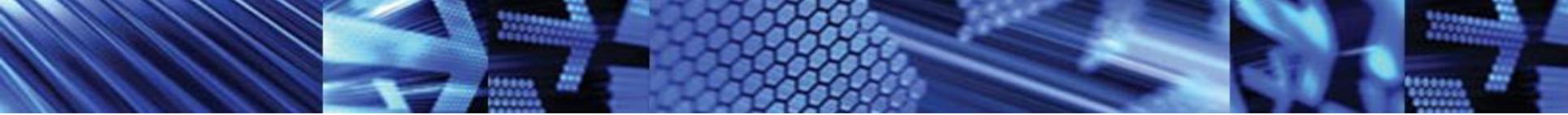




Objectives

- Better understand traveler strategic decision making
- Better understand driver tactical decision making
- Understand the motivation(s) behind traveler behaviors and decisions
- Develop approaches to overcoming “Inertia” or resistance to change
- Enable the findings to be incorporated into ATDM guidance and outreach materials, as well as into Analysis, Modeling, and Simulation (AMS) tools

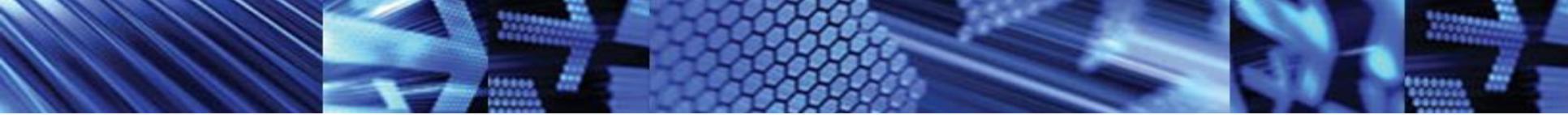




Critical Issues and Challenges

- Understanding driver choices and behaviors – what are the effects of operational decisions and events?
 - **Strategic:** Decisions take place before departure (e.g., mode choice, departure time, *route selection*)
 - **Tactical:** Decisions take place during the trip (e.g., driving speed choice, lane changes, *route modification*)
- Resistance to change & inertia - how can psychology, behavioral economics and other disciplines help us develop effective strategies and tools?
- Developing a virtual environment – maybe a game – That includes representative decisions, network/operational information, events, risks/rewards, & outcomes.





General Approach

- Key Outcomes:
 - ATDM guidance and outreach materials that will provide stakeholders with a better understanding of driver strategic and tactical decision making factors and their underlying motivations.
 - Approaches for overcoming driver resistance to change.
- Research Issues and Challenges:
 - Understanding of driver behavior and driver decision and travel choices.
 - Efficiently collecting valid data about driver decision and travel choices.
 - Ensuring the formatting, organization, and presentation of the Guide benefits intended users.



Decision Making Theory

- The decisions we make are not fully informed and rationale, and often result in sub-optimal situations
- Travelers find that it is a “good” decision-strategy to continue using modes and routes that they already know and perform reasonably well (e.g., behavioral inertia)
 - e.g., the strongest predictor of trip-level choices is the tendency for travelers to take routes or use modes simply because they chose it at least once before.
- Additionally, a traveler under time pressure may rely more on “gut” instinct rather than taking a rationale approach
 - e.g., taking a option that satisfies the goal, but is not optimal



It gets more complex...

There are many imperfect, internalized factors:

- Travelers' own past experience influences transportation decisions (e.g., route search and choice using known route options – which is usually limited to a small number of known\valued options)

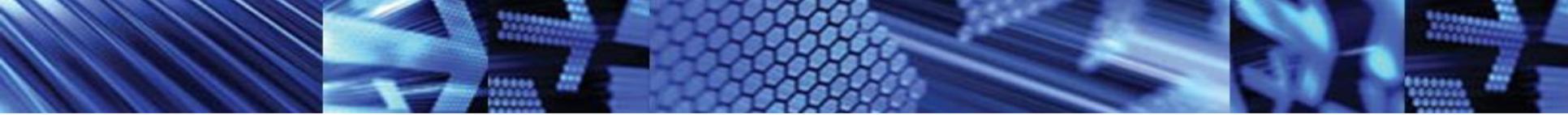
This is a contributing factor to the tendency to choose suboptimal travel options that satisfy the basic need of transportation

- Determining when to leave, given known travel time interferences (e.g., deciding a departure time around rush-hour peaks)
- Inability to assess the value of travel-time in an objective manner (e.g., persistently waiting in traffic losing time)
- A driver's situation-specific decision threshold (e.g., there is a limit to the number of decisions people want to make)

There are also many Environmental/ Trip Factors

- Traffic density
- Other driver speed
- Availability of guidance
- Traffic light timing
- Weather
- Work zones
- Traffic incidents





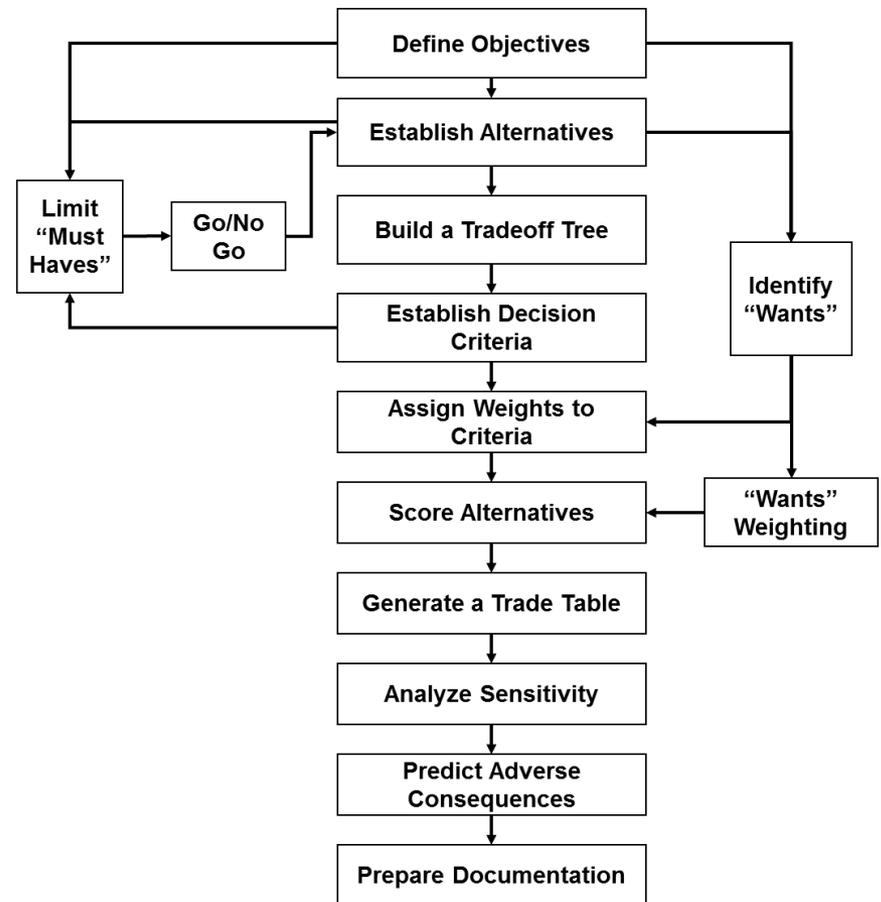
Plan for Multi-objective Trade-off Analysis

- Development of an analysis plan to provide a foundation for future users to conduct a trade-off analysis
- Iterative process to create a process and plan to determine the optimal balance between different factors in the ATDM strategy.



Multi-objective Trade-off Analysis - Key Elements

- Conflicting objectives mean that not all of them can be optimized or even achieved.
- Trade-off analysis makes decisions – and their consequences, explicit and shared among stakeholders.
- Alternatives, decision criteria, weights, etc. can be negotiated among participants



Question and Answer Session



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