I-95 / I-395 Integrated Corridor Management Initiative

Hari Sripathi, P.E.
Regional Operations Director
Northern Virginia
Project Area
Purpose of ICM Initiative

• Reduce number of trips by auto and specifically low-occupancy vehicles within the corridor
• Spread travel demand temporally and across modes
• Promote travel options through improved, comprehensive multi-modal traveler information, real-time dynamic rideshare and TSM strategies
• Provide real-time monitoring and information for commuter parking facilities in support of travel options
• Enact active and adaptive traffic management strategies to reduce impact of congestion and incidents
Assets and Activities

- Freeway / Reversible HOV
- Parallel and connecting arterial network
- Express Lanes under development
- Commuter rail, express and local bus, Metro rail
- 40,000+ parking spaces (VDOT, transit)
- 1000 vanpools, 4000 carpools daily
- 6450 “slugs” daily (2009 VDOT)
- Real-time Ridesharing Pilot (NVRC)
  - Est. 500 riders, 1000 drivers
## I-95 ICM Initiative and Other Initiatives underway

<table>
<thead>
<tr>
<th>STRATEGIES</th>
<th>Dallas</th>
<th>San Diego</th>
<th>Minneapolis</th>
<th>I-95/I-395 (VA)</th>
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<tbody>
<tr>
<td>Integrated Management</td>
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<tr>
<td>Coordinated Incident Mgmt.</td>
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<td>Dynamic Ramp Metering</td>
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<td>HOV / HOT / Managed Lanes</td>
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<tr>
<td>Increasing Transit Ridership</td>
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<tr>
<td>Congestion Avoidance Rewards</td>
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<td>Shift Time of Travel</td>
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<tr>
<td>Facilitate Rideshare Connections</td>
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<tr>
<td>Integrated Operational Systems</td>
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<tr>
<td>Increased Park and Ride Capacity</td>
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<td>Multi-agency Data Exchange</td>
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<td>Transit Signal Priority</td>
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<tr>
<td>Signal Timing</td>
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<tr>
<td>Active Traffic Mgmt / Hard Shoulder Running</td>
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Project Development through Stakeholder Engagement

VDOT and Multi-Modal Stakeholders

**Project and Operational Knowledge**
- Operations, Traffic, and Travel Demand
- As-Built Infrastructure and ITS Assets
- Transit Projects and TDM Initiatives
- Roadway Projects and Transit/TDM Initiatives

**Needs and Functional Input**
- Stakeholder Needs
- Technology Options
- Overall ICM Approach
- Coordination with Transit / Other

**Coordination On System Elements**
- System Architecture
- Technology Definitions
- System Locations
- Technology Deployment Plan

**Operational Roles and MOU Needs**
- Performance Measures
- Refined System Concept
- Roles and Responsibilities
- Multi-modal Operational Scenarios

ICM Project Development Activities

Corridor Assessment (Baseline)

Project Needs and Strategy Formulation

Deployment Recommendations

Concept of Operations
## Participating Stakeholders

<table>
<thead>
<tr>
<th>Arlington County</th>
<th>Northern Virginia Transportation Commission (NVTC)</th>
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<tbody>
<tr>
<td>City of Alexandria</td>
<td>Potomac and Rappahannock Transportation Commission (PRTC)</td>
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<tr>
<td>Clean Air Partners</td>
<td>Prince William County</td>
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<tr>
<td>Commuter Connections</td>
<td>U.S. Department of Defense</td>
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<tr>
<td>Dulles Area Transportation Association</td>
<td>U.S. Department of Transportation – Federal Highway Administration</td>
</tr>
<tr>
<td>Fairfax County Department of Transportation</td>
<td>Virginia Department of Rail and Public Transportation</td>
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<tr>
<td>City of Fredericksburg</td>
<td>Virginia Department of Transportation</td>
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<tr>
<td>U.S. Department of Transportation – Federal Transit Administration</td>
<td>Virginia Megaprojects (VDOT)</td>
</tr>
<tr>
<td>George Washington Regional Commission</td>
<td>Virginia Railway Express</td>
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<tr>
<td>Loudoun County</td>
<td>Washington Headquarters Services - DoD</td>
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<tr>
<td>Metropolitan Washington Council of Governments (MWCOG)</td>
<td>Washington Metropolitan Area Transit Authority (WMATA)</td>
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<tr>
<td>Northern Virginia Regional Commission (NVRC)</td>
<td>Metropolitan Area Transportation Operations Coordination (MATOC)</td>
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<tr>
<td>Maryland State Highway Administration</td>
<td>University of Maryland Center for Transportation Technology (CATT) Lab</td>
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<tr>
<td>Corridor Transportation Needs</td>
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<tr>
<td><strong>Freeway Needs</strong></td>
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<tr>
<td>Expand real-time traffic data and monitoring capability south of MM145 (limited or no detection)</td>
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<tr>
<td>Improve warnings of mainline and off-ramp queuing to reduce crash potential</td>
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<tr>
<td>Make better / more efficient use of road capacity to reduce / eliminate bottlenecks</td>
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<tr>
<td>Improve alternate route and mode information to improve traveler awareness of route / mode options under congestion / incident conditions</td>
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<tr>
<td>Improve incident management coordination between VDOT and counties outside Fairfax (i.e., PW, Stafford, City of Fredericksburg, Spotsylvania)</td>
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<tr>
<td><strong>Arterial Needs</strong></td>
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<tr>
<td>Optimize signal operations to handle rerouted traffic</td>
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<tr>
<td>Optimize signal operations and interchanges to reduce off-ramp queuing</td>
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<tr>
<td>Prioritize express transit services along corridor as well as between park-and-ride lot and I-95</td>
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<tr>
<td>Obtain comparative travel time data on alternate routes</td>
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<tr>
<td>Improved incident management coordination for arterials</td>
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<tr>
<td><strong>Transit Needs</strong></td>
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<tr>
<td>Reduce bus operational delay due to signal operations</td>
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<tr>
<td>Coordinate diverse, separate sources for transit information (real-time and static)</td>
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<tr>
<td>Provide accurate travel time information for express bus and rail transit services</td>
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<tr>
<td>Provide next bus / train info for drivers in order to help decide whether mode shift is appropriate</td>
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<tr>
<td>Enhanced parking information in support of more efficient use of park-and-ride capacity and increased traveler convenience</td>
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</tr>
<tr>
<td>Next bus / train info at stops (VRE, buses) to reassure users</td>
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</tr>
<tr>
<td><strong>Parking Needs</strong></td>
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<tr>
<td>Improve use of available parking capacity at park-and-ride lots (some are full all the time, others are relatively empty)</td>
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<tr>
<td>Inform drivers of parking status / availability at VDOT lots for park-and-ride, express bus, carpool / rideshare activities</td>
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</tr>
<tr>
<td>Support traveler / driver mode choice or mode shift decisions by coordinating parking availability with next train / bus information</td>
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<tr>
<td><strong>Travel Demand Management</strong></td>
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<tr>
<td>Need to improve information to travelers on options – many resources, no one portal that integrates them</td>
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<tr>
<td>Integrate trip planning functions to include rideshare / carpool / slugline options and plan for park-and-ride use to support this</td>
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<tr>
<td>Tie together / integrate currently unconnected multiple resources and services for different types of real-time traffic, travel, TDM information, etc.</td>
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</table>
Opportunity Definition

Challenges
- Shifting demand to available seat capacity
- Reducing number of peak vehicles
- Making better use of capacity at park-and-ride facilities
- Multiple sources of information on travel within corridor

What’s promising…
- Many initiatives underway
- Strong interest in developing a multi-modal corridor solution!
- High-level support and encouragement
IMPROVE QUALITY OF SERVICE FOR TRAVELERS IN CORRIDOR

MAIN NEED (GOAL) TO BE ADDRESSED

KEY OBJECTIVES/PERFORMANCE MEASURES

REDUCE DELAY
REDUCE TRAVEL TIME VARIABILITY
REDUCE PRIMARY/SECONDARY CRASHES
REDUCE SOV VOLUME TO MARK CENTER
REDUCE TRAVEL COSTS

ICM APPLICATIONS

DEPLOYMENT COMPLEXITY

LOW
MULTI-MODAL TRAVEL TIME DMS
WEB/APP TRAVEL TOOL (P1)*

MEDIUM
ATM/HSR (P1)
PARKING LOT MGMT DMS
ARTERIAL SIGNAL SYSTEMS
WEB/MOBILE APP TRAVEL TOOLS (P1)*
WEB/MOBILE APP TRAVEL TOOL (P2)*
ATM/HSR TRAVEL TOOL (P3)*

HIGH
FULL ICM MODULE AT TOC
ADAPTIVE SIGNAL SYSTEMS
ADVANCED DECISION SUPPORT

ICM STRATEGY AREAS

INFORMATION SHARING & DISTRIBUTION
IMPROVE OPERATIONAL EFFICIENCY OF NETWORK JUNCTIONS & INTERFACES
MANAGE CAPACITY-DEMAND: REAL –TIME/SHORT TERM
MANAGE CAPACITY-DEMAND: LONG TERM
PROMOTE CROSS NETWORK ROUTE/MODAL SHIFTS

STRATEGY FOCUS

REDUCE CONGESTION IN CORRIDOR

ICM Vision for I-95 / I-395 Corridor
Candidate Pilot ICM Effort

- **Multi-Modal Travel Time Information**
  - Pre-trip, en-route multi-mode travel time information (roadside signs and VA 511)
  - End-to-end user-centered trip tool based on updated VA 511
  - Address road, transit options and available parking should transit, carpool or slugging option be considered by traveler

- **Real-time Parking Management and Guidance**
  - Park-and-ride space, guidance information (VDOT and transit parking facilities) where travelers have two or more options relative to parking and either transit or carpooling / slugging
  - Present comparative travel time information for transit options (including next bus / train departure) along with parking space availability.
  - Use roadside signs and add functionality to VA 511
ICM Concept of Operations

Three Views of ICM Initiative
- Operational View
- Institutional View
- Deployment View

Provides Backbone for Staged Implementation and Operation of the System
Operational View

PRE-TRIP USER LAYER
- Trip Selection (Time, mode, route)

ICM SYSTEM LAYER
- Development of Multi-Modal Traveler Information
- Operational Control of ICM infrastructure

INFRASTRUCTURE ASSET LAYER
- ICM Operational Applications (lane control, queue warning, variable speeds, metering)

TRAVELER LAYER
- Route and Mode selection
Sample View of Integrated ICM Activities
(Example: implementing carpool-friendly operations strategy)

<table>
<thead>
<tr>
<th>5 AM</th>
<th>6 AM</th>
<th>7 AM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRAFFIC/TRANSIT DATA</strong></td>
<td><strong>TRAFFIC/TRANSIT DATA</strong></td>
<td><strong>TRAFFIC/TRANSIT DATA</strong></td>
</tr>
<tr>
<td>Exit 152 NB</td>
<td>Exit 152 NB</td>
<td>Exit 137 NB</td>
</tr>
<tr>
<td>VC Ratio = 0.7</td>
<td>VC Ratio = 0.9</td>
<td>VC Ratio = 0.75</td>
</tr>
<tr>
<td>VRE: 50% capacity</td>
<td>VRE: 90% capacity</td>
<td>VRE: 100% capacity</td>
</tr>
<tr>
<td>P&amp;R: 50% capacity</td>
<td>P&amp;R: 100% capacity</td>
<td>P&amp;R: 100% capacity</td>
</tr>
<tr>
<td>Speed: 70% FF</td>
<td>Speed: 40% FF</td>
<td>Speed: 50% FF</td>
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</tbody>
</table>

**ICMS**

- **HOV-2**
  - Info via DMS & ATIS website & personal devices
  - Recommend strategies using decision support system
- **HOV-3**
  - Info via DMS & ATIS website & personal devices
  - Set VSL to 80 mph
  - Set HOT rates

**VDOT PSTOC OPERATOR**

- Continuous monitoring
- Confirm recommendations (strategies)

**VSP**

- Enforce HOV-3
- Monitor HOV-3
Institutional Partnership

I-95/I-395 Integrated Corridor Management Partnership Activities

Operations Working Group
- Facilitates implementation and coordination of interagency efforts related to corridor operations
- Establishes Standard Operating Procedures

Policy Working Group
- Governs directions for corridor operational and institutional policies
- Sets policies
- Approves Standard Operating Procedures

Technology Working Group
- Provides guidance for and analysis of technology deployment on corridor as well as for ICMS

Travel Demand Management Working Group
- Evaluates opportunities for modal and temporal demand shift on corridor
- Coordinates between public and private entities to ‘fill every seat’ available

Performance Management Working Group
- Creates and updates corridor specific performance measures
- Monitors performance of corridor operations against these measures

Support of ICM Strategic Areas
- Information Sharing and Distribution
- Improve Operational Efficiency of Network Junctions and Interfaces
- Accommodate/ Promote Cross-Network Route and Modal Shifts

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- Manage Capacity – Demand Relationship Within Corridor – "Real-Time"/Short Term

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Support of ICM Strategic Areas
- Information Sharing and Distribution
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- Manage Capacity – Demand Relationship Within Corridor – Long Term

Support of ICM Strategic Areas
- Information Sharing and Distribution
- Accommodate/ Promote Cross-Network Route and Modal Shifts
- Manage Capacity – Demand Relationship Within Corridor – Long Term
## Deployment View: “Building Blocks”

<table>
<thead>
<tr>
<th>ICM Infrastructure</th>
<th>ICM Traveler Information</th>
<th>ICM Decision Support</th>
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</thead>
<tbody>
<tr>
<td>Arterial Enhanced Signal Operations</td>
<td>Personalized Multi-Modal Real-Time Trip Planning</td>
<td>Modeling and Decision Support</td>
</tr>
<tr>
<td>Freeway Active Traffic Management</td>
<td>Expanded Multi-Modal &amp; Parking Information for 511</td>
<td>Performance Management</td>
</tr>
<tr>
<td>Multi-Modal and Parking Information</td>
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<tr>
<td>Systems</td>
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<tr>
<td>Integrated Single Info Gateway</td>
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### Phases

- **Phase 1**
  - Multi-Modal and Parking Information Systems

- **Phase 2-3**
  - Arterial Enhanced Signal Operations
  - Freeway Active Traffic Management

- **Early Start**
  - Existing Traffic Data
  - Existing Transit Data
Development of “Work Packages” to Plan and Facilitate Deployment

• Each ICM Building Block may be further defined:
  • **Functionally** (infrastructure, traveler information, decision support components)
  • **Geographically** (infrastructure components oriented to particular subarea of corridor)

• Work Package descriptions are being developed in order to:
  • Identify early, targeted implementations for initial deployment
    • Examples: “Multi-Modal and Parking Information Systems for Dale City/Woodbridge Area”, “Initial ICM Central Systems Deployment”, “ICM Traveler Information Gateway (early start project)”
  • Incorporate particular functional elements into other initiatives to expedite deployment
    • E.g., installation of communications under other projects
  • Permit cost-effective, incremental deployment of ICM functionality
Deployment Phases: Traveler Information Tools

- Traveler information services will leverage from statewide 511 revision (Transportation Video and Data Services expansion)
  - **Early Start**: Integrate traffic and transit data through single-gateway access (web / mobile, plus display kiosks)
  - **Phase 1**: Provide personalized travel info by capturing and displaying road and mode travel times and service status, parking availability, etc.
  - **Phase 2**: Develop integrated personalized traveler information tool that can plan trips across multiple modes based on traveler needs and real-time information.
Transportation Video & Data (TVD) Services Mobile Apps Under Development

- Home Screen
- List of Travel Times
- Twitter Feed
- Map
Potential Multi-Modal 511 Interface Approach
Kiosks

- Pentagon
- Mark Center
- Ft. Belvoir
- Quantico
- Other Major Employers
- Major Shopping Malls
- Rest Areas
Deployment Phases: ITS Infrastructure

• ITS infrastructure should initially focus on multi-modal / parking information, and then expand to active and adaptive strategies

  • Phase 1. Comparative travel time and parking information (real-time)
    • Freeway and arterial DMS
  
  • Phase 2. Active traffic management
    • Ramp metering upgrades – existing ramps
    • Ramp metering installation – outside Beltway (with HOV bypass lane)
    • Hard-shoulder running on key segment
    • Queue warning systems

  • Phase 3. Enhance signal operations
    • Adaptive control (US 1)
    • Bus priority (key connections from transit / parking facilities to I-95)
Multi-Modal Travel Times on DMS / Park-and-Ride Management

“Reach the Beach” Example (under construction)
Example
@US 17/
Warrenton Rd
Active Traffic Management and Shoulder Travel Lane
I-395 south / Edsall Road Proposed HSR

DMS on three Edsall Rd exit direction signs. Propose 2 mini-gantries thru interchange to permit additional peak capacity on shoulder
Adaptive Ramp Metering with HOV Bypass

Upgrade 18 metered ramps along I-395 to vary rates based on real-time mainline flows

Implement new ramp meters (some with HOV bypass lane)

May require widening at some entrance ramps
Transit signal priority along express bus routes

Adaptive control along:
- Arterial alternate routes (incidents, congestion)
- Key routes between park-and-ride and I-95
Deployment Plan Example

VC = 1.02
Speed Index 35%

VC = .93
Speed Index 52%

Crashes: 200, Injury: 57, Fatalities: 2

Legend
Deployment Phases: Corridor Decision Support System

Phase 1 (Performance Management)
- Collect, archive traffic flow, travel time, speed info for all VDOT routes in corridor
- Collect, archive transit operational info (all services) including travel time, schedule adherence, riders / loading factor, etc.

Phase 2 (Modeling and Decision Support)
- Use macroscopic operations model to assess trends, compare information and guidance strategies, incentives to reduce traffic volume
- Output recommendations directly into real-time traveler information and roadside displays; promote alternative modes, expedite travel during events, incident periods.
I-95/I-395 ICM Functional System Architecture Core Elements

- Traveler Information Function (TIF)
- Information Dissemination Function (IDF)
- Performance Measurement/Decision Support System (PDMS)
- Data Exchange Function (DEF)

Core Elements:
- ATM
- ICMM
- Existing ATMS

Supporting Systems:
- Traveling Public
- VDOT 511
- Multi-Modal ICM Info Signs
- ATM Signs
- RITIS
- Other agencies (other DOT’s, etc.)
- Advanced Data Management Store (ADMS)
- VDOT PSTOC TMS

Data Sources:
- New Traffic Data Sources
- Commuter Connection
- VRE
- Fred’burg FRED
- Arlington ART
- Alexandria DASH
- Fairfax Connector
- WMATA
PDMS System Concept (building blocks)

ATM, TMS and ICM System Components

Implementation of Strategies in Real-Time Based on Real-Time Data and Trends

Modeling and Simulation of Candidate Strategies Using Real-Time and Archived Data

Modeling and Simulation Using Real-Time and Archived Data

Performance Management (report, monitor MOE’s)

Expand Traffic and Transit Data Sources and Outputs

Data Sources (“All Roads and Modes”)

Input Strategies to Modeling Engine

User

ADMS
How do we achieve benefits?

Better traveler information

Decision-related
  • Temporal, mode shift, parking, lane choice

Traveler connections (rideshare, train, bus, etc.)

Freeway operations improvements (HOV, Bus, SOV)

HSR and ATM related

Metering operations
  • Overall flow
  • HOV / bus preferential treatments

Arterial operations improvements (Bus, HOV, SOV)

Transit-specific (bus priority)

Enhanced coordination (adaptive control tools)
## Potential Benefits in Corridor

<table>
<thead>
<tr>
<th>Benefit</th>
<th>ICM Pilot Deployment (Corridor-wide)</th>
<th>Signal Upgrades / TSP (PW. Stafford, F-burg)</th>
<th>Hard Shoulder Running / ATM (I-95 between Rt 610 and Rt 630)</th>
<th>Ramp Metering (Rt 3 to I-495)</th>
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<tbody>
<tr>
<td>Delay Reduction</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Travel Time Reduction</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>Reduction in Travel Time Variability</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Crash Reduction</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Reduced Fuel Consumption</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Reduced Emissions</td>
<td>2</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>Reduced SOV Volumes</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Reduced Travel Costs</td>
<td>1</td>
<td>2</td>
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### Beneficiaries

<table>
<thead>
<tr>
<th>Beneficiaries</th>
<th>ICM Pilot</th>
<th>Signal Upgrades/TSP</th>
<th>Hard Shoulder Running/ATM</th>
<th>Ramp Metering</th>
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</thead>
<tbody>
<tr>
<td>Drivers / passengers (auto)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Transit users</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Freight carriers</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
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</table>

**LEGEND:**  
1 Primary Benefit  
2 Secondary Benefit
Ultimately, it’s about…..

**Mobility**: it’s the freedom to move where you want to, when you want to, and how you want to

……..that’s what people want
Contact Information

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