Real-Time Traffic Management at Northern Region Transportation Operations Center

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ITSMD
November 6, 2014
Presentation Overview

- NRO Transportation Operations Center (TOC) Overview
- ITS Infrastructure
- Signal Operations Center (SOC) Overview
- Arterial Traffic Management
  - Recurring congestion management
  - Non-recurring congestion management
- Operations Engineering and Decision Support
- Evaluation and Implementation of Active Traffic Management Strategies
### Congestion in Washington, DC-VA-MD

**Urban Mobility Report 2010**
- Rank 1\textsuperscript{st} for yearly delay per auto commuter
- Rank 2\textsuperscript{nd} for congestion cost per auto commuter
- Rank 4\textsuperscript{th} for total congestion cost

<table>
<thead>
<tr>
<th>Urban Area</th>
<th>$ (millions)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles-Long Beach CA</td>
<td>$11,997</td>
<td>1</td>
</tr>
<tr>
<td>New York-Newark NY-NJ-CT</td>
<td>$10,878</td>
<td>2</td>
</tr>
<tr>
<td>Chicago, IL- IN</td>
<td>$9,476</td>
<td>3</td>
</tr>
<tr>
<td><strong>Washington, DC-MD-VA</strong></td>
<td><strong>$4,066</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Dallas-Fort Worth-Arlington TX</td>
<td>$3,649</td>
<td>5</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>$3,403</td>
<td>6</td>
</tr>
</tbody>
</table>
Congestion in Washington, DC-VA-MD

Top 10 bottleneck locations

<table>
<thead>
<tr>
<th>Rank</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I-495 CW @ I-270/Exit 35</td>
</tr>
<tr>
<td>2</td>
<td>I-66 W @ VA-234/Exit 47</td>
</tr>
<tr>
<td>3</td>
<td>I-495 CW @ American Legion Bridge</td>
</tr>
<tr>
<td>4</td>
<td>I-95 HOV N @ US-1/Exit 161</td>
</tr>
<tr>
<td>5</td>
<td>I-66 E @ Monument Dr</td>
</tr>
<tr>
<td>6</td>
<td>I-270 Spur S @ I-270</td>
</tr>
<tr>
<td>7</td>
<td>I-66 E @ I-495/Exit 64</td>
</tr>
<tr>
<td>8</td>
<td>I-495 CCW @ Greenbelt Metro Dr/Exit 24</td>
</tr>
<tr>
<td>9</td>
<td>I-295 S @ DC-MD State Border</td>
</tr>
<tr>
<td>10</td>
<td>I-66 E @ Vaden Dr/Exit 62</td>
</tr>
</tbody>
</table>

Source: MWCOG NCR Congestion Report
Transportation Operations Center

- Command post for traffic, incident, special event, weather, and emergency management & information flow
- 24/7 operations
- Safety Service Patrol (SSP)
- Interstates: I-66, I-395, I-95, and I-495 in six counties
- Arterial and Signal Operations: 1,450 signalized intersections in Fairfax, Loudoun and Prince William Counties
Transportation Operations Center

McConnell Public Safety & Transportation Operations Center (MPSTOC) – Located in Fairfax County

- County of Fairfax Department of Public Safety Communications (DPSC or 9-1-1 Center)
- County of Fairfax Office of Emergency Management (OEM)
- VDOT Transportation Operations Center (TOC)
- Virginia State Police (VSP) Division 7 Communications Center
- County of Fairfax Police Department - Forensic Facility
Transportation Operations Center

The right people with the right tools at the right place at the right time

Operations Floor: 12,000sq ft.
Partner Supervisors in the center
Resource Sharing: video wall and CAD

VDOT TOC Operators
VDOT Signal Operations Center near the operations floor
VDOT Situation Room: overview TOC
ITS Assets

- CCTV: 291
  Some are portable CCTV
- Coverage on Interstates
  I-66, I-395, I-95, and I-495
- Arterial Camera Coverage
  - Major Corridors
  - Critical Intersections
  - Near Interchanges
  - Evacuation Routes
- Future Plan
  Additional coverage on arterials
- Dynamic Message Signs (DMS)
- Ramp Meters
- I-66 Shoulder Travel Lane
- Reversible HOV Facility
ITS Assets

- Traffic Signals: 1,400
- Detection: 16,000 at signals and around 200 on freeway
Signal Operations Center (SOC)

• TOC and SOC are located at same location (MPSTOC)
• Real-Time Traffic Signal Operations
• Arterial Incident Management:
  - Monitor police CAD systems and provide traveler info to VA511
  - Adjust signal timing in real-time
  - Coordinate with TOC
  - Monitor work zone
• Coverage Hours:
  - Weekday: 5:00 am to 9:00 pm
    Two work shifts
  - Weekend: 9:30 am to 6:00 pm
    One work shift
Signal Operations Center (SOC)

- Signal System Health Management
  - Central Signal System (MIST)
    - Signal on Flashing
    - Detector Failures
    - Signal Preemption
    - Communication
    - Pedestrian

- Dispatch Signal Technicians
  - Respond to Emergency
  - After hours calls handled by TOC
Signal Operations Center (SOC)

- **Non-Recurring Congestion Management**
  - Incidents: Monitor detour routes and adjust signal timing
  - Work Zones: Monitor the traffic impact by major construction
  - Weather: Mobilize and 24/7 operations during major events
  - Special Events: Develop and Implement special timing plans

- **Real-Time Monitoring Tools:**
  - Police CADs (VSP and Fairfax County) and traffic alerts from localities (Loudoun, PW, and Arlington Counties)
  - CCTV
  - Central Control System (MIST): Comparison of Traffic Flows
  - Google Maps
  - RITIS
  - Freeway Incident Notification Sent by TOC
Signal Operations Center (SOC)

Real-Time Traffic Management and Freeway and Arterial Coordination – Example
Tractor Trailer Accident EB I-66 at Nutley Street on 10/30/2014
Arterial Traffic Management

Traffic Signal Optimization Program

- Goals to reduce recurring congestion, and improve mobility and safety
- An ongoing effort for more than 15 years
- Currently in the 5th round of optimization
- 1,400 signals grouped into 21 networks
- 3 Counties: Fairfax, Loudoun and Prince William Counties
- 8 Timing Plans: Weekday (AM, Midday, PM, Off-Peak) Weekend (AM, PM, Saturday Peak and Sunday Peak)
- Special Event Timing Plans: Holiday season plans, 4th of July plans, and major construction detour plans
Arterial Traffic Management

Traffic Signal Optimization Process

- Data Collection
- Data Analysis
- Network Setup
- Optimization
- Simulation
- Implementation & Fine Tuning
- Evaluation & Recommendation
Arterial Traffic Management

Traffic Signal Optimization Benefits

- Economic Benefits Based on the 4th Round of Optimization
  - Stop, Delay and Fuel Consumption
  - Benefit to Cost Ratio – 49:1
  - Overall Savings - $97,742,104

- Environmental Benefits
  - Annual Emission Reductions of 555.24 metric tons

- Travel Time and Level of Service Improvements

- Update of Pedestrian and Vehicular Clearance times based on the latest MUTCD and VDOT guidelines

- Digital Library of signal networks used by VDOT and consultant engineers for traffic studies

- Operational and Geometric Recommendations
Arterial Traffic Management

Traffic Signal Optimization Constraints

• Over-Saturated Conditions (Image Below)
• Emergency Vehicle Preemption
• Signal Timing Plan Transition
• Early Green Time Release
• Pedestrian Timing Requirements
• Heavy Traffic Volume on Side Street
• Bi-Directional Traffic
• Lane Reduction
• Detector Failure
• Work Zone
Operations Engineering and Decision Support

Implement and Evaluate Active Traffic Management Strategies

- I-66 Shoulder Travel Lane
- Lane Closures and Work Zone Management
- Ramp Meter System Evaluation
- Adaptive Signal Control Strategy (ASCT)
- I-66 ATM Project

Engineering and Decision Support Tools

- Different Level of Modeling
- Traffic Data Collected from Sensors
- 3rd Party Data If Available
- Data Analysis
- Field Experience
I-66 Shoulder Travel Lane (STL) Operations

- Previous schedule
  5:30 to 10:00 AM & 3:00 to 8:00 PM
- New Schedule since August, 2008
  5:30 to 11:00 AM & 2:00 to 8:00 PM

Impact of STL Operation Hour Extensions

- Traffic became harmonious with the new STL operation schedule
- Promoting freeway safety
- Increased throughput
Operations Engineering and Decision Support

• Traffic Impact Analysis for Work Zone and Major Construction Projects
  
  I-495 NB Lane Closure Prior to America Legion Bridge
  • Request for lane closures on weekend
  • Congestion scans pulled from RITIS for the work zone area
  • Queuing Analysis conducted to evaluate the lane closure impacts
Active Traffic Management Strategy

24 Metered Ramps on I-66 and I-395 Inside Beltway

- 6 on I-66: 3 EB and 3 WB
- 17 on I-395: 7 SB and 10 NB
- 1 at I-395 is being replaced
Active Traffic Management Strategy

Ramp Meter System Evaluation for Meters on I-66

• Before Conditions:
  - Fixed-time control and fixed schedule prior to the evaluation
  - Highly congested in peak and off-peak directions during peak and off-peak periods

• Evaluation Methods:
  - VISSIM simulation study was conducted to evaluate the performance of fixed-time control and the adaptive ramp metering algorithm

• Actions Taken After the Assessment:
  - Activated WB meters in AM peak hour, and activated EB meters in PM peak hour
  - Activated WB ramp metering at 2:30 pm in the PM peak period prior to the start of congestion
  - Recommendation to deploy adaptive ramp meter control for I-66 Active Traffic Management (ATM) project
Active Traffic Management Strategy

Adaptive Signal Control Strategy (ASCT)
• Pilot tested InSync on Braddock Road (Rt.620) in 2012
• OPAC - Optimized Policies for Adaptive Control
  - Little River Turnpike (Rt.236) from Duncan Drive to Guinea Road - Six signalized intersections
  - Just outside the Capital Beltway
  - Major Trip Generators:
    Northern Virginia Community College
    Fair City Mall
    Other schools and shopping centers
  - After Evaluation is Underway

• Lessons Learned:
  - Do not expect an One-Size-Fits-All Solution

New Project: Evaluation and Analysis of ASCT for implementation on 9 Corridors in NOVA
  - Begin in March, 2015
Active Traffic Management Strategy

I-66 Active Traffic Management (ATM) System

- Combination of ATM Treatments
- Continuous CCTV Coverage
- Dynamically Use of Shoulder Travel Lane as Condition Warrant
- System-Wide Adaptive Ramp Meter Control

Before-and-After Evaluation to Quantify the Effectiveness of ATM Strategies

- Define, Exam, and Analyze Operational Performance Measures and Safety Measures
- MOEs: Travel Time, Travel Time Reliability, Duration of Congestion, Queue Length and Throughput, etc.
- Conducted by VDOT VCTIR
Ongoing Projects and Initiatives

Next Generation Traffic Signal Controller
- Existing Controller and Software: 170 and BiTran
- New Controller and Software: 2070 and D4 Firmware
- Additional functionalities to operate signals
- Complete transition in 2-3 years

Communication Infrastructure Upgrade
- Broadband for Signal Control
- CCTV Installation at Signalized Intersections

Transit Signal Priority (TSP) Project
- Working with WMATA to implement TSP on Rt. 7

Travel Time for Major Arterials

Connected Vehicle Initiative
- Roadside Equipment (RSE) Installation
Questions?

THANKS!

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