Welcome to Best Practices in Enforcement on Managed Lane Facilities

Audio:
- Via Computer - No action needed
- Via Telephone - Mute computer speakers, call (866) 863-9293 passphrase: 97625572

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Closed captioning is available at:
http://www.fhwa.dot.gov/tpr

You will be notified of the availability of the recording and PowerPoint presentation from this session.
State Road and Tollway Authority (SRTA)
Overview
Tolling Operations
I-75 South Metro Express Lanes
I-85 Express Lanes
Enforcement
Customer Experience
SRTA is a state-level independent authority created by the Georgia General Assembly to:

- Operate Georgia toll facilities
- Serve as a State transportation financing arm
  - Manage ~ $1.3B in transportation bonds
  - Issue & service toll revenue financed debt
  - Administer GTIB (Georgia Transportation Infrastructure Bank) Program

SRTA is governed by a five-member Board
SRTA Tolling Operations

Customer Service

Operations

Toll Operations Command Center

www.GeorgiaTolls.com
### Registered Lane

#### I-75 South Metro Express Lanes

<table>
<thead>
<tr>
<th>Toll Exempt</th>
<th>Tollored</th>
<th>Prohibited</th>
</tr>
</thead>
</table>
| • Over-the-road buses  
• Emergency vehicles | • Single driver  
• Carpools  
• Motorcycles  
• Alternative Fuel Vehicles | • Vehicles with more than 6 wheels |

#### I-85 Express Lanes

<table>
<thead>
<tr>
<th>Toll Exempt</th>
<th>Tollored</th>
<th>Prohibited</th>
</tr>
</thead>
</table>
| • Motorcycles  
• Alternative Fuel Vehicles  
• Over-the-road buses  
3 or more person carpools  
• Emergency vehicles | • Single driver  
• 2 Person carpools | • Vehicles with more than 6 wheels |
I-75 South Metro Express Lanes

- 12 miles of newly constructed roadway
- Lanes extends between SR 155/ McDonough Road and SR 138/ Stockbridge Highway
- Express Lanes were constructed within the median of the existing roadways
- Lanes are reversible, allowing traffic to travel northbound in the morning and southbound in the evening
- Traffic flow will be adjusted to support special events such as NASCAR races and spring break travel
Groundbreaking October 6, 2014
Construction took approximately two years
Lanes were opened to traffic January 2017

Georgia Department of Transportation (GDOT) is responsible for reversing lanes
SRTA is responsible for setting tolls
I-85 Express Lanes Overview

- 15.5 miles
- 1 lane in each direction
- Painted, rumble-striped buffer; no physical barriers
- 66 active toll points, ½ mile apart
- Dynamically priced
- Lanes operate 24/7
- Registered lane, even for toll-exempt vehicles
- 2 axles; no more than 6 wheels
- 6C transponder technology
- $182M original project budget
- Won federal grant -$110M
- Express Lanes $60M
- Opened October 1, 2011
- 1st Pricing Demand Management Strategy Project in GA
- HOV2+-HOT3+ Conversion

High Occupancy Vehicle (HOV)
High Occupancy Toll (HOT)
I-85 Express Lanes

“Invisible Barrier” solution

- Overhead tolling system detects vehicle entry/exit
- Gantry spacing deters dodging into the Express Lanes
- Gantry to gantry monitoring detects entry/exit violations
- Automatic toll violation notices
- Indirectly enforces double white line weaving
Enforcement

Violations:
- Using the Express Lanes without a Peach Pass transponder
- Occupancy (vehicle does not meet 3+ requirement to ride free) – Automatic License Plate Recognition (ALPR)
- Addressing crossing the solid, double white line – Gantry Controlled Access

Penalties:
- SRTA toll violation = $25 + toll amount
- May also be issued citation by law enforcement
Vehicle Occupancy Enforcement

- Qualifying carpoolers self-declare HOV status by telephone, smart phones, or online account.

- Tolling Back Office transmits list of “Toll-Exempt” vehicles to a mobile Automatic License Plate Recognition (ALPR) system onboard police cars.

- ALPR scans license plate and notifies officer to check occupancy for vehicles registered with SRTA in the 3+ non-toll mode.

- The ALPR reads license plate of passing vehicles and notify officers to check occupancy of only “Toll Exempt” vehicles:
  - Full list updated daily
  - Incremental updates every 5-10 minutes throughout the day.

- Officer’s on board computer system sends “stop/citation” information back to SRTA.
Customer Experience

Toll Mode Options

- There are 2 Modes of a Peach Pass
  - Toll: when there are <3 occupants in a vehicle
  - Non-toll: when there are 3+ occupants

- Toll Mode Duration Options
  - 4 hours
  - 1 day
  - Weekdays
  - Indefinite

- Change between Modes
  - 15 minutes before using Express Lanes
  - Call, online, in person, Mobile App.
  - Automated confirmation

*Toll Mode Change Options apply only for the I-85 Express Lanes*
Customer Experience

Violation Processing

- **DWL Violations:** Entering or exiting Express Lane by crossing the solid, double white line
  - No Double penalties
  - Fine and Fee reductions

- **Unregistered Use:** Using the Express Lanes without a Peach Pass
  - Violator to Customer
  - Fine and Fee reductions

- **Occupancy:** Occupancy (vehicle does not meet the appropriate number of occupants for toll-free access)
  - Declaration status validation
Customer Experience

Payment Options

- Pay N Go
  - Payment card purchased at one of our retail partners location to pay violations

- Online
  - Notification provided when customers access their accounts online

- Interactive Voice Response (IVR system)

- Payment Plans
  - Violations with 10 or more transactions
Thank You!
March 28, 2017
Joseph Averkamp
FHWA Webinar

Best Practices in Enforcement on Managed Lanes Facilities
Overview

- High Occupancy Vehicle and High Occupancy Toll Lanes are a key tool used in Managed Lane Systems

- Most systems rely on people honestly declaring if they are qualified to be in the lane
  - Switchable Tag for HOT
  - Entering Lane for HOV

- Enforcement by Human Roadside Observers is challenging
Conduent has developed and tested an Automated Vehicle Occupancy Detection System

Conduent Vehicle Passenger Detection System™

Conduent has conducted a series of pilots to assess the system

- Halifax Harbour Bridges
- 495 Express Lanes Northern Virginia
- Colorado DOT I25
- CalTrans I5 in Orange County
- SANDAG I15
- Jougne, France
- LA Metro I110
Primary Focus Of Pilots

- What level of automated accuracy can be achieved?
- What is the Violation Rate on the roadway being evaluated?
- How well can human enforcement perform?
Primary Focus Of Pilots

- What level of automated accuracy can be achieved? ~95%
- What is the Violation Rate on the roadway being evaluated? Varies from 11% to 28% depending on the roadway
- How well can human enforcement perform? High volume roadways are challenging and pulling vehicles over can create a Safety and Congestion issue
Focused Discussion:
Caltrans Trial: I-5 in Irvine, CA Testing
HOV2 Lane, Three Month Trial

Front Seat Image Capture Equipment

Rear Seat Image Capture Equipment
Conduent VPDS Produces High Quality Images For Manual Image Review

Note: Images Redacted for Privacy
Single Occupant Vehicle Rate Accuracy: Human versus Machine

Conduent VPDS accuracy as compared to Human Roadside Observers

<table>
<thead>
<tr>
<th></th>
<th>Average Vehicle Count For A Three Hour Period</th>
<th>XVPDS SOV Rate Accuracy</th>
<th>Roadside Observer SOV Rate Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mornings 6am-9am</td>
<td>1774</td>
<td>95.0%</td>
<td>35.7%</td>
</tr>
<tr>
<td>Jan 27, 28, 29 Tues, Wed, Thurs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evenings 3pm-6pm</td>
<td>2250</td>
<td>95.3%</td>
<td>35.6%</td>
</tr>
<tr>
<td>Jan 27, 28, 29 Tues, Wed, Thurs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Statistics From the CalTrans Trial

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Measure</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period of Analysis</strong></td>
<td>January 27,28,29: 6 am-9 am, 3 pm – 6 pm</td>
<td></td>
</tr>
<tr>
<td><strong>Total Vehicles Reviewed</strong></td>
<td>12,073</td>
<td></td>
</tr>
<tr>
<td><strong>Violation Rate</strong></td>
<td>11.65%</td>
<td>17.4% adjusted down for LEVs</td>
</tr>
<tr>
<td><strong>Total Violations</strong></td>
<td>1,406</td>
<td>11.65% out of 12,073</td>
</tr>
<tr>
<td><strong>Number of Hours During Analysis Period</strong></td>
<td>18</td>
<td>3 days for 6 hours each day</td>
</tr>
<tr>
<td><strong>Number of Vehicles Seen Per Hour</strong></td>
<td>671</td>
<td>This represents 11 vehicles per minute or one vehicle every 5.4 seconds</td>
</tr>
<tr>
<td><strong>Violators Per Hour</strong></td>
<td>78</td>
<td>This is the average number of Violators passing this location each hour.</td>
</tr>
</tbody>
</table>

**The Roadside Observers see a Vehicle every 5.4 seconds---Don’t Look Away!**
Vehicle Occupancy Detection Concept of Operations

1. Downstream Police Officer on Roadway
2. Police Officer in Back Office
3. Back Office Tolling Operation

Network

Local Processing

Ticket

Toll
Concept of Operations For High Occupancy Toll Lanes

ALL Vehicles Captured By VPDS

- Input from Toll Collection System
  - Switchable Tag Setting
  - Lane Rules

- Automated Output from Conduent VPDS
  - HOV Score
  - Images

- Manual Image Review of Declared Violators

- Accuracy of Declared Violators After Manual Image Review = ~ 99%

Conduent Confidential and Proprietary
Economics: The Technology May Work But What About the Business Case?

- Consider a “typical” Toll Lane
  - 10,000 vehicles per day
  - Violation Rate of 10%-- in studies, Violation Rate was 11% -28%
  - Yields 1,000 violations per day
  - 250 Commuting Days a year—5 days X 50 weeks
  - This yields 250,000 Violations or Toll Adjustments Per Year

- Finances
  - $10 Toll Charge X 250,000 Toll Adjustments = $2.5 million per year in “found” revenue on one lane
    - Supported with Manual Review and Correspondence Management

Conduent Confidential and Proprietary
Lessons Learned

- Good news! Most people in the HOV/HOT lanes are qualified to be there: 72%-89% 
  - Conversely, 11%-28% of the vehicles are not qualified

- Revenue may be important but....
  - Safety and Congestion: Stops by enforcement officers lead to Congestion and Safety concerns
  - Equity: Equity on the road is important----if a select percentage don’t adhere to the rules, others may follow if there is no visible means of enforcement
  - Improving Flow: Reducing non-qualified vehicles may help restore free flow: an 11% to 28% violation rate is the difference between Service Level E or F and Service Level A or B

- Perfection cannot be the enemy of the good
  - 95% accuracy is not good enough for completely automated enforcement, but it is a good start. When augmented by manual review, the number of mis-categorized vehicles can be reduced to ~1%

- For the naked human eye, identifying HOV/HOT violators at highway speeds is very challenging.
95 Express Incident Management & Enforcement Lessons Learned
March 28, 2017

Javier Rodriguez, P.E., FDOT District Six, TSM&O Program Engineer
Agenda

- Project Overview
- Incident Management Resources
- Enforcement
- Lessons Learned
Project Overview

- Phase 1 Completion
  - Northbound – Dec 2008
  - Southbound – Jan 2010

- Phase 2 Completion
  - Oct 2016

- HOV to HOT Conversion
  - 1 HOV Lane to 2 Express Lanes

- Congestion–Priced Tolling

- Bus Rapid Transit (BRT)

- Ramp Signaling
Incident Management Resources

Maxor Elements

• Dedicated TMC Express Lane Operators
• Road Ranger Service Patrol
  ✓ Added flatbed wrecker
  ✓ Added heavy duty wrecker
• Incident Response Vehicle & Operators
• Law Enforcement

Quick Clearance Procedures
**Enforcement**

- Electronic Toll Enforcement
- Florida Highway Patrol Support
  - Enforcement
    - Toll Violation
    - Speeding
    - HOV
    - Improper Lane Change (Lane Diving)
    - Hard Closures
  - Incident Management
    - Relocation of Incidents
    - Crash Investigation
    - Express Lanes (EL) & Local Lanes (LL)
Lessons Learned

Operations

- Provide Full Width Shoulders
- Separate EL from LL
- Provide Means of Physically Closing Facility
- Operational Changes should be made ‘Quickly’
  - Adequate Supporting Staff & Resources
  - Evaluate & Adjust as Necessary
  - Mitigate Bad Driver Behavior
Lessons Learned

Incident Management

- Dedicated Resources
  ✓ Specially Trained & Equipped
- Multi-Agency Partnerships
  ✓ FHP Hireback Program
  ✓ Traffic Incident Management (TIM) Team
  ✓ Table Top Exercises
  ✓ Coordination Meetings
- Quick Clearance Procedures
  ✓ Dedicated Strategic Staging Areas
Lessons Learned

Closing Facility

- Posting “CLOSED” – 87% Violations
- Hard Closures
- Post-Incident Pricing
- Regulatory Lane Status Signs
  - Color DMS
  - Allows for white text on black background
  - Enforceable per MUTCD
- Automated Gate System
Lessons Learned

- Driver Awareness
  - Lane Diving (Moving Violation)
  - Toll Violation
Lessons Learned

➢ Express Lane Markers

• Lane Diving
• Type and Installation
• Spacing
• Maintenance
Lessons Learned

Roadway Design

- Reduced Shoulder Width
- Median Emergency Stopping Sites

✓ February 2017 – February 2018
Thank you,

Javier Rodriguez, P.E., FDOT District Six, TSM&O Program Engineer
javier.rodriguez2@dot.state.fl.us
Carma Mobility Solutions
Extending mobility freedom to everyone

**CarmaCar**
Carshare where people really live and work

**USP:**
San Francisco’s original carshare service (2002); non-profit; 400 cars.

**Competition:**
\[ + \] = 95% US Market Share

**Momentum:**
- Aggressive pod expansion
- Introduction of corporate carshare
- Close government partnerships
- Data-driven momentum
- Roll-out of new app, hardware
- 3-minute sign-up and approval

**Vision:**
High-occupancy in our fleet of cars; then high-occupancy in every car.

**CarmaZoom**
High-occupancy commute carshare

**USP:**
World first high-occupancy carshare service introduced 2015

**Competition:**
First-to-market. Closest business is Bridj.

**Momentum:**
- Extends utilization to off-peak hours
- Extends utilization to new areas
- Ideal employment campus solution
- Far less costly than a new shuttle
- Valet service, simple reservations
- 3-minute sign-up and approval

**Vision:**
High-occupancy in our fleet of cars; then high-occupancy in every car.

**CarmaCarpool**
Peer-to-peer commute carpool

**USP:**
World’s leading commute carpool solution since 2007.

**Competition:**
(Only new entrants focus on the commute; Waze in Israel)

**Momentum:**
- Market leader
- 250+ APIs, being used globally
- Government partnerships
- Toll rebates for verified carpools
- Community management expertise
- Employer partnerships

**Vision:**
High-occupancy in our fleet of cars; then high-occupancy in every car.
PPP Partnerships
In partnership with local governments and transportation agencies

**Tolling**
- Texas Department of Transportation, Central Texas Regional Mobility Authority; Bay Area Toll Authority; Contra Costa Transportation Authority, Caltrans

**Carpooling**
- Washington State DOT; Northern Virginia Regional Council; US Dept of Defense; Metropolitan Transportation Commission; and Federal Highway Administration

**Carsharing**
- City and County of San Francisco; City of Berkeley; and University of California and Metropolitan Transportation Commission

**Parking**
- San Francisco Metropolitan Transportation Authority
Carpool Incentives

Real-time SOV / HOV travel alerts
Real-time availability at parking lots
Real-time alerts on rider / driver availability at roadside pick-up zones
Real-time incentive confirmations
Parking Discounts

Shift from cars-per-lot to people-per-lot
Near-field occupancy detection at fixed locations
World’s first iBeacon implementation for transportation
Managed Lane Discounts

Interoperable with any tolling network via back-end reconciliation
Real-time toll discounts with optional in-car alerts for *verified carpools*
Toll sharing amongst vehicle occupants
# Tolling Enforcement vs Verification

Dominated by legacy roadside systems provided by giant vendors

<table>
<thead>
<tr>
<th>Highway Patrol Support Systems</th>
<th>Switchable Transponders</th>
<th>Video Analytics (Geometric)</th>
<th>Infrared</th>
<th>In Car Sensors</th>
<th>Mobile Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M, Kapsch Trafficcom, Transcore, Siemens, IBM, Schneider Electric</td>
<td>Sirit, Transcore, Kapsch TrafficCom, Telematic Wireless</td>
<td>Xerox (VPDS), Cubic (NextCity)</td>
<td>Siemens, Vehicle Occupancy Detection Corporation (Dtect)</td>
<td>Delphi, Siemens</td>
<td>Carma</td>
</tr>
</tbody>
</table>

“**The Wildcard is Smartphone Tolling**”
- Mark Cantelli, Xerox, VP, State Government Transportation

- Invulnerable to weather conditions, sun reflections, vehicle geometry, window tint, posture, skin color, travel speed
- No roadside infrastructural investment required
- High reliability, accessibiiliy and scalability
Carma Occupancy
Automated Occupancy Verification Using Mobile Technology

Ambient Occupancy Detection
• Beacon technology or embedded in Toll Tag
• Near Field Communications for detection upon vehicle entry / exit

Occupant Devices
• Smartphone, with Carma app installed
• Optional Beacon for occupants without a smartphone

Continuous Monitoring of Coordinated Proximity
• Occupancy verified throughout a trip
• Patent-pending (US US 20110059693)
• Enabling non-PII travel pattern analysis

Occupancy API
• Toll Authority queries web-API for verified occupancy at any time and location in network.

In-App Occupancy Display
• Verified occupancy status can be inspected in the app, but no user interaction required at any time.

Offline Reconciliation
• Smartphones without data connection report occupancy once reconnected to data.