MTC- Tech Transfer Seminar
ATM Strategies for Arterials
Sept 30, 2015
Oakland, CA

SENSYS
networks

Sensors and Safety Measures for Pedestrians in Crosswalks

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Introduction

SAMS – Safety and Mobility System - Project

- **Data fusion of Intersection detection data (vehicles, pedestrians) and signal event data to provide analytics for intersection mobility and safety**
  - Builds on existing intersection infrastructure
  - Non-intrusive : does not affect controller operations

- **Uses**
  - 24x7 monitoring/data collection
  - Intersection mobility performance measurement
  - Multi-modal / Pedestrian mobility and safety analytics
  - Vehicle safety and conflict analysis

# SAMS

System Configuration
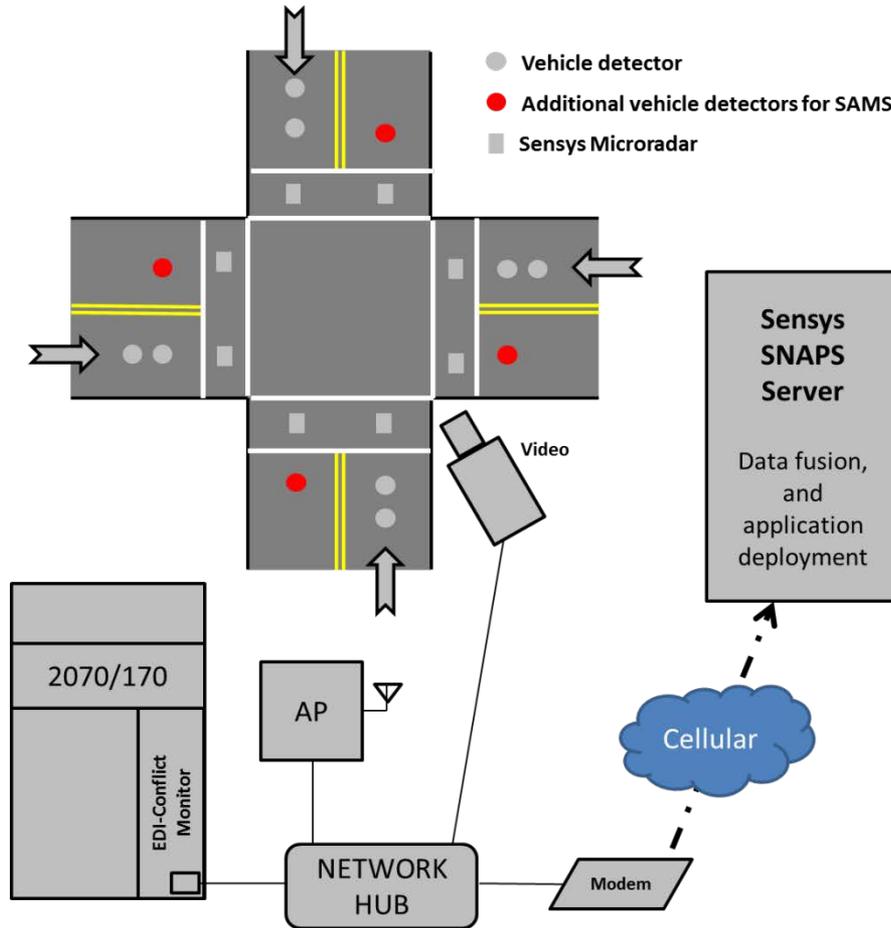
Test site in Danville, CA
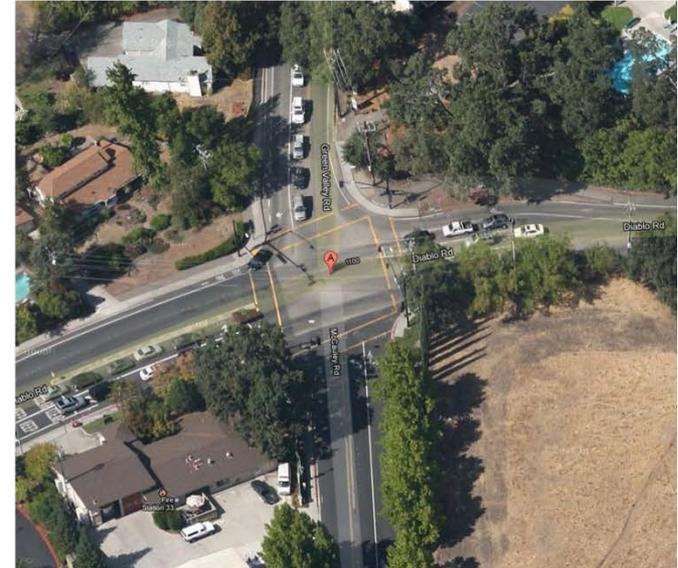
- No controller access required.
- Quick installation/upgrade.

Pedestrian detection

MicroRadar

Sensys MicroRadar : parking/bicycle/pedestrian detection

- In-ground sensor transmit high frequency RF pulses and measure reflections.

- For pedestrians, detection zone covers 2-8 ft.

- Sampling rate of 1 – 8 Hz

- Can detect stationary/moving pedestrians.

Micro C mode – Raw data

Object reflection

Baseline
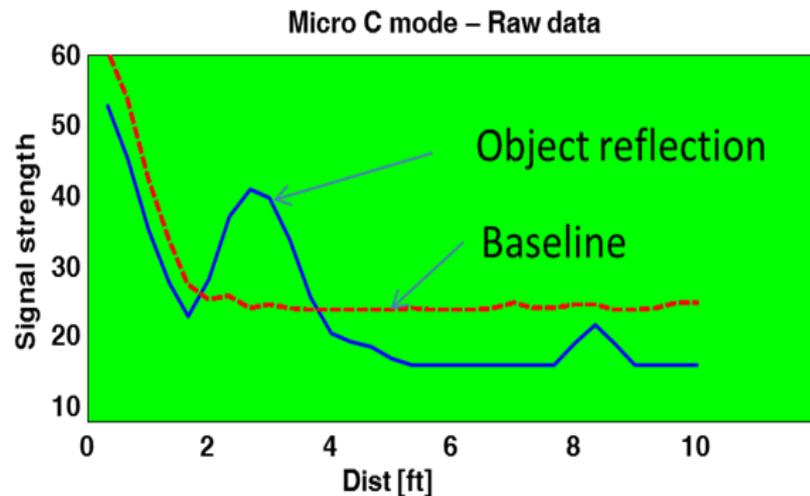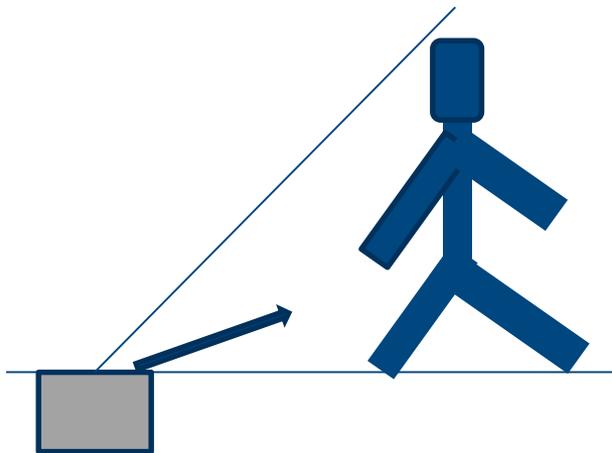
Pedestrian detection

Field setup
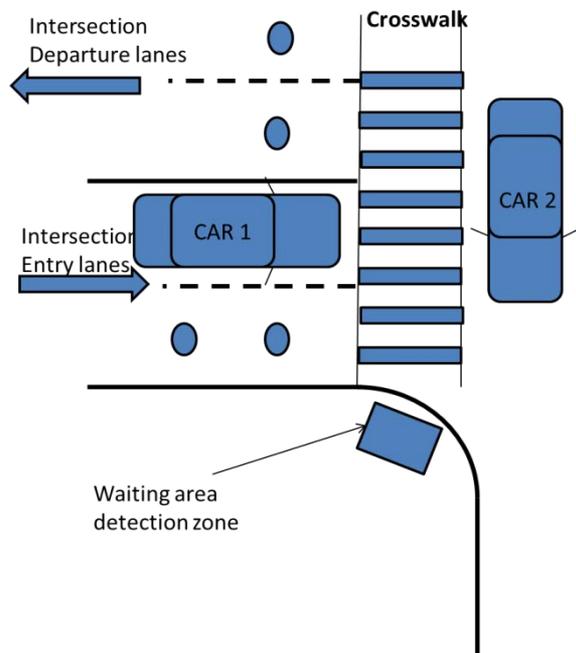
Installation at Diablo/Green Valley

Pedestrian detection

Data processing

- **Generate detection events**
  - Detect event – Time corresponding to object entering zone of detection
  - Undetect event – Time corresponding to object leaving detection zone

- **Data filtering, for sensors inside crosswalk**
  - Bulk data analysis for vehicle/ped differentiation
  - Signal phase information – to segregate active pedestrian signal
  - Data fusion with magnetometers, to flag vehicle detection events

Pedestrian Detection

Demo

Demo - Pedestrian crosswalk active

# Applications - Safety

Pedestrian safety.

- **Indirect safety/exposure statistics**
  - Cycle by cycle pedestrian occupancy, along with conflicting vehicle counts
  - Obtained with limited detection setup

- **Direct safety/exposure statistics**
  - Measure and reliably detect vehicle/pedestrians within the crosswalk
  - Obtained with enhanced coverage of crosswalk

Applications - Safety

Crosswalk occupancy/utilization with limited detection

- Cycle by cycle pedestrian occupancy obtained using data fusion.
- A proxy for pedestrian counts (which are difficult to measure).

Total Occupancy time – 1s
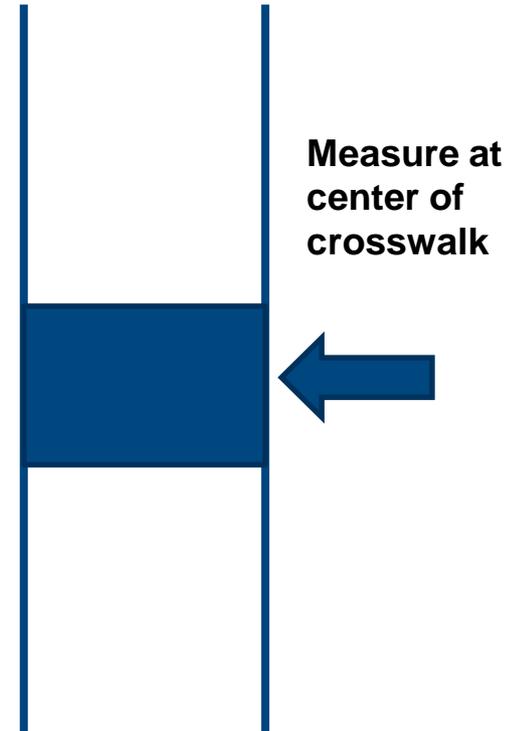
Measure at center of crosswalk

Applications - Safety

Crosswalk occupancy/utilization with limited detection

- Cycle by cycle pedestrian occupancy obtained using data fusion.
- A proxy for pedestrian counts (which are difficult to measure).

Total Occupancy time – 2.2s

Measure at center of crosswalk
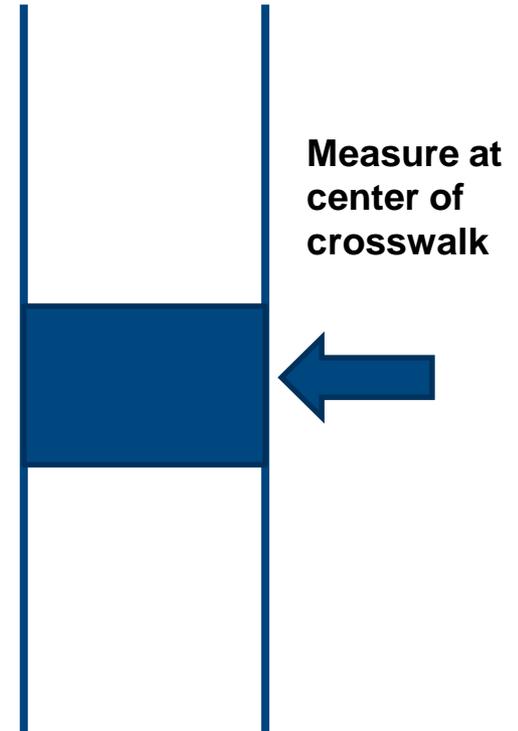
Applications - Safety

Crosswalk occupancy/utilization with limited detection

- Cycle by cycle pedestrian occupancy obtained using data fusion.
- A proxy for pedestrian counts (which are difficult to measure).

Total Occupancy time – 12.8s

Measure at center of crosswalk

Crosswalk occupancy/utilization with limited detection

$$Crosswalk\ utilization\ ratio = \frac{Total\ Pedestrian\ occupancy}{Total\ Ped\ Walk + FDW}$$
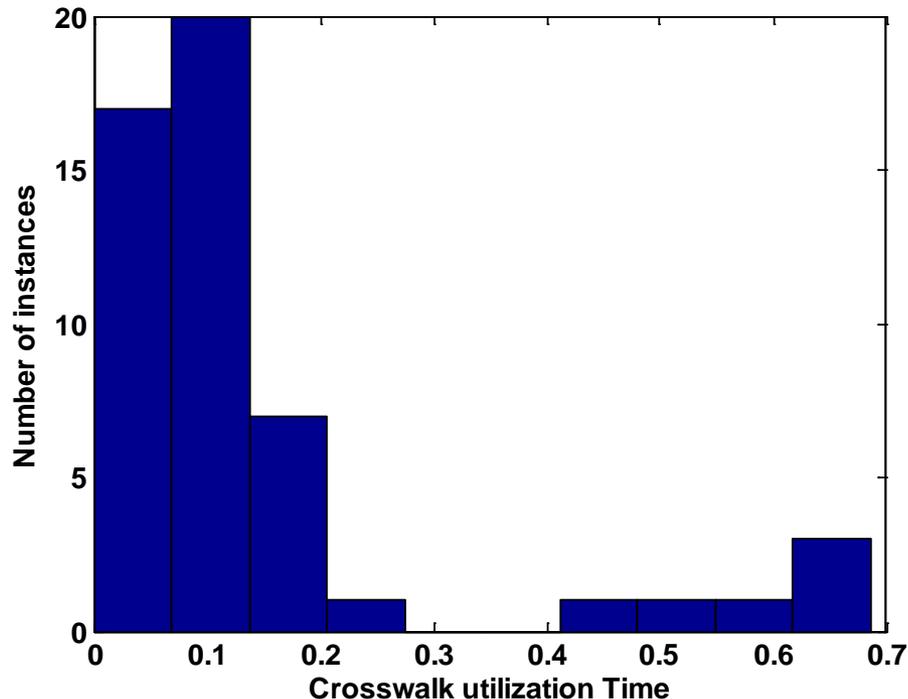
- **Uses**
  - Dynamic Right turn on red signs.
    - Determine portions of day when pedestrian crosswalk usage is heavy, and dynamically not allow right turns on red.
  - Determine Time of day pedestrian signal actuation schedule.

Applications - Safety

Vehicle obstruction of pedestrian signals – Cycle by cycle measures..

- Compare proportion of time a car, pedestrian occupies the far side of the crosswalk. (Measure of conflicts).
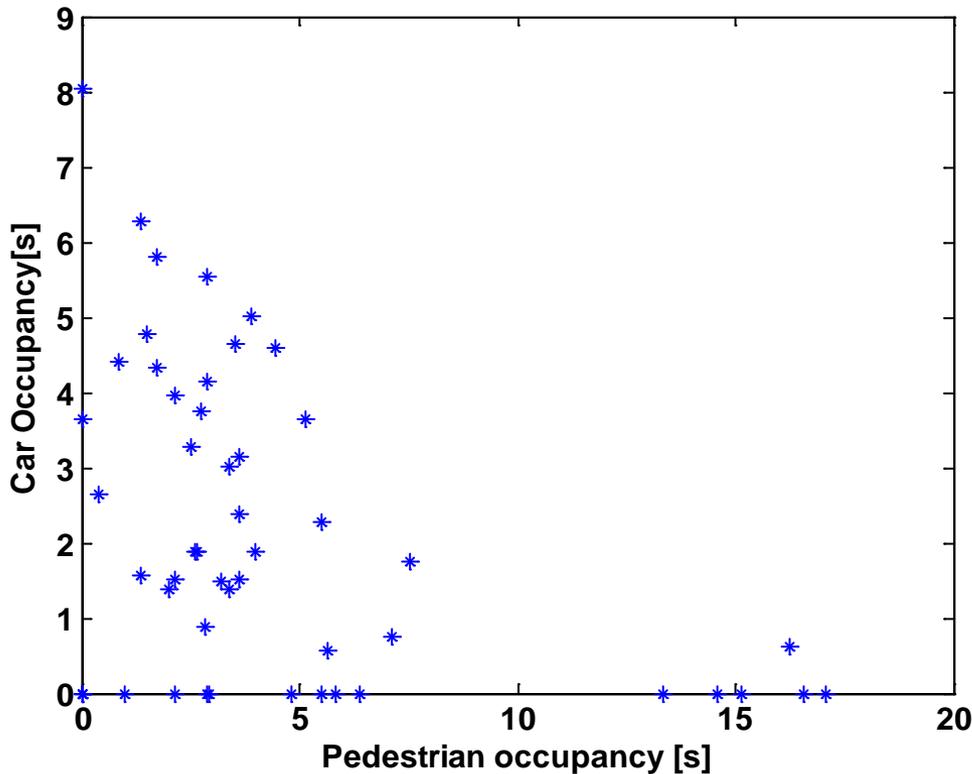
Applications - Safety

Intersection safety characterization – Measuring rare events

- **Red Light Violations.**
  - Detect Red light violators, year round statistics.
  - Vehicle speeds for right turn on red.

- **Yellow light behavior.**
  - Determine statistics of vehicles crossing during yellow.

- **Permissive left turns.**
  - Compute headways gaps, and speeds in opposing through lanes.

- **Intersection safety analysis.**
  - Detect, capture conflicts.

Applications - Safety

Red light violations

Violator rate. All weekdays by Time of day

Legend: Total (6 months) - 666

Y-axis: Rate per 15 min.
X-axis: Time of Day [hr]
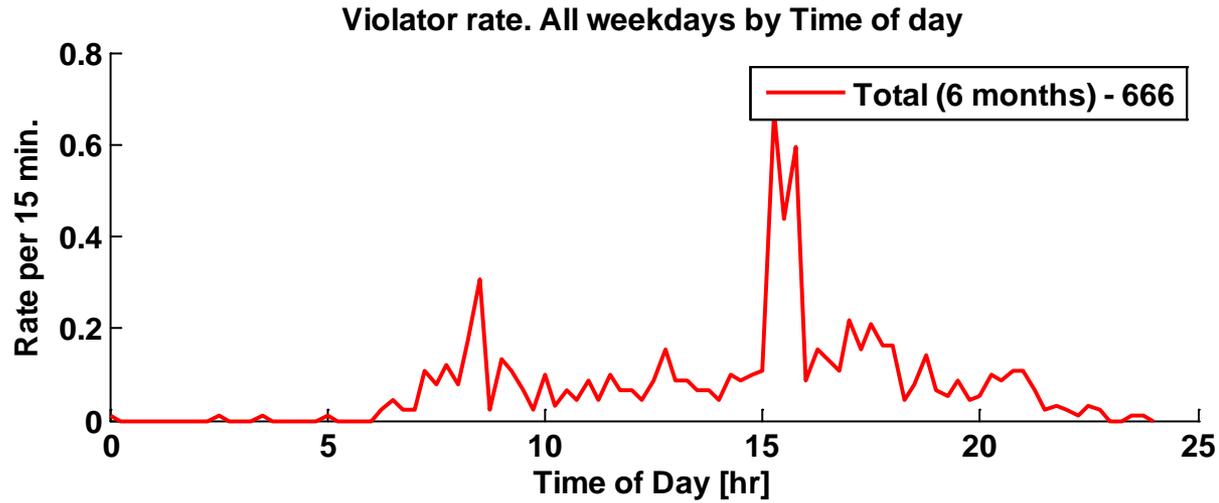
SB – Through/Left turn shared lane

Total violations by weekday over 6 months by Time of day

Legend: Mon, Tue, Wed, Thu, Fri

Y-axis: Violations per 15 min.
X-axis: Time of Day [hr]
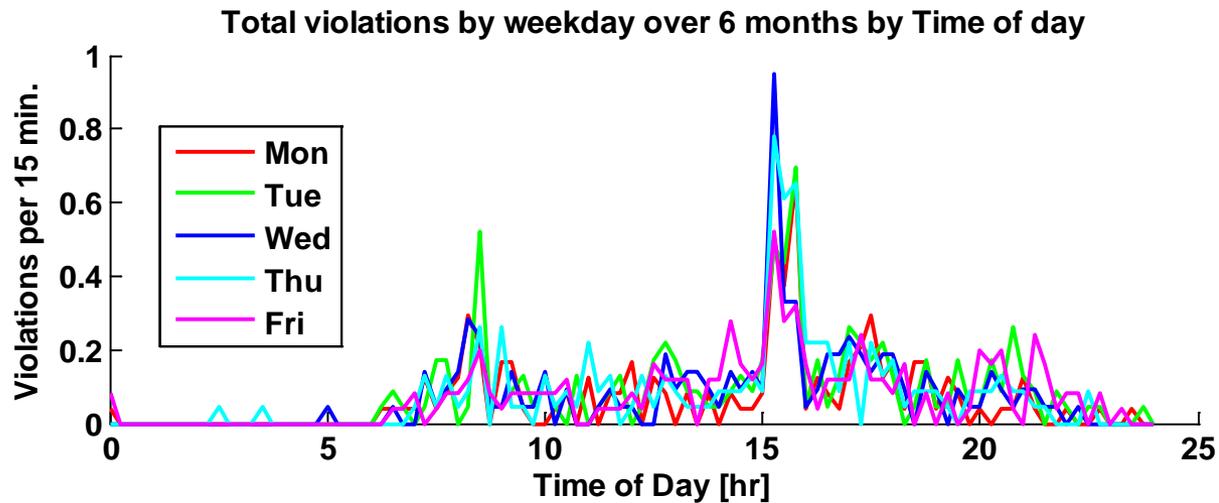
Safety-Critical Dynamics in Multi-Modal Transportation Systems

Ongoing research by SafeTREC, UC Berkeley

- Evaluating multi-modal safety at signalized intersections using surrogate measures of traffic safety

- Emphasis on routine monitoring over long periods of time so as to develop and validate theories with statistical significance

- A report card of multi-modal safety-critical dynamics:
  - Layer 1: Volume counts/mode shares
  - Layer 2: Mode-specific safety-critical dynamics (red-light running, jaywalking)
  - Layer 3: Multi-modal safety-critical dynamics (cars yielding to pedestrians)

Summary

Intersection Safety and Mobility System
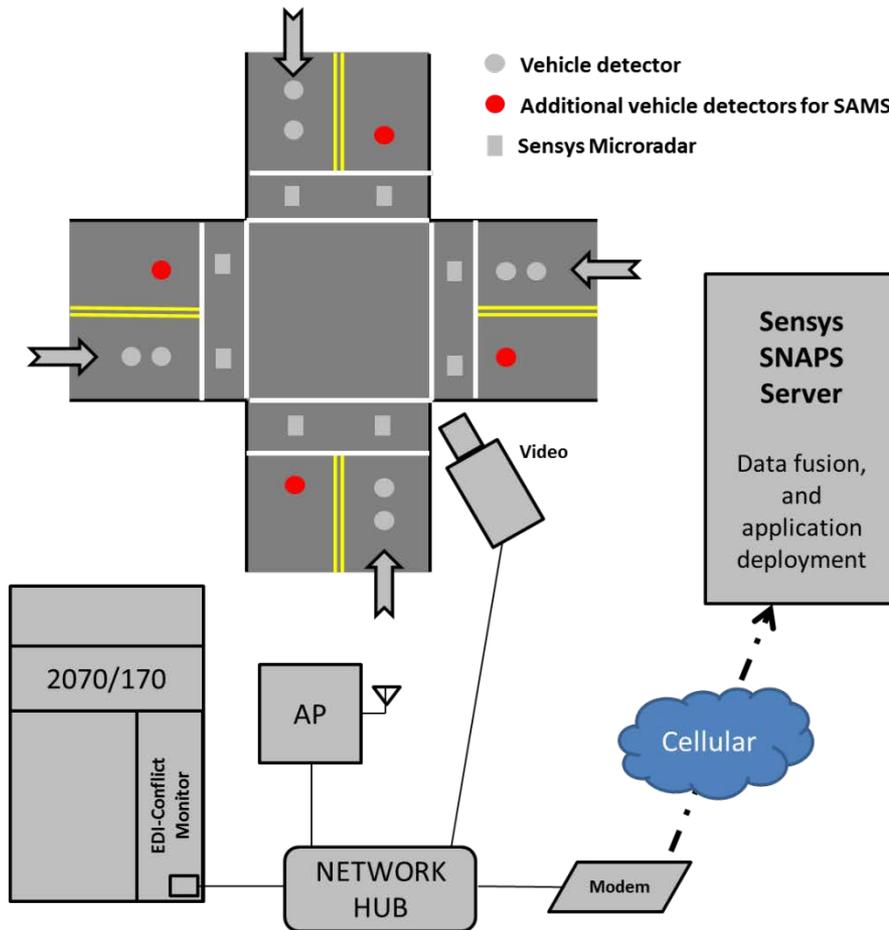
- Reliable detection of pedestrians and vehicles
- Independent of controller
- 24x7 Safety Measures
  - Cross-walk Utilization
  - Vehicle-Pedestrian Occupancy
  - Red Light Violations
- 24x7 Mobility Measures
  - Turn Movement Counts
  - V/C Ratios
  - Signal Coordination

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Questions?

Demo - Pedestrian crosswalk active

15 25 46

Demo - Pedestrian crosswalk active

15 25 47

Demo - Pedestrian crosswalk active

15 25 48

Demo - Pedestrian crosswalk active

15 25 49

Demo - Pedestrian crosswalk active

15 25 50

Demo - Pedestrian crosswalk active

15 25 51

Demo - Pedestrian crosswalk active

15 25 52

Demo - Pedestrian crosswalk active

15 25 53

Demo - Pedestrian crosswalk active

15 25 54

Demo - Pedestrian crosswalk active

15 25 55

Demo - Pedestrian crosswalk active

15 25 56
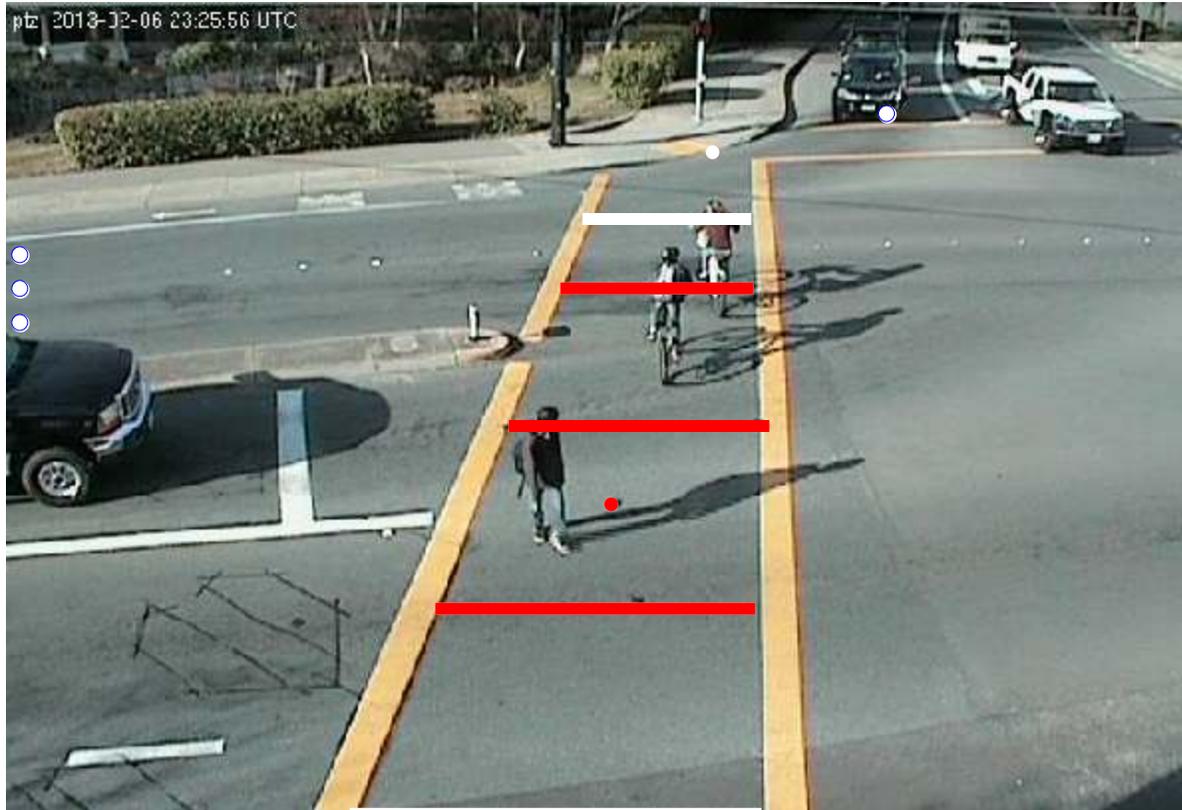
Demo - Pedestrian crosswalk active

15 25 57

Demo - Pedestrian crosswalk active

15 25 58

Demo - Pedestrian crosswalk active

15 25 59

Demo - Pedestrian crosswalk active

15 26 00

Demo - Pedestrian crosswalk active

15 26 01

Demo - Pedestrian crosswalk active

15 26 02

Demo - Pedestrian crosswalk active

15 26 03

Demo - Pedestrian crosswalk active

15 26 04

Demo - Pedestrian crosswalk active

15 26 05

Demo - Pedestrian crosswalk active

15 26 06