INTEGRATED CORRIDOR MANAGEMENT
Enhancing personal mobility for all travelers

presented by
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VA I-95 Corridor Vision

- VDOT Secretary/Commissioner’s New Technology Initiative
  Application of new and emerging concepts and technologies to address regional mobility needs
- Application Concepts
  Integrated Corridor Management (ICM) and ATM/HSR/Q-Warning Systems, Connected Vehicle (CV)
- Treatment for HOV Lane Terminations
  Problem: Bi-directional HOV lane creating large vehicle queues at its terminations and hazardous situations for drivers when they are un-expectantly encountered
  Solution: Deploy hazard detection and warning system at both HOV termination locations. Queue warnings will be relayed through variable message signs along with mile marker location of the queue.
- Real-time Inclement Roadway Warning System
  Problem: Hazardous weather related situations for drivers when they are un-expectantly encountered
  Solution: Real-time inclement roadway warning system employing weather sensors at critical locations will relay hazardous information to approaching drivers including high-wind and frozen roadway conditions
- Technologies for Optimal Multimodal Route Selection
  Proposed technologies focus on optimizing the roadway network capacity through effective route decisions. Suite of technologies will monitor travel times for each multimodal option from a given location -- Information at all ICM nodes such as transit stations, park and ride locations, and truck related elements - overnight parking availability, height and weight restrictions, and roadside inspection stations
- Connected Vehicle (CV) Ready
  Proposed technologies produce data elements used within CV environment - travel times, parking availability, and stopped queue ahead are applications envisioned for CV.
Today's Corridors: Independent Systems

- Efforts to date to “reduce congestion” have focused on optimization of individual systems
- Significant investments in ITS Technologies
- Tremendous opportunities to integrate operations to manage total corridor capacity

With Integrated Corridor Management

Significant Congestion • ICM Systems • Managing All Corridor Capacity

multi-agency collaboration and coordination
ICM Benefits

- **Congestion management tool** combining advanced technologies and innovative practices.
- **Proactively** manages available capacity across modes along a corridor optimizing the use of transportation infrastructure assets.
- Corridor is **managed as a system**— multi modal, multi agency, multi-jurisdictional accessibility, flexibility, reliability

Purpose of VA ICM Initiative

- Address multi-modal commuting and through traffic issues in I-95/I-395 corridor, including:
  - Auto, carpool, rail, bus, other options
  - Connectivity between modes
- Identify **innovative technologies** to facilitate multi-modal local, regional and national corridor travel
- Identify tools to provide real-time traveler Information related to travel times and parking
- Address tools to **enhance capacity and safety** such as hard shoulder running, Q-Warning and other active traffic management schemes
I-95/I-395 Project Details

- I-95 / I-395 ICM ConOps & Project Development Task began in October, 2011
- Project Limits - Spotsylvania Interchange to 14th Street Bridge
- Project Segments
  I. US 1/17 to Rt 610 (MM126-144)
  II. Rt 610 to I-495 (MM144-170)
  III. I-495 to 14th St Br (I-395, MM0-8)
- Develop ICM application strategies, and technology-based solutions

Key ICM Deliverables

- Concept-of-Operations
- ICM Architecture and Systems Engineering Management Plan
- Deployment Plan - Technology Bundles/Project Works Packages (Corridor-wide and Segment-based)
- ICM Partnership - Institutional Framework for ICM Implementation
Stakeholder Engagement & Project Development

VDOT Internal Discussion → Narrow the field → Strawman Development

Multi-Modal Stakeholders

Project and 
Operational 
Knowledge

Needs and 
Functional 
Input

Coordination 
On System 
Elements

Operational 
Roles and 
MOU Needs

Corridor Assessment 
(Baseline)

Project Needs and 
Strategy Formulation

Deployment 
Recommendations

Concept of 
Operations

ICM Project Development Activities

Institutional View: The ICM Partnership

Metropolitan Washington Council of Government
Corridor Connections
City of Fredericksburg
Federal Highway Administration
Virginia State Police
Northern Virginia Regional Commission
Fredericksburg Area Metropolitan Planning Organization
County of Aiken

Virginia Department of Transportation
Potomac and Rappahannock Transportation Commission
I-66 Corridor Coalition
Virginia Department of Rail and Public Transportation
Washington Metropolitan Transit Authority
Metropolitan Area Transportation Operations Coordination
Virginia Railway Express
Fairfax County Sheriff’s Department
Fairfax County Department of Transportation

1-961-395 Integrated Corridor Management Partnership

Virginia Department of Rail and Public Transportation
Washington Metropolitan Transit Authority
Metropolitan Area Transportation Operations Coordination
Virginia Railway Express
Fairfax County Sheriff’s Department
Fairfax County Department of Transportation
State-of-Play & Activities Integration

• Freeway / Reversible HOV Operations
• Parallel/Connecting arterial Operations
• HOT Operations (under development)
• Commuter rail, express and local bus, Metro rail Operations
• 40,000+ parking spaces (VDOT, transit)
• 1000 vanpools, 4000 carpools daily
• 6450 “slugs” daily (2009 VDOT)
• Real-time Ridesharing Pilot
  – Est. 500 riders, 1000 drivers

Corridor Transportation Needs

<table>
<thead>
<tr>
<th>Freeway Needs</th>
<th>Expand real-time traffic data and monitoring capability south of MM145 (limited or no detection)</th>
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<td>Improve warnings of mainline and off-ramp queuing to reduce crash potential</td>
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<td>Improve alternate route and mode information to improve traveler awareness of route/mode options under congestion / incident conditions</td>
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<td>Arterial Needs</td>
<td>Improve incident management coordination between VDOT and counties outside Fairfax (i.e., PW, Stafford, City of Fredericksburg, Spotsylvania)</td>
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<td>Optimize signal operations to handle rerouted traffic</td>
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<tr>
<td>Transit Needs</td>
<td>Optimize signal operations and interchanges to reduce off-ramp queuing</td>
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<td>Prioritize express transit services along corridor as well as between park-and-ride lot and I-95</td>
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<td>Obtain comparative travel time data on alternate routes</td>
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<td>Parking Needs</td>
<td>Improved incident management coordination for arterials</td>
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<td>Reduce bus operational delay due to signal operations</td>
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<td>Coordinate diverse, separate sources for transit information (real-time and static)</td>
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<td>Provide accurate travel time information for express bus and rail transit services</td>
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<td>Provide next bus / train info for drivers in order to help decide whether mode shift is appropriate</td>
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<td>Enhanced parking information in support of more efficient use of park-and-ride capacity and increased traveler convenience</td>
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<td>Travel Demand Management</td>
<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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<td>Support traveler/driver mode choice or mode shift decisions by coordinating parking availability with next train/bus information</td>
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<td>Need to improve information to travelers on options – many resources, no one portal that integrates them</td>
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<td>Integrate trip planning functions to include rideshare / carpool / slug-line options and plan for park-and-ride use to support this</td>
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<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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**Needs Highlight**

- Need real-time, multi-modal, end-to-end, traveler information data and services
- Need a single access point to an integrated multi-modal trip planning to include TDM options
- Need real-time parking availability
- Need enhanced incident management
  - Local incident info from local police CAD
  - Arterial incident coordination
- Need optimized signal operations
- Need to address Mark Center traffic impact

**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
Trip View: Entire Corridor
(I-95/395 and surrounding / connecting routes)

(885,000 home-based work trips daily)

HOV Non-Peak, 40,000, 4%
SDV Non-Peak, 240,000, 27%
Transit Non-Peak, 7000, 1%
HOV Peak, 120,000, 14%
SDV Peak, 460,000, 52%
Transit Peak, 20,000, 2%

HBW trips (main focus)

The Commuter's View of ICM
ICM Vision for I-95 / I-395 Corridor

**MAIN NEED (GOAL) TO BE ADDRESSED**

- Improve mobility for travelers in corridor

**KEY OBJECTIVES/PERFORMANCE MEASURES**

- Reduce delay
- Reduce travel time variability
- Reduce travel costs
- Reduce primary/secondary crashes
- Reduce SOV volume to mark center

**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

**DEPLOYMENT COMPLEXITY**

- Low
- Moderate
- High

**ICM Applications in I-95/395**

- **Travel Time Information for All Travel Modes**
  - Pre-trip and en-route travel time information for multiple travel modes along the corridor (95/395. HOT, US1, bus, train)
  - Delays, congestion, restrictions at bases / work locations
  - Personal trip planning tool (end-to-end, compare/mix travel modes)
  - Address road and transit options and available parking should transit, carpool or slugging option be considered by the traveler

- **Real-time Parking Management and Guidance**
  - Park-and-ride space and guidance information (VDOT, VRE, WMATA parking facilities near I-95) for travelers entering the corridor via arterials, where they may have two or more options relative to parking and either carpooling, slugging or using transit.
  - Comparative travel time information for transit options (including next bus / train departure) would be presented along with parking space availability.
Supporting ITS Technologies

- Vehicle Detection Systems
- CCTV Cameras
- Video Incident Detection Systems
- Full-Matrix DMS
- Fiber Optics Communications
- High-Speed Wireless Communications
- Roadside Wireless Networks
- Bluetooth Probe Readers

Integrated Multimodal ITS

- Real-time traffic signal timing, control, and coordination, Transit signal priority
- Adaptive ramp metering
- ATM Tools – HSR, DLM, QW
- Multimodal traveler information / Actionable traveler information
- Integrated electronic payment
- HOT lanes/congestion pricing

connectivity is key
**Multi-Modal 511 Interface Approach**

**Deployment View:**
*Project Packages Derived from “Building Blocks”*

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<th>ICM Infrastructure</th>
<th>ICM Traveler Information</th>
<th>ICM Decision Support</th>
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<td>Arterial Enhanced Signal Operations</td>
<td>Freeway Active Traffic Management</td>
<td>Personalized Multi-Modal Real-Time Trip Planning</td>
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<td>Multi-Modal and Parking Information Systems</td>
<td>Expanded Multi-Modal &amp; Parking Information for 511</td>
<td>Modeling and Decision Support</td>
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<td>Early Start</td>
<td>Integrated Single Info Gateway (including kiosks)</td>
<td>Performance Management</td>
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- **Phase 1**
  - Integrated Single Info Gateway (including kiosks)
- **Phase 2-3**
  - Arterial Enhanced Signal Operations
  - Freeway Active Traffic Management
  - Personalized Multi-Modal Real-Time Trip Planning
  - Modeling and Decision Support

**Existing Traffic Data**

**Existing Transit Data**
Concept of Operations: Functional View

- Five distinct layers of activities:
  - Pre-Trip User Interface
  - System Layer
  - Infrastructure Asset Control
  - Traveler Interface (en-route)
  - Communications

- To enable these operational activities, consider specific ICM building blocks categorized into:
  - Infrastructure-Based ITS Services (typically operations-oriented)
  - Traveler Information Services
  - Decision Support

I-95/I-395 ICM System (ICMS) Architecture

Functional System Architecture Core Elements
ICM System (ICMS) Context Diagram

ICM Success Factors

• Success of ICM depends on
  – End-to-End Trip Making Guidance
  – Intra and Inter Modal Shifts

• TDM Strategies are the Drivers
  – Intra Modal – SOV to HOV
  – Inter Modal – Highway to Bus, Rail

• TDM Enablers
  – Dynamic Ride Share,
  – Flex Hours/Telework
  – Ingress Opportunities – Real Time Travel Conditions, Parking Information (P&R), Transit Info (Next Bus/Rail)/BRT
  – Last Mile Opportunities – Shuttle/Zip Car/Bike/Walk

• ICM Partnership
  – Operations Integration (Data/Information Exchange)
  – Inter-Agency Coordination
ICM – A Paradigm Shift?

- From moving vehicles to moving people and freight
  Accessibility to Facilities and Services, Reliability, Flexibility

- From Individual Modes and Facilities to End-to-End Trips focusing on multiple modes and connectivity

- From Individual Jurisdictions to Multiple adopting a more balanced approach meeting local, regional and national transportation needs

- Intermodal ITS - opportunities to structure freeway, arterial, and transit operations where modes can work together and thrive in a corridor
  managing demand and supply dynamically

Desired Outcome

the freedom to move where you want to, when you want to, and how you want to

[ mobility ]

that’s what people want
For more information...

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ICM Deployment Concept Examples
Multi-Modal and Parking Information Systems

Comparative Travel Times

Next Train / Parking Information

Park and Ride Space Availability (Freeway signage)

Arterial / Transit Signal Priority

CANDIDATE SIGNAL GROUPS

• Transit signal priority along express bus routes

• Adaptive control along:
  • Arterial alternate routes (incidents, congestion)
  • Key routes between park-and-ride and I-95
**Active Traffic Management Strategies**

- Major Gantry (1/2 mile Spacing) HSR (left shoulder), Speed Restriction

- Major Gantry (1/2 mile Spacing) Normal Operation, No HSR

**Proposed Hard Shoulder Running (MM 139 to MM 145)**

**ICM Preliminary Device Locations (sheet 1 of 4)**

- Consider fiber comms from Exit 130 to 145 and trunk wireless or leased connection to NRO fiber at Rt 234 (MM152)

- HSR "Phase 2" South of MM139 Requires shoulder upgrade

*Proposed Hard Shoulder Running with full lane signals/ctype warning MM139.1-145.3

Q-Warning Q-Warning Q-Warning

**Proposed TMS components needed:** MM139.1-145.3 existing CCTV at exit 130

- VRB at 1 mile intervals
- CCTV at 1 mile intervals
- IDS at 3/4 mile intervals along shoulder
ICM Preliminary Device Location Legend

- Hard Shoulder Running
- Dynamic Traffic Management
- Multi-modal Travel Time Sign
- Transit Departure Info and Parking Sign
- Park-and-Ride Advance Info Sign
- Parking Guidance Sign
- Traffic Hot Spot
- Enhanced Real-Time Signal Coordination
- Adaptive Ramp Metering
- Park-and-Ride Lot
- Metro Station
- VRE Station
- Vehicle Detection System
- CCTV Camera
- Incident Detection System
- Fiber Optics
- Traveler Info Kiosk With Corridor-Related Info

ICM Preliminary Device Locations (sheet 2 of 4)
Upgrade existing metering

ICM Preliminary Device Locations (sheet 3 of 4)

ICM ATIS Kiosk at Mark Ctr (multiple Locations)

Q-warning

Upgrade existing metering

ICM ATIS Kiosk at Pentagon (multiple Locations)

Q-warning

Upgrade existing metering

Upgrade existing metering

Upgrade existing metering

Upgrade existing metering

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Q-warning

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ICM Preliminary Device Locations (sheet 4 of 4)
Proposed Working Group Structure

Operations & Technology Working Group
- Establishes implementation of emergency procedures related to corridor operations
- Establishes Standard Operating Procedures
- Provides guidance for and analysis of technology deployment on corridor and for ECRS
  Support of ICM Strategic Areas
- Information Sharing and Distribution
- Impose Operational Efficiency of Network junctions and intersections
- Accommodate Progress Cross-Response Status and Modal Shifts
- Manage Capacity/Demand Relationship within Corridor - "Real-Time"/"Short-Term"

Policy Working Group
- Seeks directions for corridor operational and institutional policies
- Sets Policies
- Supports Standard Operating Procedures
  Support of ICM Strategic Areas
- Information Sharing and Distribution
- Impose operational Efficiency of Network junctions and intersections
- Accommodate/Produce Cross-Response Status and Modal Shifts
- Manage Capacity/Demand Relationship within Corridor - "Real-Time"/"Short-Term"
- Manage Capacity/Demand Relationship within Corridor - "Long-Term"