

BeCamGreen



**Reduce single occupant vehicle trips by
measuring and enforcing vehicle occupancy**

BeCamGreen Definition

is an innovation activity
to develop an ITS solution.....real time vehicle occupancy detection
based on deep learning and big data,
to help reduce traffic especially with SOVs and
boost new policies on sustainable mobility.

Why is BeCamGreen important?



What: Sensor that measures Vehicle Occupancy and can be used for enforcement action

- Requires zero action by a vehicle occupant

The sensor supports:

- Reducing vehicle congestion without building new capacity
- Encouraging HOV vice SOV
- Helping Demand Management
- Supporting City Access Strategies

Two Pilots: EU and USA



- EU Conducted in 2017
- EIT Digital, the leading European open-innovation and go-to-market organization led the solution
- Indra provided Vehicle Occupancy Detection System to measure and enforce HOV



- Fluxedo and POLIMI
 - Provide Big Data Model to build patterns and Traffic Model

Hyperspectral Camera Results

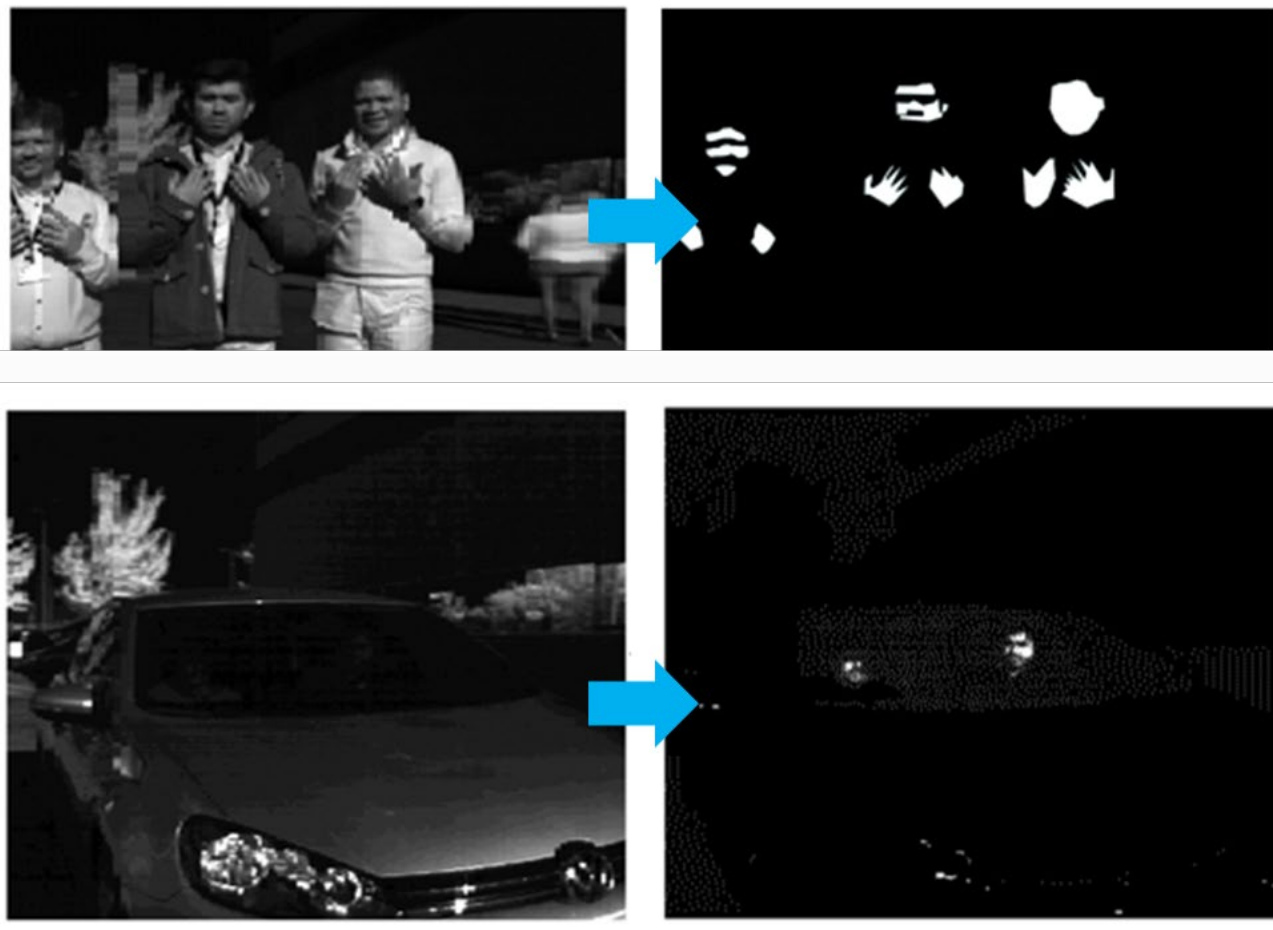
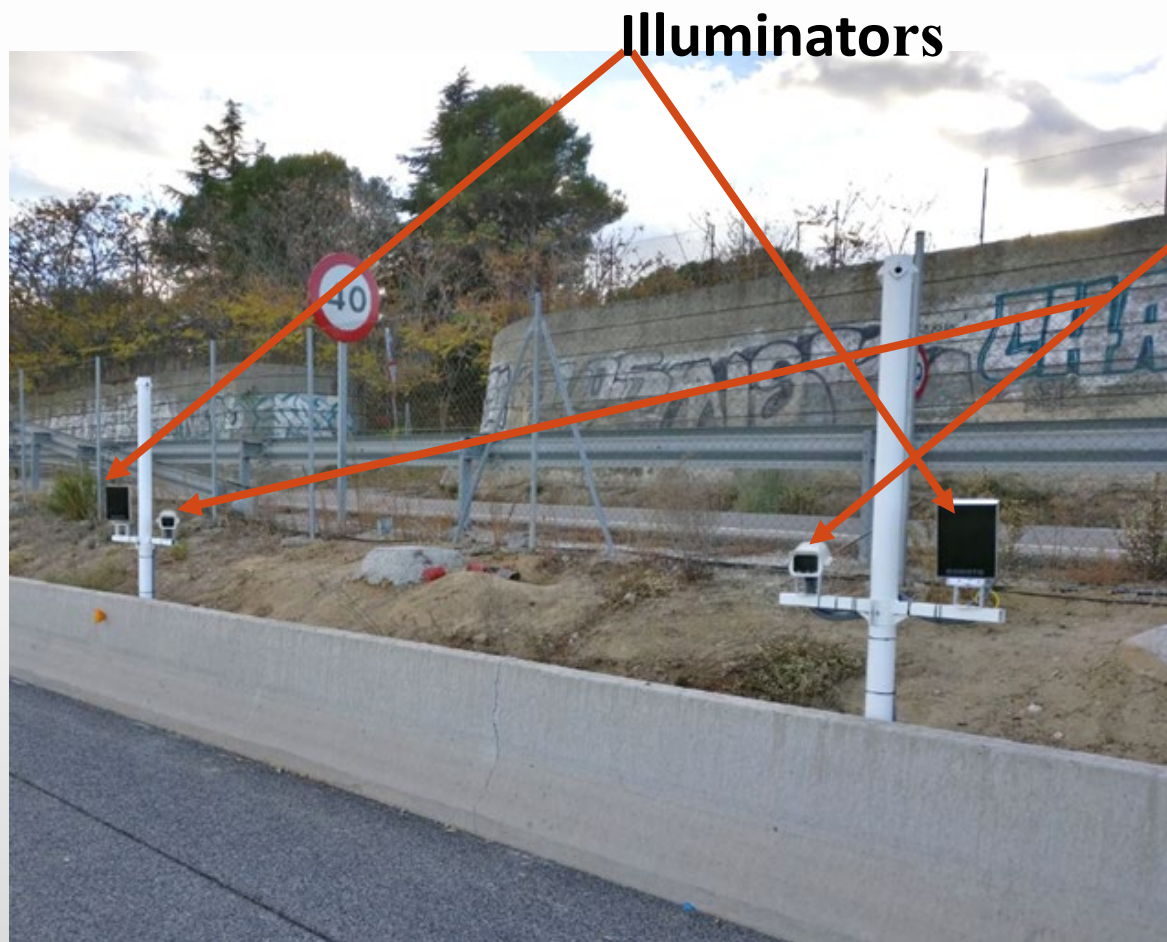


Figure 1. Results of multi-spectral analysis of the skin

- Indra's tests showed the Near IR wavelength band is required to detect human skin
- Skin response to NIR is homogeneous for all humans due to skin's high water content
- Melanin has little to no effect on NIR

Installation on A6 HOV lane near Madrid



Cameras

- Front seat occupant probability of detection is higher than rear seat occupant probability of detection
- False (no occupant) % is higher than False (occupant)

USA Pilot: I-880 Pilot in San Francisco

Pilot Site Location

Freeway: I-880

Location: Between Industrial Parkway and Tennyson Road

Lane: Northbound HOV lane

Occupancy Requirement: 2 or more persons

HOV hours: 5:00-9:00am and 3:00-7:00pm

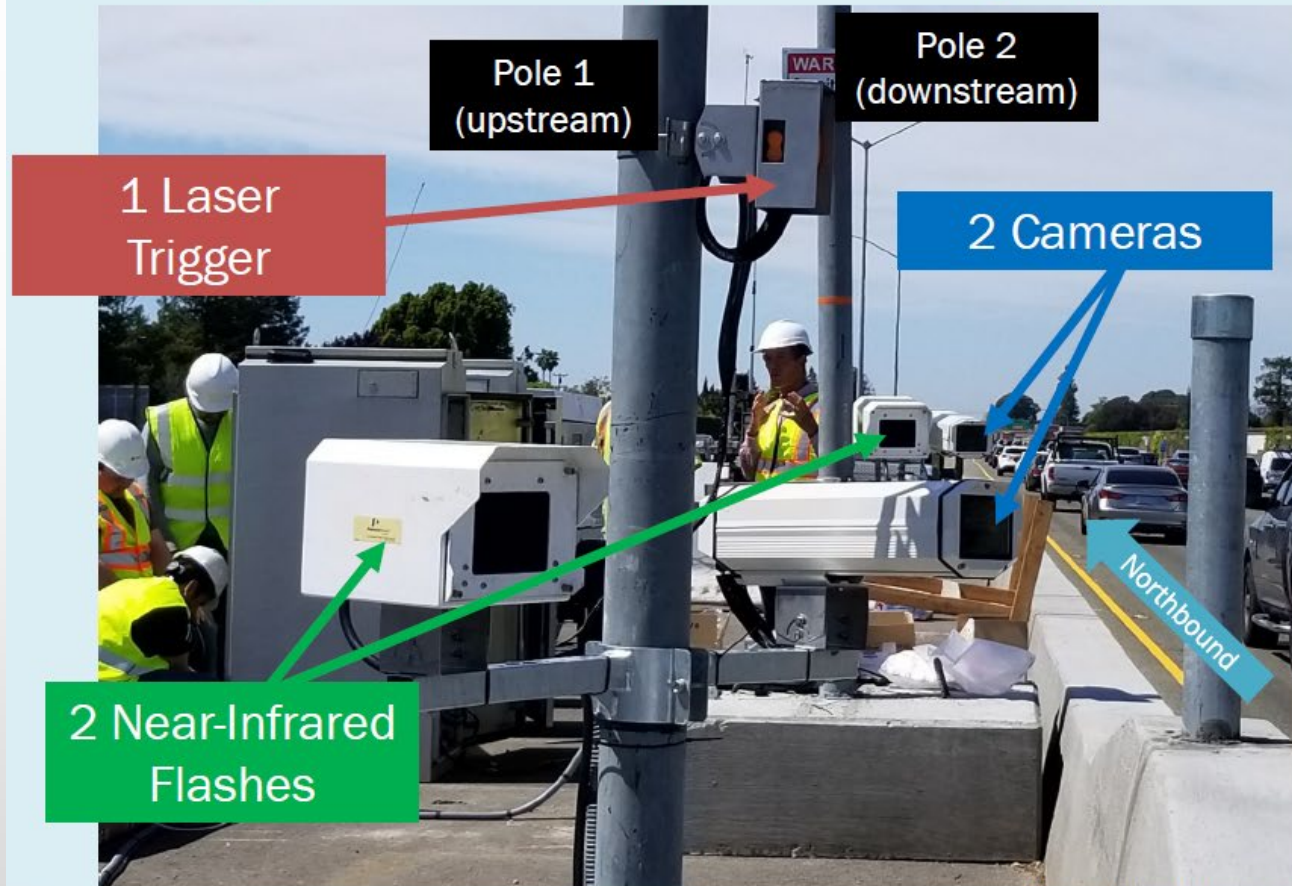


MTC's Slides are from MTC Staff presentation to MTC's Operations Committee on Nov. 9, 2018

<https://mtc.legistar.com/Calendar.aspx> see minutes

Indra Vehicle Occupancy Detection System

Sample VOD System Equipment



System Comparison

System Elements	Conduent	Transcore/NEC	Indra
Number of Cameras	2	1	2
Number of Near-Infrared Flashes	2	2	2
Number of Laser Triggers	1	1	1

Photo: Indra VOD system



METROPOLITAN TRANSPORTATION COMMISSION

Accuracy of actual occupants (1, 2, 3+)

Overall System Accuracy Rate = 78% to 88%

System Accuracy Rate = % True Positives + % True Negatives, where:

- % True Positives = Actual SOV, System Accurately Identified as SOV
- % True Negatives = Actual HOV2 (or HOV3+), System Accurately Identified as HOV2 (or HOV3+)
- % False Positives = Actual HOV2 or HOV3+, but System Inaccurately Identified as SOV
- % False Negatives = All Other Inaccurate Occupancy Determinations

Accurate	System-Declared Occupancy	Actual Occupancy	Range of Results
% True Positives	SOV	SOV	34% to 44%
% True Negatives	HOV	HOV	37% to 48%
Inaccurate	System-Declared Occupancy	Actual Occupancy	Range of Results
% False Positives	SOV	HOV	5% to 6%
% False Negatives	HOV	SOV	7% to 16%

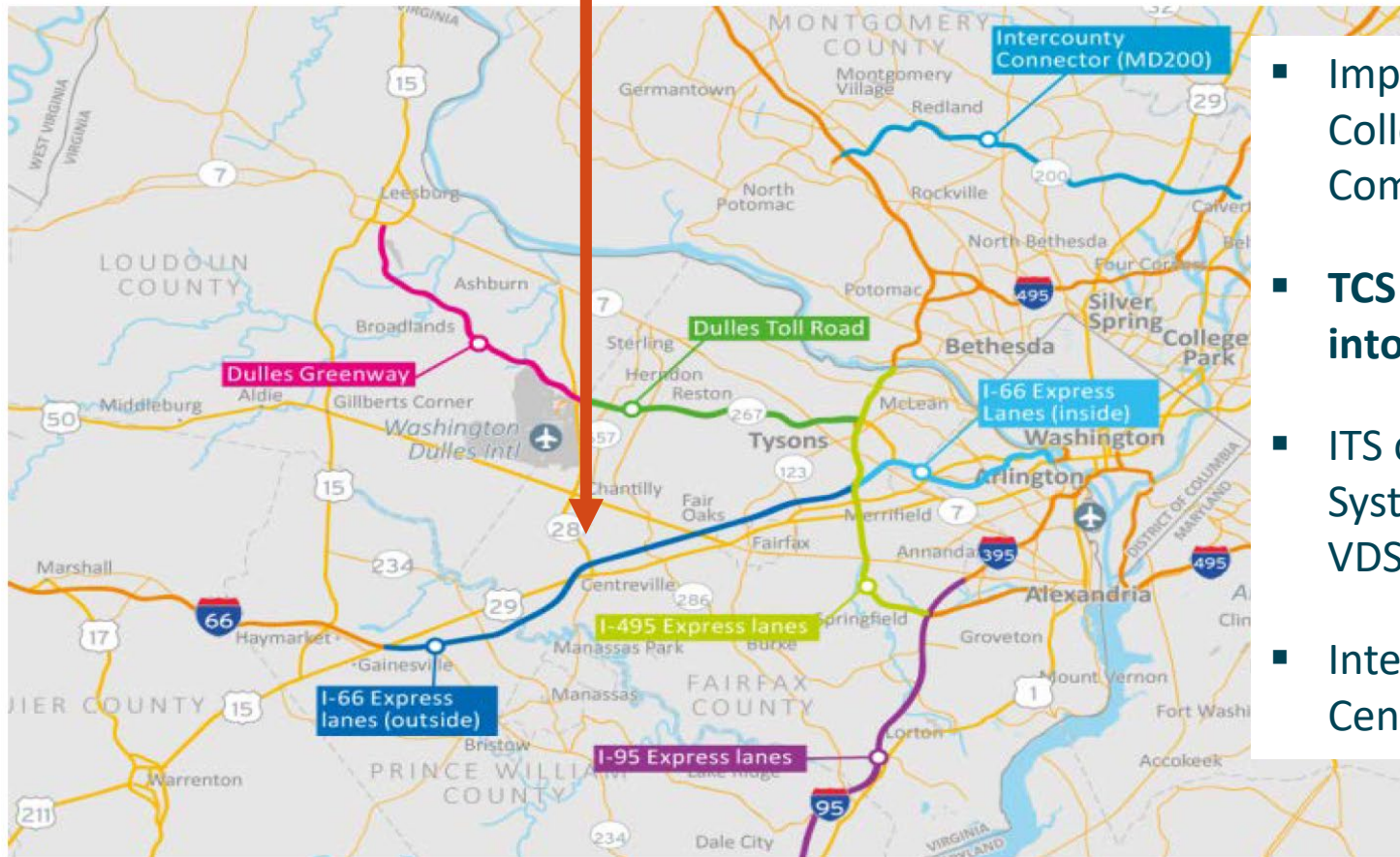
Drivers wrongly
identified as
potential
violators



San Francisco Pilot

- **Indra's Vehicle Occupancy Detection system, which uses artificial vision and deep learning, achieved the highest overall system accuracy rate in tests carried out on an HOV lane on I-880 in the San Francisco Bay Area**
- The Indra solution achieved the highest overall system accuracy rate of 88%.

I-66 Express Lanes (outside)– Virginia



- Implementation of a Road Side Toll Collection System, ITS and Network Communication System.
- TCS integrated with Indra's VOD System into each TCS Point
- ITS consists of a Traffic Management System (Indra's HORUS Product) and CCTV, VDS and Dynamic Message Signs.
- Interface with VDOT's Traffic Management Center

**Occupancy Detection Systems are being deployed.
Which state will be the first to authorize enforcement?**