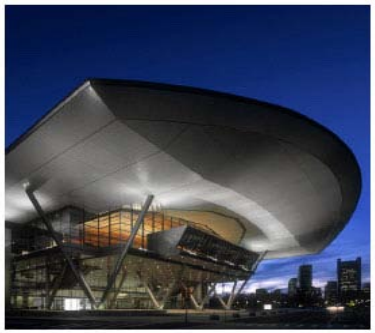

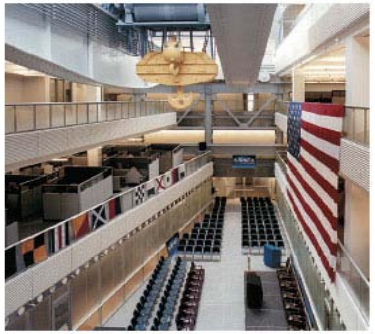

Presentation to Team Florida

Critical Issues in Occupancy Enforcement and the I-15 ML Test

Susan Carlson

May 12, 2011

Overview of Presentation

- Background on Occupancy Enforcement and Managed Lanes
- Key Needs for Effective Enforcement
- Options and Plans for Occupancy Enforcement Strategies
- Recent Occupancy Camera Test at SANDAG
- Test Results
- What's Next?

HNTB

Background on Managed/ HOT Lanes Enforcement Issues

- Number of planned or implemented projects now include 23 metropolitan areas
- Goals: mobility management and increasingly revenue generation
- Toll technology not an issue but HOV enforcement is the major issue.
- How to effectively enforce occupancy without major barriers to HOV participation

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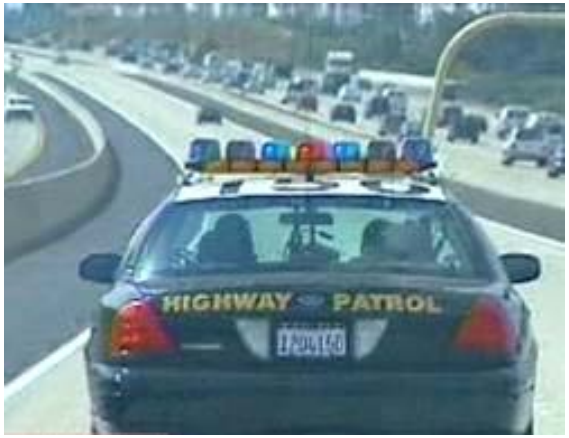
What are the Enforcement Issues?

- More lanes and longer roadways and networks
- Multiple entry and exit points
- Labor intensive and costly manual enforcement
- Need more automated methods to enforce HOV occupancy requirements



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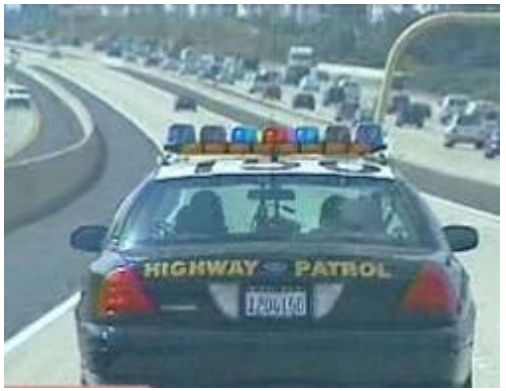
What Are Our Enforcement Options?

1. Manual enforcement
2. Manual enforcement with technology assist
3. Fully automated enforcement technology



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What are the Fully Automated Enforcement Options?

- No options are currently in production
- "Connected vehicle" (formerly Intellidrive) offers opportunities in the medium to long term
- Biometrics still a future vision
- Occupancy enforcement camera prototype

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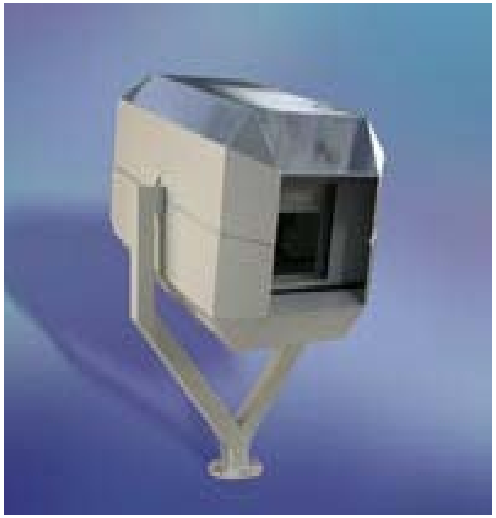
Vehicle Occupancy Camera

- Lane based camera system
- Aimed at interior of vehicle
- Infrared wavelength based
- Images of occupants obscured to avoid privacy issues
- Ties an image to an occupancy record



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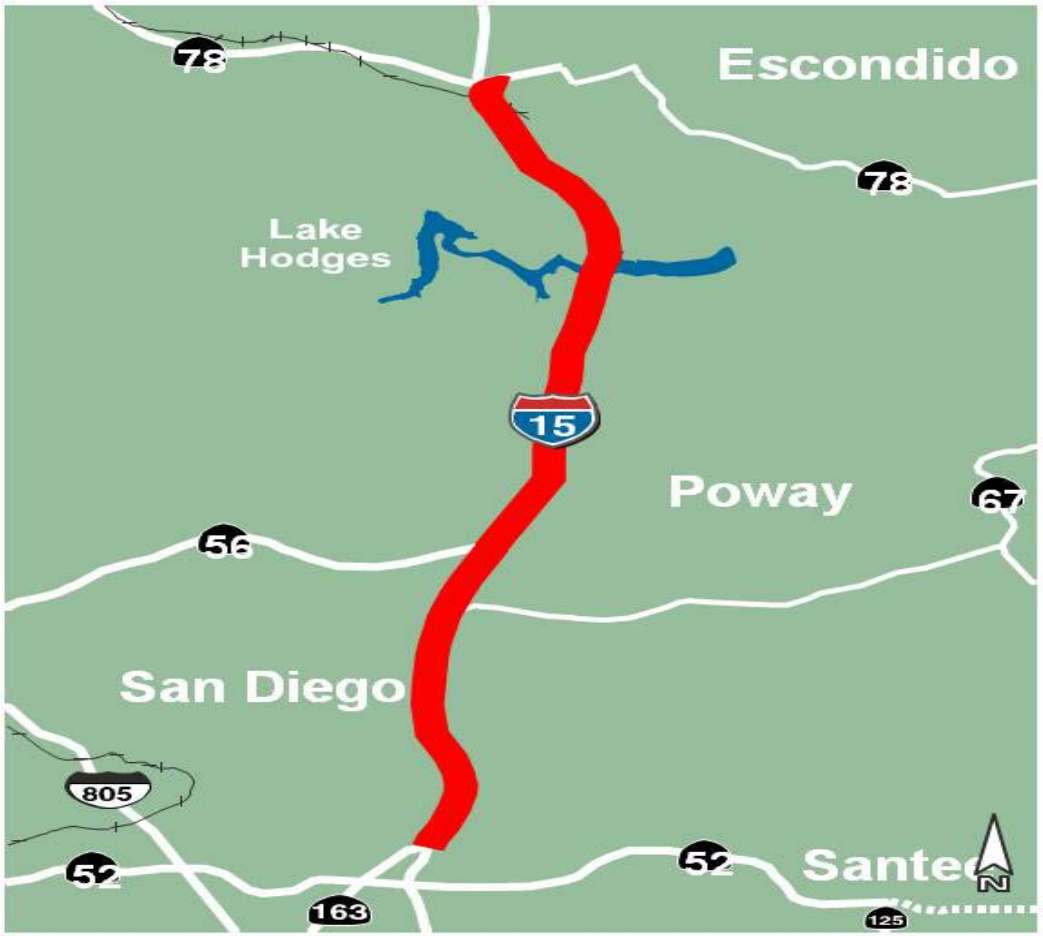
I-15 Managed Lanes
San Diego



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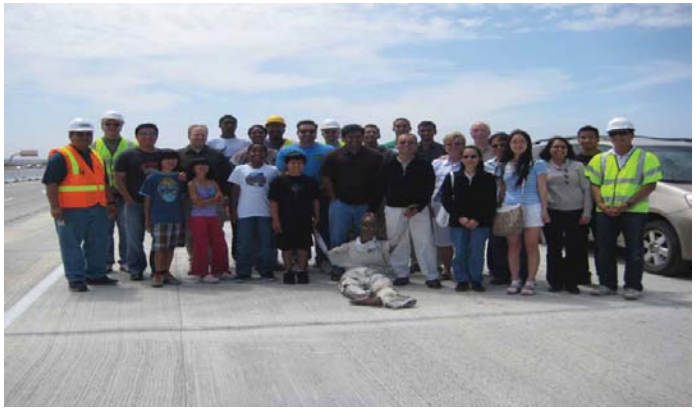
SANDAG VOL Occupancy Camera Test Summer 2010

- FHWA VPP based project for Violation Enforcement
- RFP in 2009 for testing on I-15 ML
- Delcan System Integrator with Vehicle Occupancy Limited (VOL) camera selected
- Controlled tests took place weekend of July 30,2010
- Test Team: Delcan, SANDAG, HNTB, PATH/CCIT SMG, Caltrans and CHP and volunteers



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Description of VOL Technology

- External trigger signal detects presence of vehicle.
- Camera then illuminates the windshield area with two different wavelengths of infrared light.
- Two digital infrared pictures are taken of the windshield at the instant of illumination.
- Near real time processing of images through VOL's algorithm
- Record created with number of occupants
- The system obscures the images of occupants in the vehicle by placing a green blob over their faces.

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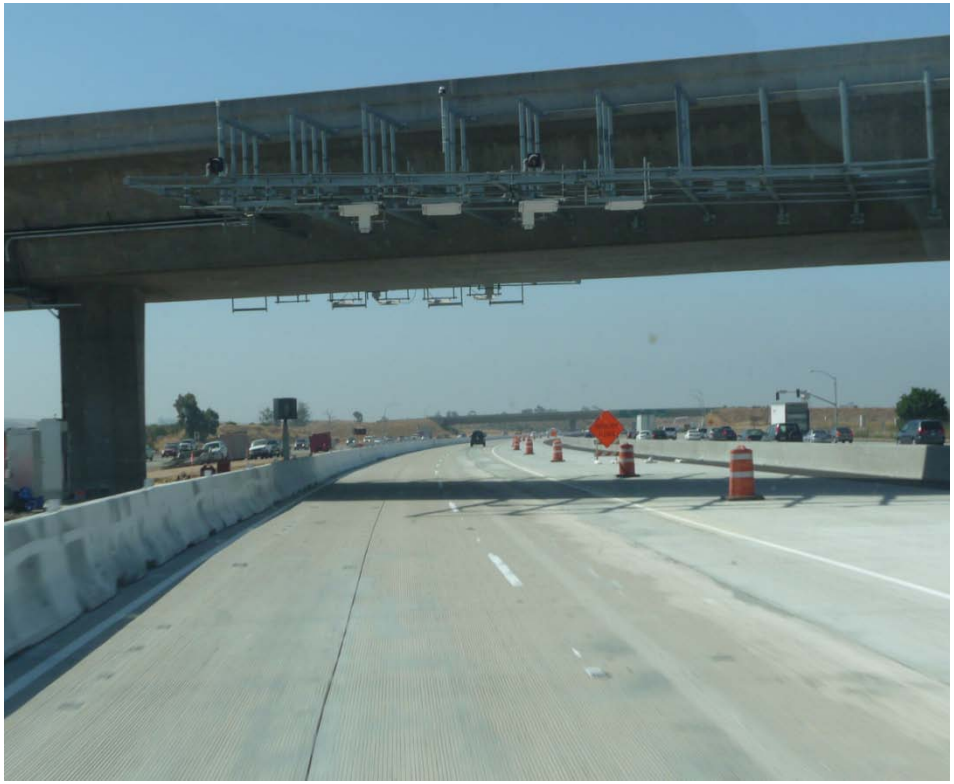
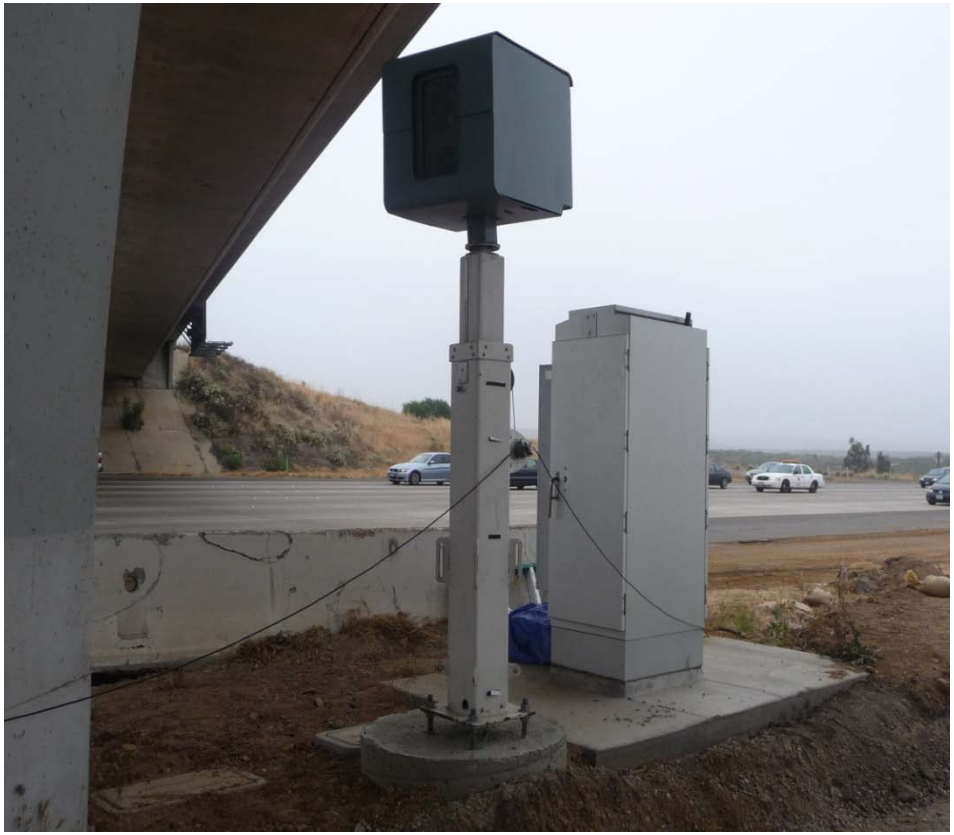
Miramar Way Test Site Looking South



Miramar Way Test Site Equipment Close-up



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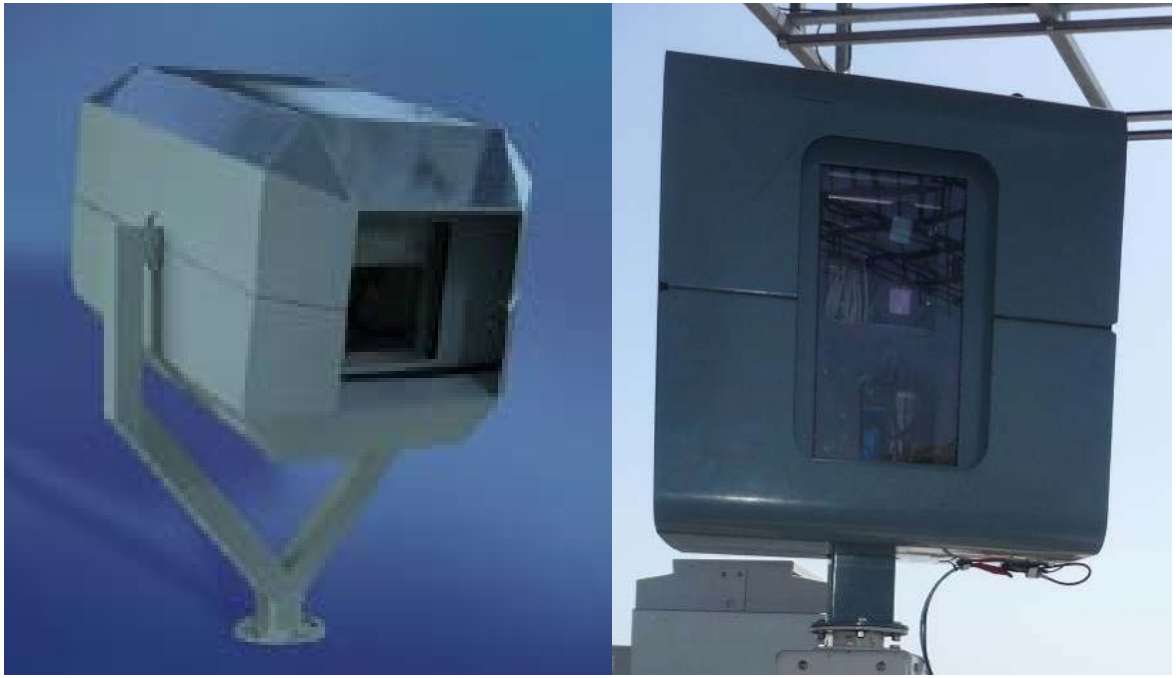
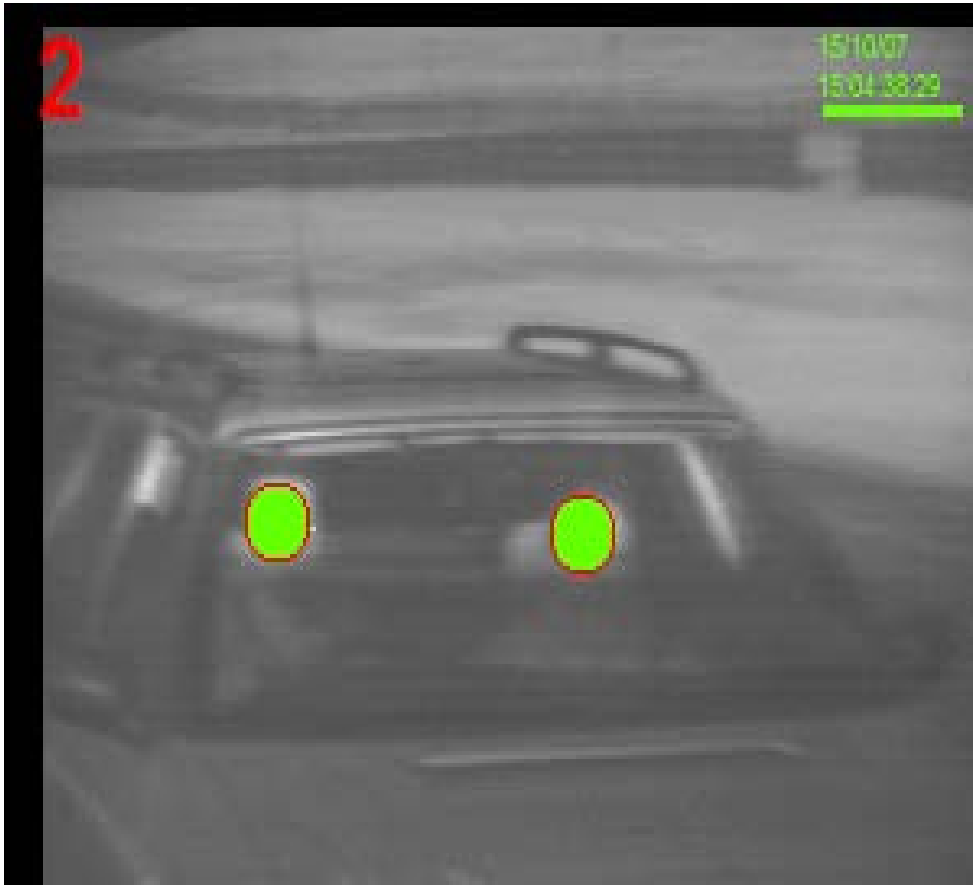
SANDAG

Planned P90 Versus Working Prototype P30



Automated Occupancy Camera at Work



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Summary of Testing:

- 552 controlled test points/runs
- Focus on all possible scenarios
- 48 Semi-Controlled Runs
- Multiple days data available from uncontrolled testing

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Controlled Tests Results

	Including Default Cases		Excluding Default Cases	
Outcome	No.	Percent	No.	Percent
Pass (*dtect* occupancy = known occupancy, including SOV)	77	14 %	18	4 %
Fail – Undercount (*dtect* occupancy less than known occupancy)	466	84 %	466	95 %
Fail – Overcount (*dtect* occupancy more than known occupancy)	3	1 %	3	0 %
Missing (*dtect* image not found)	6	1 %	6	1 %
TOTAL	552	100 %	493	100%

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Controlled Tests Results

- Day time tests better than nighttime (17% versus 10% accuracy)
- SUV and small truck accuracy best (30% and 14%)
- Performance was not particularly speed sensitive
- The higher number of occupants, the lower the performance
- Triggering by toll system scanners 99% performance
- Issues were identified regarding the proper obscuration of occupants' faces for privacy and the correct capture of proper image area.

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Controlled Tests Results

- If the detection of each occupant is treated as an event, accuracy is approximately 20%.

Controlled Tests excluding Dummy	Total events	Pass	Fail	Passing rate (%)
Driver	546	180	366	32.97%
1st row middle	20	4	16	20.00%
Passenger	346	36	310	10.40%
2nd row driver side	208	2	206	0.96%
2nd row middle	54	21	33	38.89%
2nd row passenger side	150	20	130	13.33%
3rd row driver side	10	1	9	10.00%
3rd row middle	40	12	28	30.00%
3rd row passenger side	31	2	29	6.45%
Total	1405	278	1127	19.79%

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Semi and Uncontrolled Tests Results

- Semi Controlled test accuracy (including missing images): 6.25%
- Uncontrolled test sample accuracy: 19%
- Consistent with controlled tests

Major Technical Issues

- Adapting P30 to 12 foot lane expanded field of view was not adequate
- Lack of precise trigger control
- Power density of the infrared lasers needed to be doubled
- Camera exposure reduced to capture higher speed vehicles impacted image quality/timing
- System did not deal well with partial faces
- Detected areas outside of region of interest
- VOL post processing

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Issues that Still Represent Hurdles to Fully Automated Occupancy Camera Implementation

- Full rear seat identification
- Identification of small passengers
- Gantry mounting or other multi-lane solution
- Integration into the toll system, including triggering
- Being “evidence package worthy”
- Privacy issues
- Proving the cost benefit based on production costs

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Next Steps to Move Forward

- Work with existing prototype vendors to encourage further development.
- Share information and ideas within this industry.
- Set-up additional proof of concept tests and pilots perhaps on multi-agency basis.
- Engage the larger toll system integrator market to develop a system module much like toll VES.
- Engage VES manufacturers and defense industries in a development dialogue.

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