I-66 Active Traffic Management Initiative

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“……more congestion, longer commutes, and missed economic opportunities…..That trend must be reversed and this is the time to do it.”

Governor Bob McDonnell
Strategic Approach to New Technology Deployments
Advancing VDOT Operations Program

- Address Recurring and Non-Recurring Congestion
- Approaches – Non-Pricing, Pricing, Context Sensitive
- Suite of Solutions - ATM, ICM, DMA, CV, Hybrid
- Candidate Multimodal Technology Applications
- Organizing Strategy: Network/Corridor Based
- SYOIP – Project Development & Delivery
New Technology Deployment Framework

VDOT Vision & Strategic Goals

OSD Vision for Advancing Operations Program

US and International Best Practices

Agency and University Partnerships

Candidate Multi-Modal Applications

- Active Traffic Management
- Integrated Corridor Management
- Dynamic Mobility Applications
- IntellDrive
- Security Applications

TIGER II Projects

ARRA II Projects

ARRA I Projects

Conceptual Project Designs

Develop ITS/Operations Projects (ConOps, Arch, SysEng)

OSD Operations Program

SYOIP for Delivery

Desired Technology Environment & Operational Outcomes

Program-Level Metrics/Measures

Lessons Learned/Benefits
I-66: Haymarket to DC
I-66: Haymarket to DC

**Project Objective** – Application of ATM/ICM strategies to facilitate dynamic transportation network management based on prevailing traffic conditions

**Context** – Very heavy vehicular traffic both east and west bound during on and off-peak periods – rated as the 2nd highest congested network in the Nation (TTI Mobility Rep)

**Technology Applications** - Active Traffic Management (ATM) and Enhanced Traveler Information
- **Speed Harmonization:** speed limits are dynamically changed based on observed traffic conditions
- **Queue Warning:** dynamic message signs inform travelers of approaching queues/bottlenecks
- **Hard Shoulder Running:** lane control signs manage the use of shoulders as a travel lane

**ICM Nodal Information** - Enhanced corridor-specific traveler information, such as real-time transit and parking information, and travel times. Provide parking availability via dynamic message signs along I-66. Park-and-ride lots to be retrofitted with advanced parking management system (APMS) which would track parking space availability and communicate directly with the parking information signs

**Dynamic Network Management** - The provision of real-time transit information in tandem with real-time traffic conditions would allow commuters to make informed modal choices based on prevailing traffic conditions. Proposed enhanced corridor specific traveler information system would incorporate real-time transit information from transit providers that operate along I-66 into VA511

**Connected Vehicle Test Bed** - Outfit VDOT and transit vehicles with on-board equipment to support testing of various Connected Vehicle technology application (pavement assessment, SPat, safety). Planned deployment of Connected Vehicle roadside equipment (RSE) infrastructure
Bottleneck Locations

- US-15 to Fairfax Co. Line: 63,000 (EB) VPD, 57,000 (WB) VPD
- Fairfax Co. Line to I-495: 91,000 (EB) VPD, 90,000 (WB) VPD
- I-495 to Arlington Co. Line: 64,000 (EB) VPD, 65,000 (WB) VPD

High Accident Locations*

- SR-234: 99 crashes
- SR-28: 130 crashes
- SR-7100: 1225 crashes
- I-495: 65 crashes

* Crashes per year
I-66 ATM Project

- **Project Limits**
  - Mile Marker 40 (US-15) to Mile Marker 74.8 (DC Line)

- **ATM Applications**
  - Enhanced Shoulder Lane Control
  - Dynamic Lane Management (Lane Tapers in advance of Closures, HOV-2 Lane Status, Shoulder Lane Operations Status)
  - Queue Warning (due to congestion, incidents, weather, etc.)
  - Dynamic Ramp Metering and Merge Control
  - Speed Harmonization

- **Phasing**
  - **Phase 1:** MM 58 (US-50) to MM 65 (I-495)
  - **Phase 2:** MM 40 (US-15) to MM 58 (US-50)
  - **Phase 3:** MM 65 (I-495) to MM 74 (DC Line)
Phase 1: MM 58 (US-50) to MM 65 (I-495)
- Enhance existing shoulder running – operate based on congestion levels rather than time schedule
- Lane and speed control signals over all lanes (1/2 mile spacing)
- Merge control at US 50 eastbound ramp (EB I-66)
- Queue warning signage
- Expanded detection and CCTV
- Replace older static regulatory signs and DMS – shoulder and HOV lanes

Phase 2: MM 40 (US-15) to MM 58 (US-50)
- Lane and speed control signals over all lanes (1/2 mile spacing)
- Queue warning signage
- Expanded detection and CCTV
- Replace older static regulatory signs and DMS – HOV lanes

Phase 3: MM 65 (I-495) to MM 74 (DC Line)
- Lane and speed control signals over all lanes (1/2 mile spacing)
- Queue warning signage
- Expanded detection and CCTV
- Merge control at Dulles Connector
## Benefits Assessment (Technical Consensus)

<table>
<thead>
<tr>
<th>LIKELY BENEFITS IN CORRIDOR</th>
<th>Roadway Segment</th>
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<tbody>
<tr>
<td></td>
<td>US 15 to US 50</td>
<td>US 50 to I-495</td>
<td>I-495 to DC</td>
<td></td>
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<tr>
<td>Safety benefits (in terms of accident reductions)</td>
<td>🟡</td>
<td>🟠</td>
<td>🟠</td>
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<tr>
<td>Congestion reduction benefits during peak periods</td>
<td>🟠</td>
<td>🟡</td>
<td>🟠</td>
<td></td>
</tr>
<tr>
<td>Congestion reduction benefits during off-peak periods such as weekends</td>
<td>🟠</td>
<td>🟠</td>
<td>🟠</td>
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</tbody>
</table>

**Highest Benefits**

**Likely Benefits**
## Goals and Objectives

<table>
<thead>
<tr>
<th>Objectives</th>
<th>GOALS</th>
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</thead>
<tbody>
<tr>
<td>Improve Safety</td>
<td></td>
<td></td>
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<tr>
<td>Improve Mobility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improve Environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce Primary Crashes</td>
<td>●</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Reduce Secondary Crashes</td>
<td>●</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Reduce Severity of Crashes</td>
<td>●</td>
<td></td>
<td></td>
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<tr>
<td>Reduce Weather-Related Crashes</td>
<td>●</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Reduce Incident Duration</td>
<td>●</td>
<td>○</td>
<td></td>
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<tr>
<td>Support Work Zone Management</td>
<td>●</td>
<td>○</td>
<td></td>
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<tr>
<td>Reduce Congestion (i.e., travel times)</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Improve Reliability</td>
<td>●</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Increase Throughput</td>
<td></td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Improve Traveler Information</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Reduce Emissions</td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Reduce Fuel Consumption</td>
<td></td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

- ● Primary goal supported by objective
- ○ Secondary goal supported by objective
Context of System Operation
Proposed ATM Functionality – Integrate with Existing HOV / HSR Activities

- Vehicle Data Collection
- Roadway Image Monitoring
- Incident Detection
- Environmental Detection

- Operator Review and Intervention
- ATM Control
- ATM Decision Support

- Road Status Information (VA 511, Police, etc.)
- Roadway Messaging (Lane, Queue Warning, Shoulder, Speed, HOV Access)
- Gate Control (HOV ramps)
- Ramp Metering Rates

Data Collection & Condition Monitoring
Data Processing & Decision Support

Information & Control Output
ATM Display Concept – With Hard Shoulder Running (HSR)

Example with HOV Lane and Shoulder Running (ATM Gantry)

Example with HOV Lane and Shoulder Running (Mini-gantry)

½ mi spacing (typical)

Travel Time on DMS
(advance of decision point. Full structure, include shoulder displays provided on mini-gantry)

¼ mi spacing (typical)

No Closer than 800 feet Before Exit Sign

Gantry

Interchange

ATM Gantry

Mini-gantry

Full DMS
Display Options

Separate Lane and Queue Warning (similar to Washington State, Europe)

Integrated Full-Color Displays (using MUTCD-based sign graphics)
Enhanced Merge Concept (EB US-50 off-peak)
### Road Icing VSL Example

<table>
<thead>
<tr>
<th>Road Icing VSL Example</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Left Aux DMS</strong></td>
<td><strong>L1</strong></td>
<td><strong>L2</strong></td>
<td><strong>L3</strong></td>
<td><strong>shldr</strong></td>
</tr>
<tr>
<td><strong>Road Icing</strong></td>
<td><strong>Reduce Speed</strong></td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td><strong>Road Icing</strong></td>
<td><strong>Reduce Speed</strong></td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td><strong>Road Icing</strong></td>
<td><strong>Reduce Speed</strong></td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td><strong>Road Icing</strong></td>
<td><strong>Reduce Speed</strong></td>
<td>40</td>
<td>40</td>
<td>40</td>
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<tr>
<td><strong>Road Icing</strong></td>
<td><strong>Reduce Speed</strong></td>
<td>45</td>
<td>45</td>
<td>45</td>
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<tr>
<td><strong>Road Icing</strong></td>
<td><strong>Reduce Speed</strong></td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td><strong>Road Icing</strong></td>
<td><strong>Reduce Speed</strong></td>
<td>55</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>

**Notes:**
- HEAVY ICING
- Shoulder Emergency Stops Only
Example: Peak Hour (HOV + HSR) Accident – 2 right lanes + shoulder closed
Implementation Activities

CURRENT

• Completion of Concept of Operations (May 2011)
• Simulation Activities
• Project Development Activities

UPCOMING

• PE Phase FY12
• Phase 1 implementation FY12-13
• Phase 2 implementation FY13-14
Summary

- I-66 is well-suited for ATM applications

- Perceived Benefits
  - Reduction in Crashes
  - Improved Operating Speeds
  - Reduced Incident Duration
  - Reduced Emissions

- Regional Stakeholders Engagement and Support

- Peer-to-Peer Activities initiated

- Project Development Activities underway
Existing Activities (1 of 2)

• **Hard Shoulder Running (US-50 to I-495)**
  - Existing TOD Ops in Peak Direction
  - SLCS Con Ops (2008) proposed demand-based HSR capability

• **HOV Operations**
  - HOV-2 Left Lane in Peak Period Direction (VA-234 to I-495)
  - HOV-2 All Lanes in Peak Period Direction (I-495 to DC Line)
  - Gate Control – HOV Lane ramps
    - Monument Dr, Stringfellow Rd
Existing Activities (2 of 2)

- **TMS Components**
  - Dynamic Message Signs – Advisory and Travel Time (near future)
  - DMS for HOV lanes
  - CCTV
  - Vehicle detector stations
  - Fiber trunk backbone and tail circuits
    - Part of regional ring (along Rts 66, 234, 95, 110)

- **PSTOC**
  - Freeway and arterial operations
  - Police / rescue / incident management
What is Active Traffic Management?

ATM utilizes intelligent transportation system (ITS) technologies in an integrated fashion to proactively manage the flow of traffic to.....

• Improve Mobility - Maximize Use of Roadway Capacity
  • Reduce congestion
  • Variability of travel times
  • Increase throughput

• Enhance Safety
  • Reduce primary/secondary crashes
  • Reduce weather-related crashes
  • Reduce crashes involving law enforcement/EMS

Idea is to “Prevent the Heart Attack before it Occurs.”
How Does ATM Maximize Capacity and Safety to Reduce Congestion?

• Reduces stop-and-go traffic and maximizes “throughput”
  • TOOLS
    • Dynamic Lane Management
    • Speed Harmonization
    • Hard Shoulder Running

• Reduces exposure to potential rear-end collisions due to traffic stoppages, inconsistent speeds in corridor
  • TOOLS
    • Queue Warning
    • Speed Harmonization
# Benefits of ATM*

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Low Range</th>
<th>High Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash reduction (%)</td>
<td>10%</td>
<td>30%</td>
<td>Includes rear-end and other collisions</td>
</tr>
<tr>
<td>Incident duration (%)</td>
<td>9%</td>
<td>70%</td>
<td>quicker incident detection, increased accessibility to incident</td>
</tr>
<tr>
<td>Secondary crash reduction (%)</td>
<td>30%</td>
<td>50%</td>
<td>Based on crashes occurring in same time frame and upstream from prior crashes</td>
</tr>
<tr>
<td>Travel time reduction (%)</td>
<td>10%</td>
<td>30%</td>
<td>For ATM with shoulder running scheme introduced</td>
</tr>
<tr>
<td>Delay reduction (%)</td>
<td>3%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Increase in vehicle throughput (traffic flow rate) in congested zones</td>
<td>3%</td>
<td>7%</td>
<td>Assumes no additional “induced” demand created due to improvement</td>
</tr>
</tbody>
</table>

* From FHWA Scanning Tour
Washington State (I-5)

Early Results indicate Reduction in Accidents by 60% after 6 Months of operations

Minneapolis (I-35)