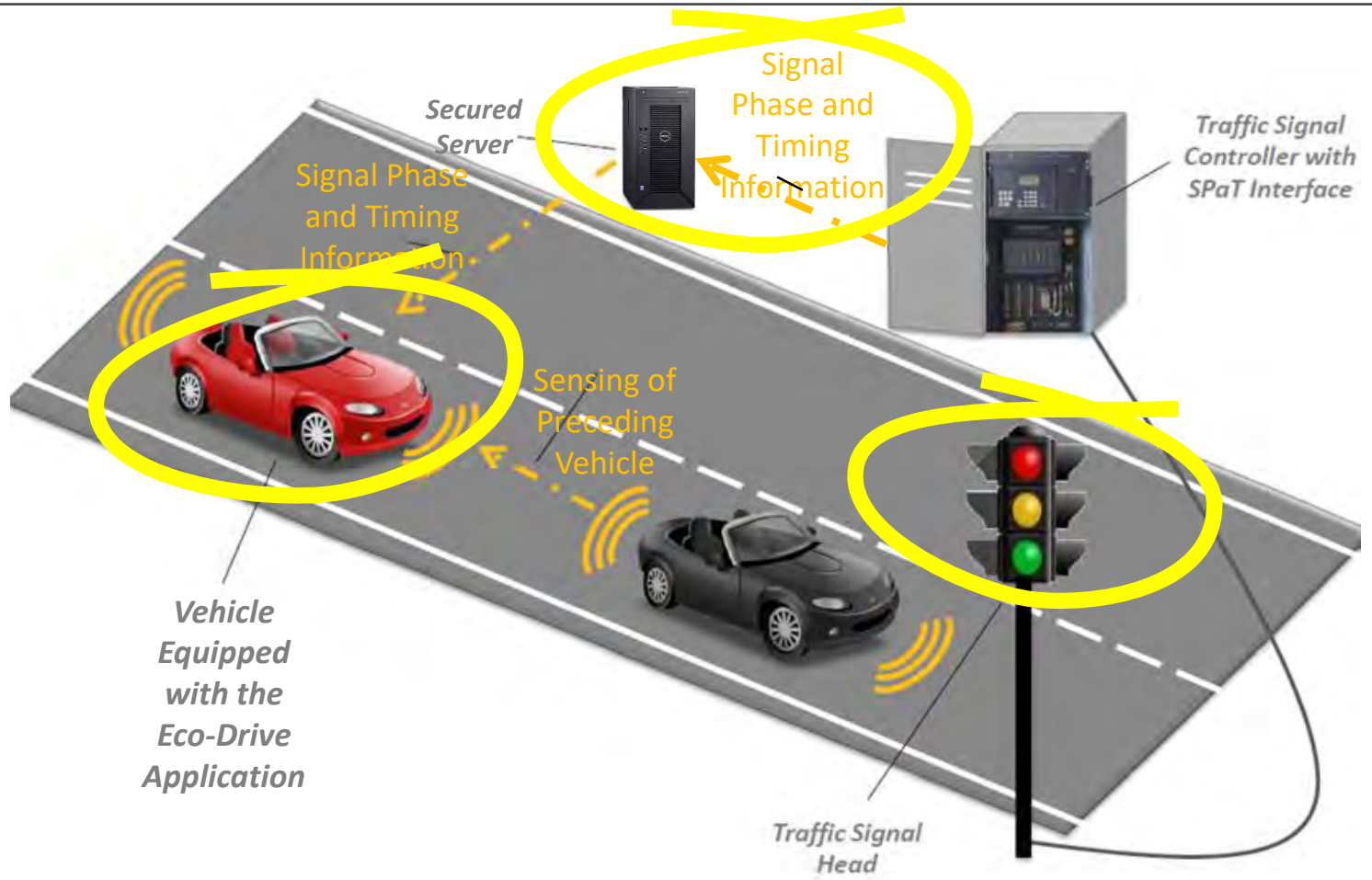
Understanding Connected Eco-Driving System for Class 8 Trucks:

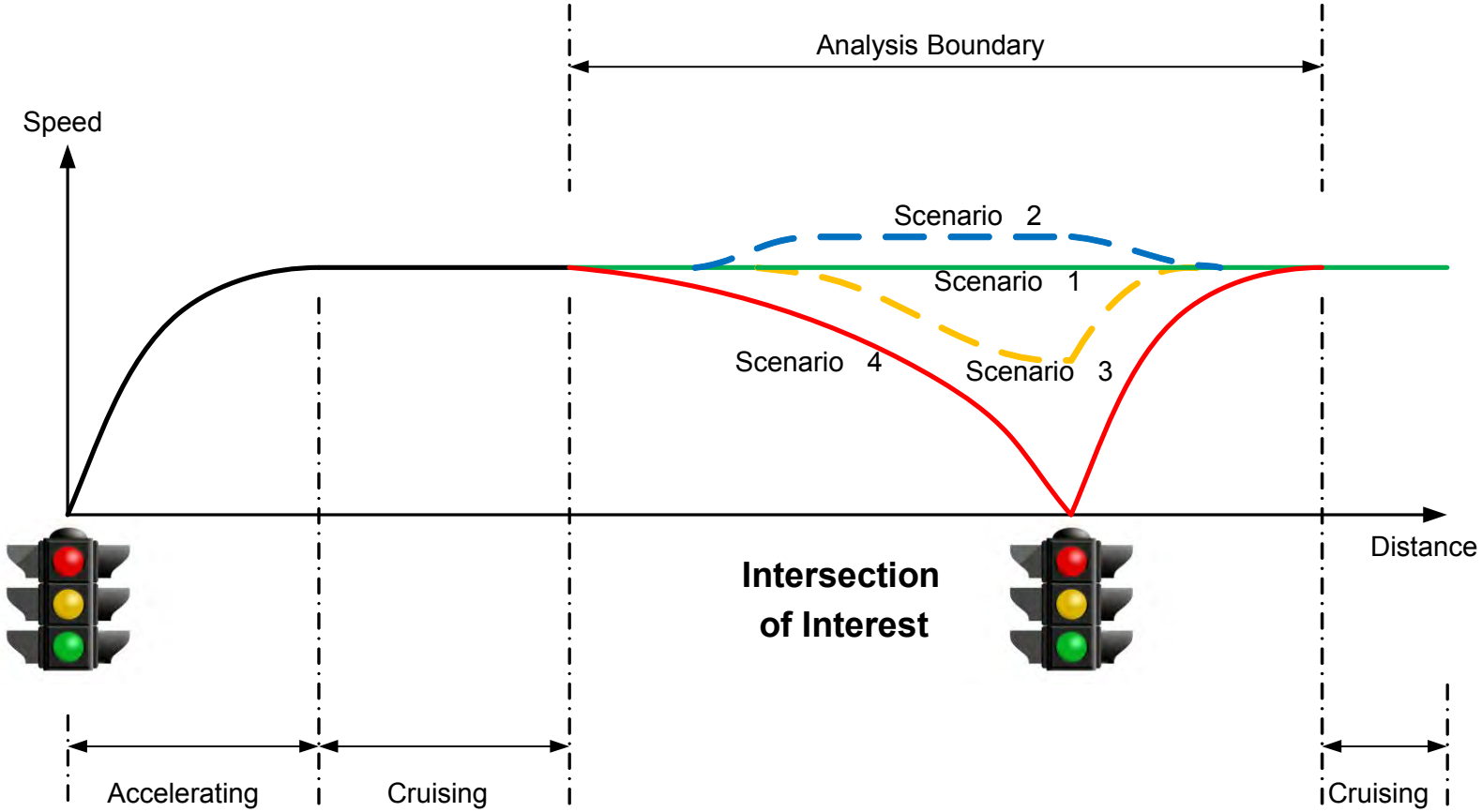
Lessons Learned from Real-World Implementation and Evaluation

Inefficiencies at Intersections

Connected Eco-Driving at Signalized Intersections



Connected Eco-Driving Scenarios

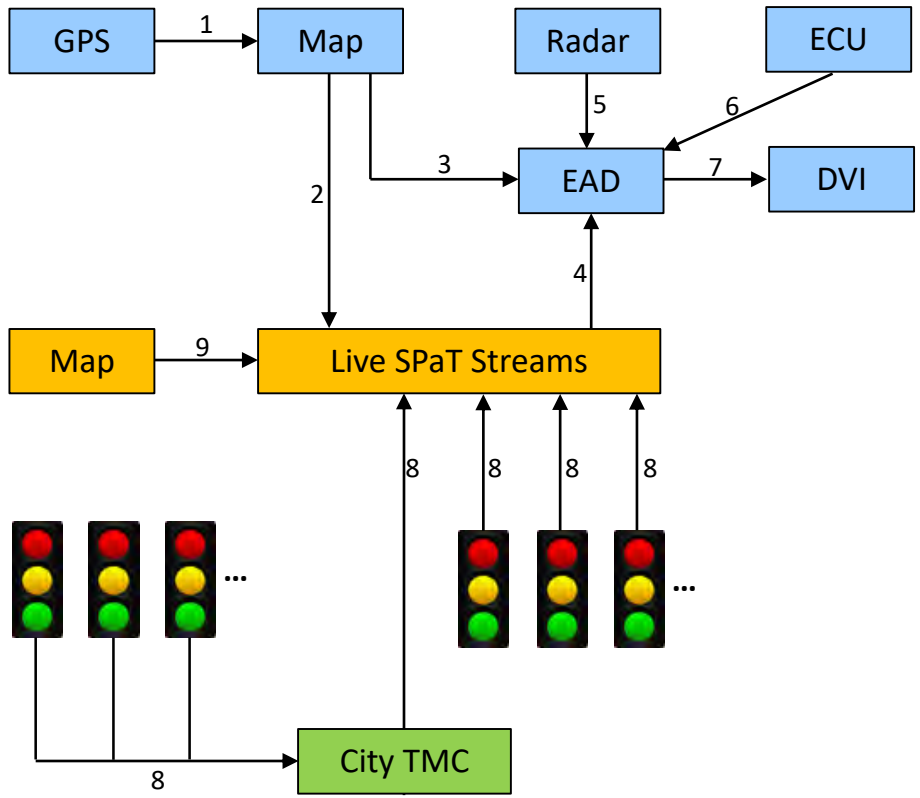


System Architecture: On-Board Application

Connected Vehicle

TSIS Server

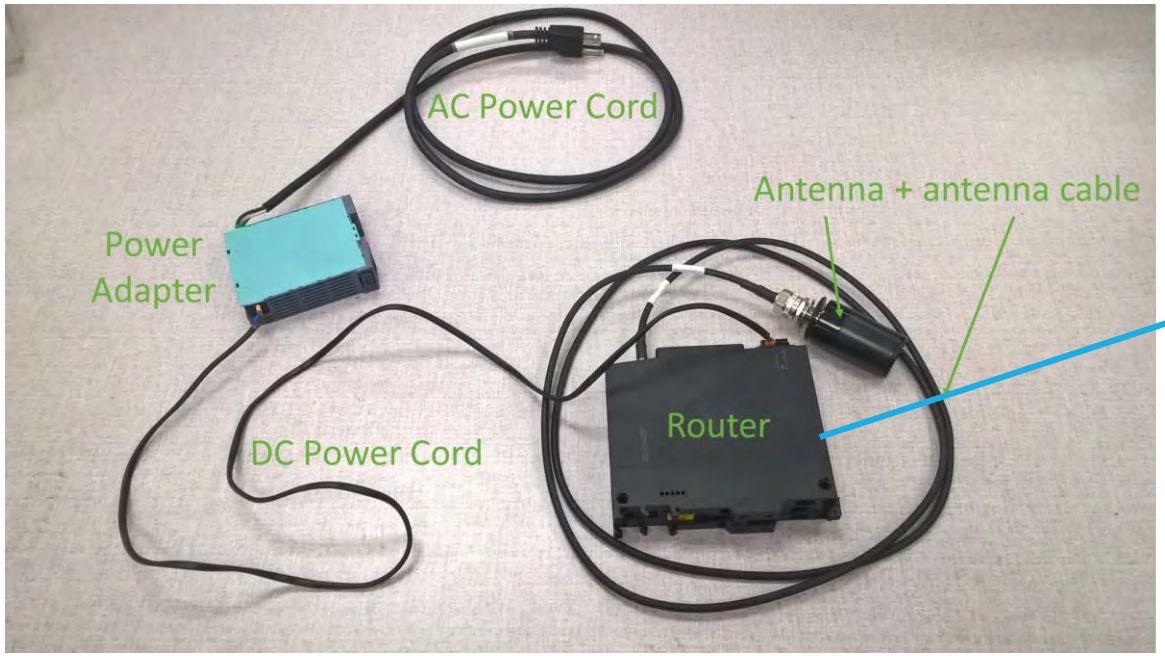
Connected Intersections



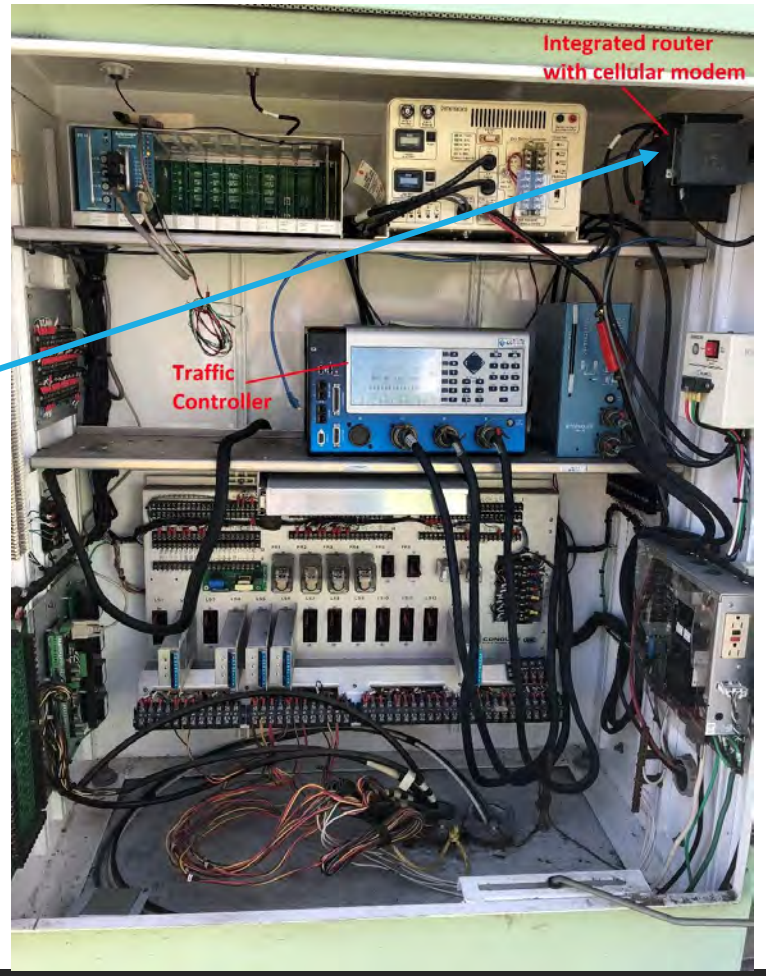
Component	Description
GPS	For identifying truck position
Map	Digital map
Radar	For detecting preceding vehicle
ECU	For reporting engine parameters
EAD	Trajectory planning algorithm
DVI	Driver-vehicle interface on 7-in display
Map	Digital map of Southern California
Live SPaT Streams	Real-time SPaT from connected intersections
City TMC	Traffic management center

ID	Data Elements	Update Frequency (Hz)
1	Latitude, longitude, & heading	1
2	Upcoming intersection & direction	1
3	Distance to intersection	1
	Roadway speed limit	1
4	Upcoming SPaT	1
5	Preceding vehicle detection signal	10
6	Vehicle speed (ECU)	10
7	Upcoming SPaT	1
	Roadway speed limit	1
	Recommended driving speed	10
8	Real-time SPaT	1
9	Upcoming intersection & direction	1

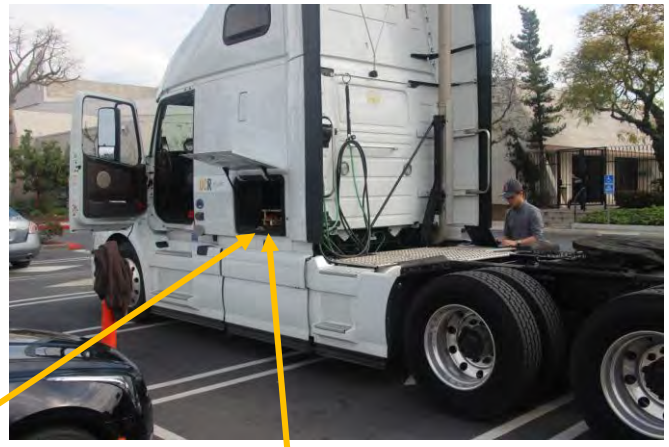
Connected Intersection

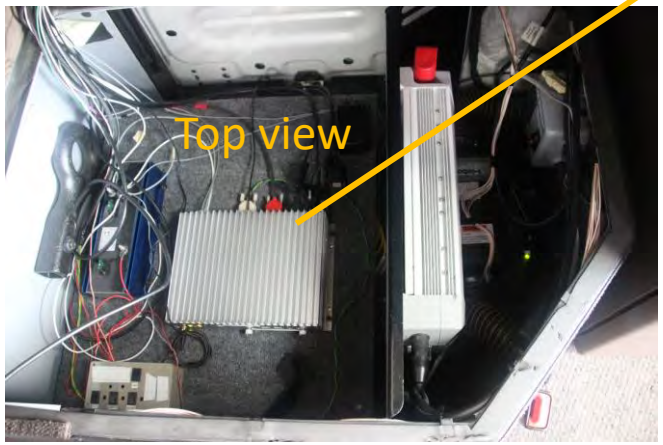


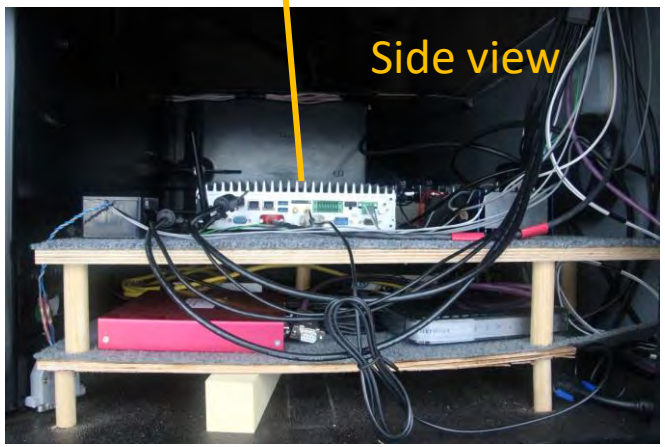
Connected to 4G-LTE cellular network



Connected Vehicle





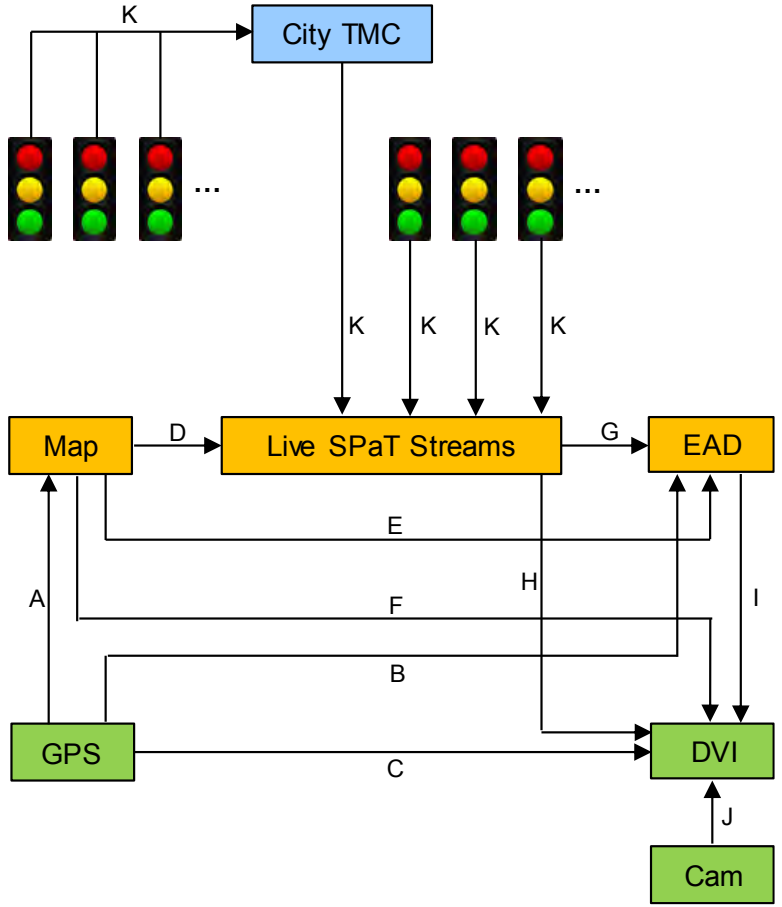


System Architecture: Mobile Application

Connected Corridor

TSIS Server

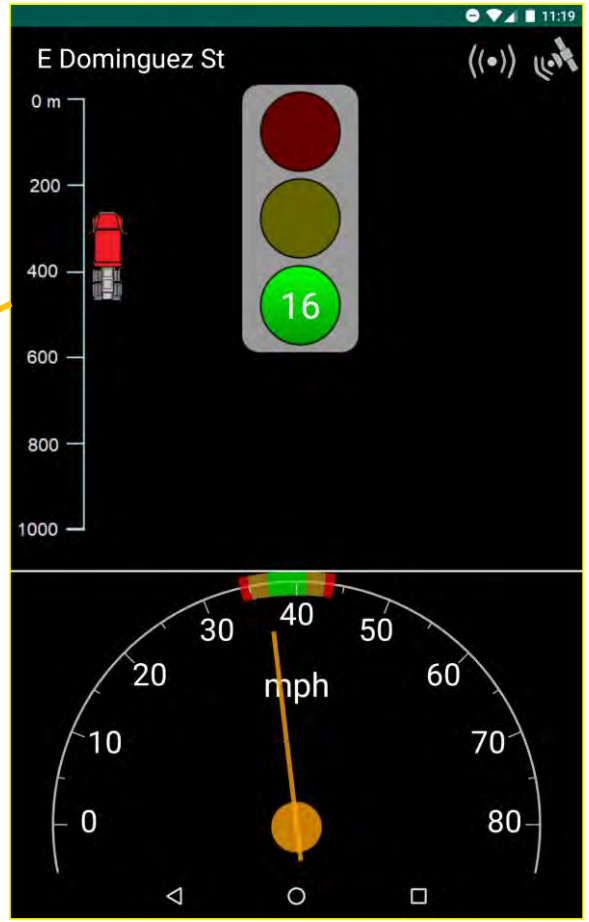
Connected Truck

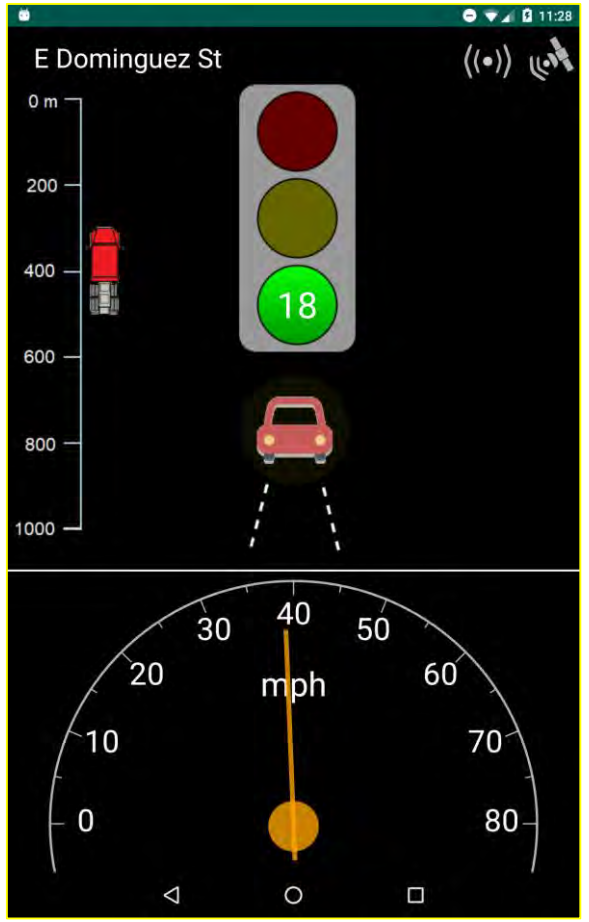


Component	Description
City TMC	Traffic management center
Map	Digital map of Southern California
Live SPaT Streams	Real-time SPaT from connected intersections
EAD	Eco-Approach and Departure algorithm
GPS	GPS for identifying truck position
Cam	Camera for detecting preceding vehicle
DVI	Driver-vehicle interface on tablet

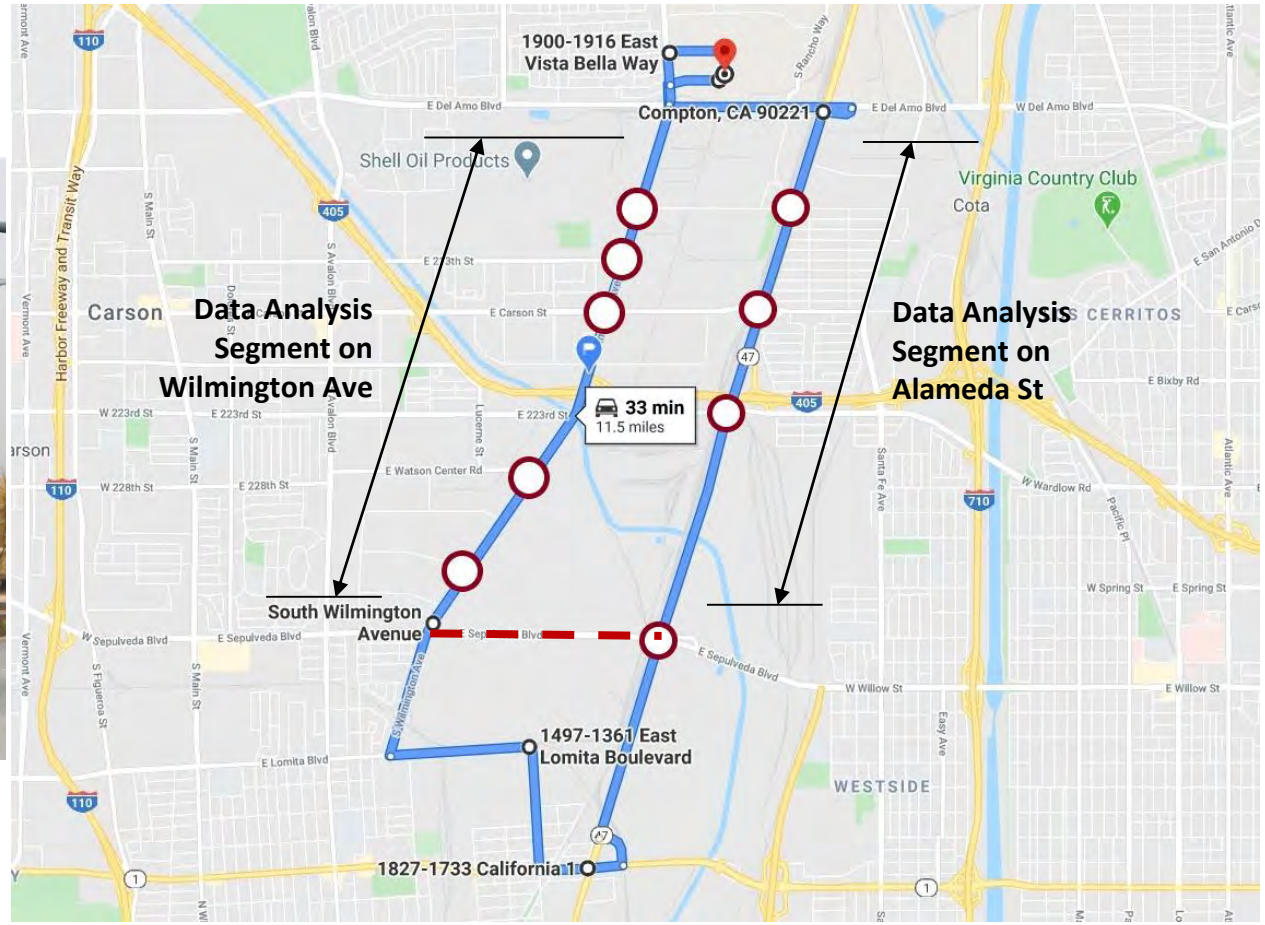
ID	Data Elements	Update Frequency (Hz)
A	Latitude, longitude, & heading	1
B	Veicle speed (GPS)	1
C	Veicle speed (GPS)	10
D	Upcoming intersection & direction	1
E	Distance to intersection	1
	Roadway speed limit	1
F	Distance to intersection	1
	Roadway speed limit	1
G	Upcoming SPaT	1
H	Upcoming SPaT	1
I	Recommended driving speed	10
J	Preceding vehicle detection signal	10
K	Real-time SPaT	1

Eco-Drive Mobile Application

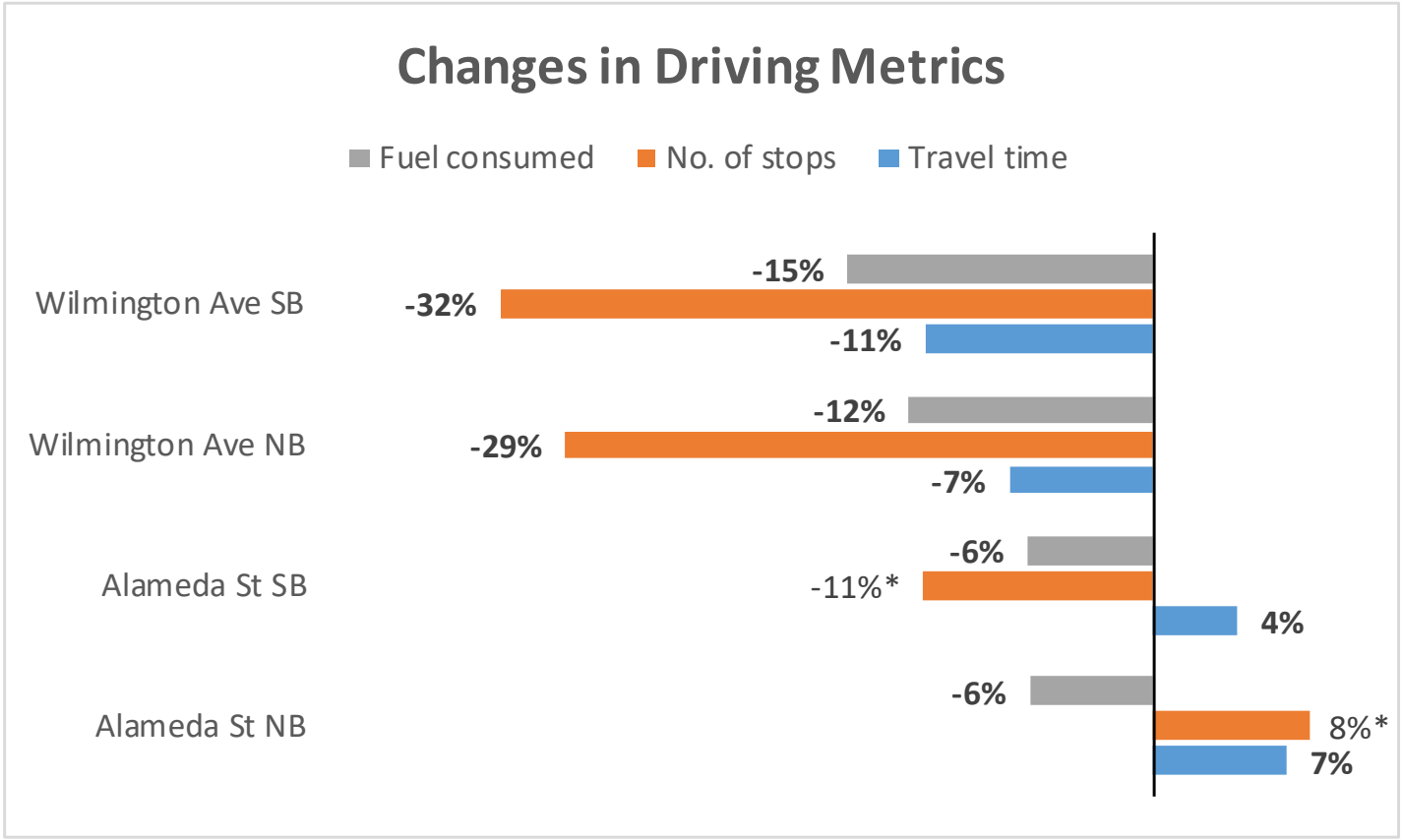




Field Experiment



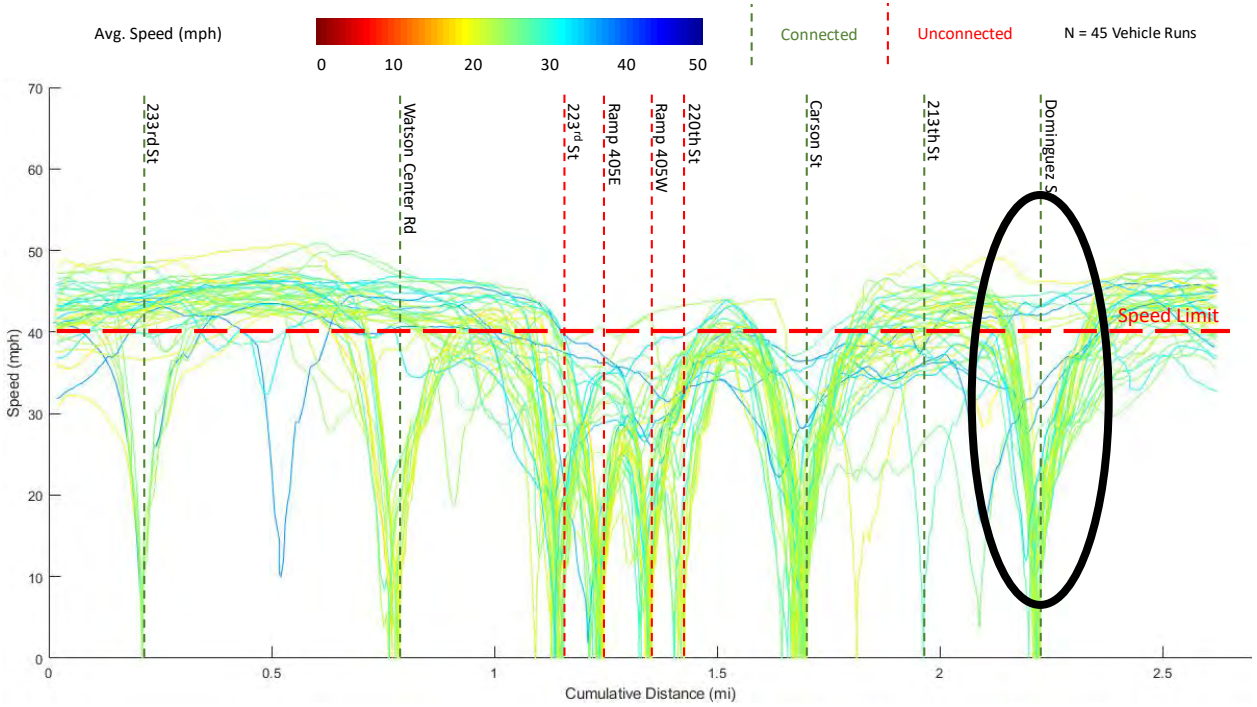
Results: Eco-Drive vs. Baseline



*All changes are statistically significant at 5% significance level, except those with *.*

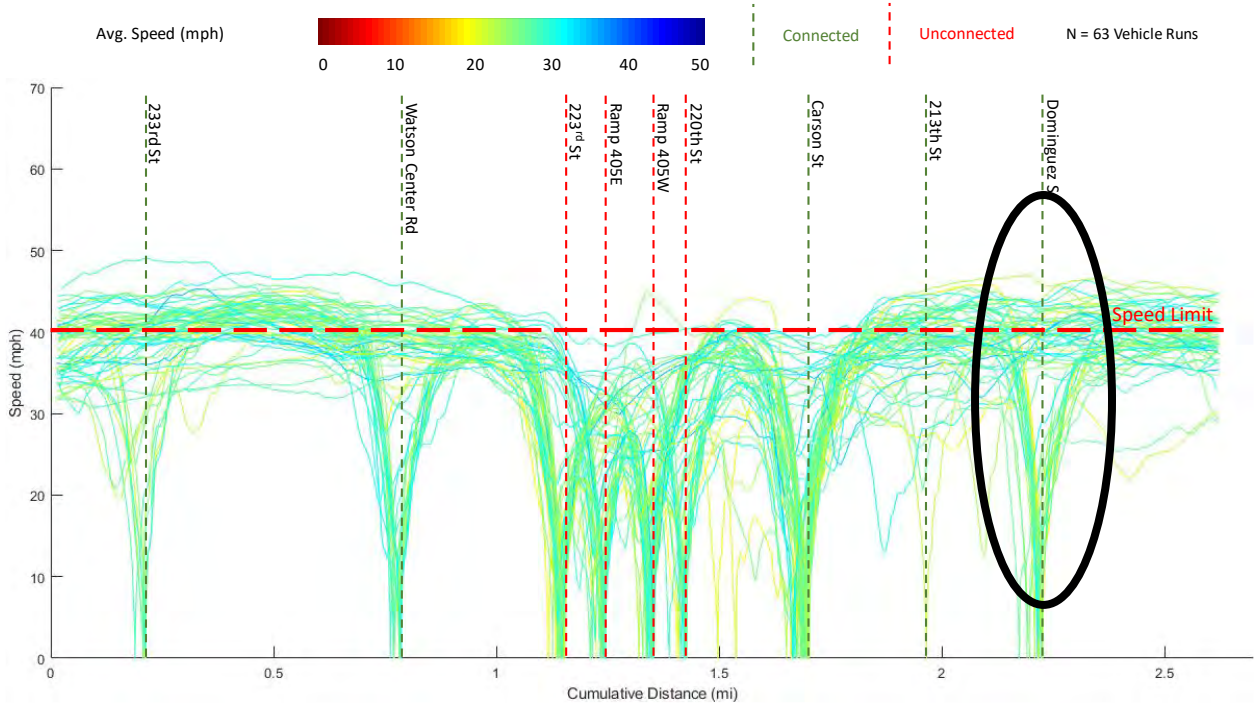
Wilmington Ave Northbound

Baseline



Travel direction

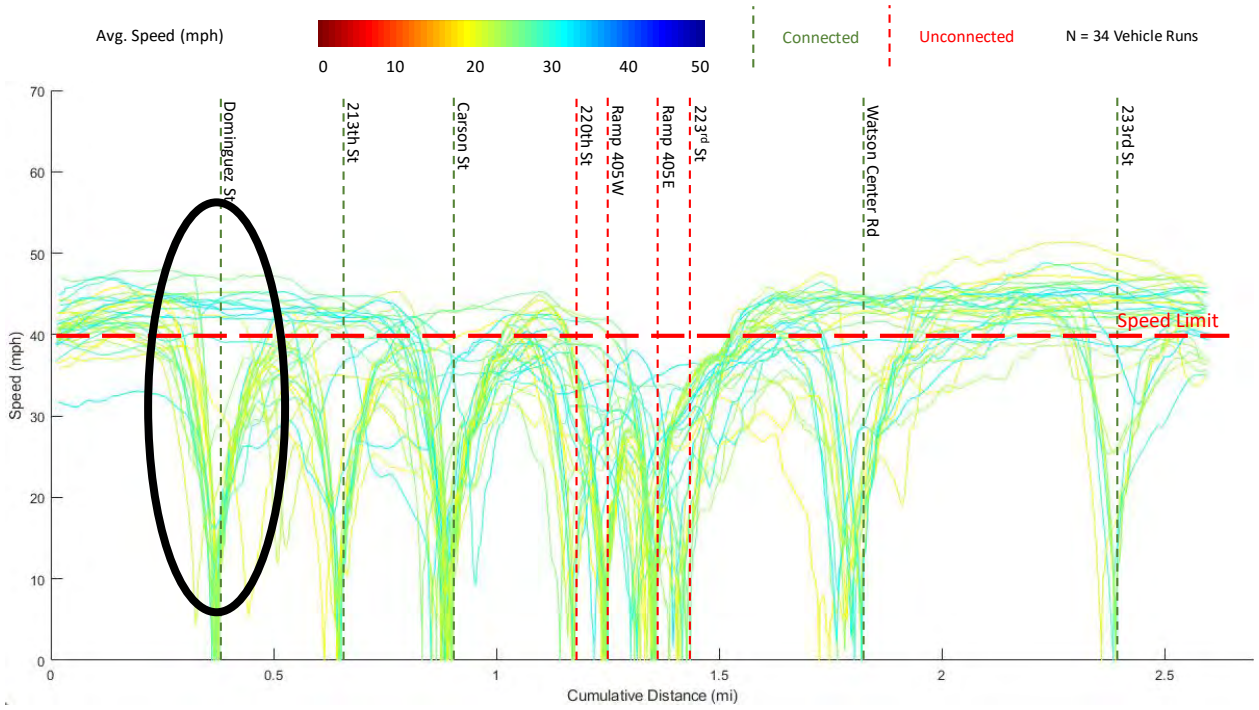
Eco-Drive



Travel direction

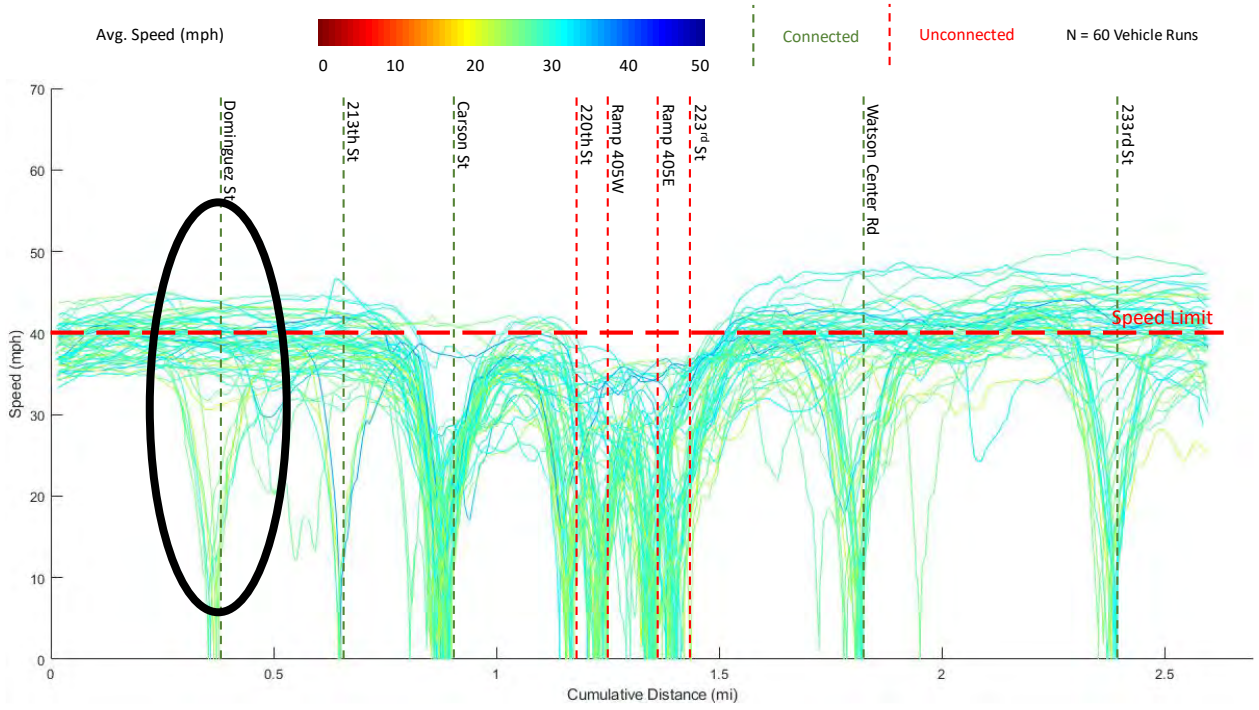
Wilmington Ave Southbound

Baseline



Travel direction

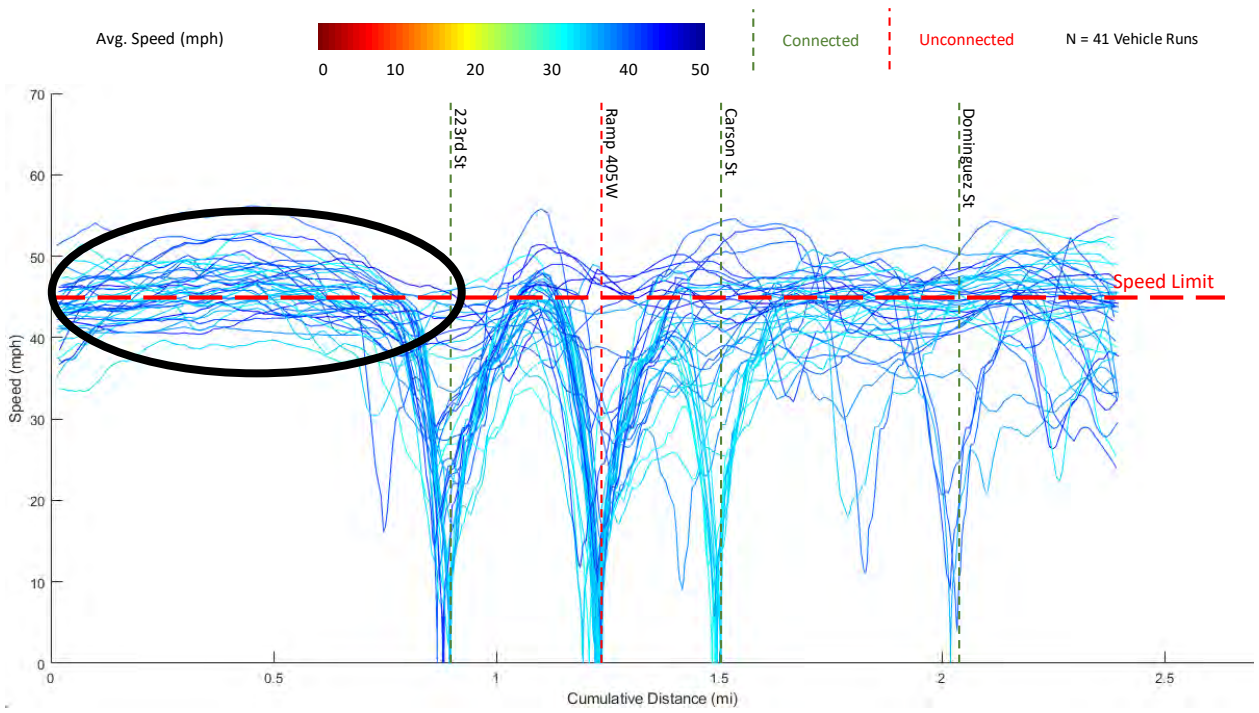
Eco-Drive



Travel direction

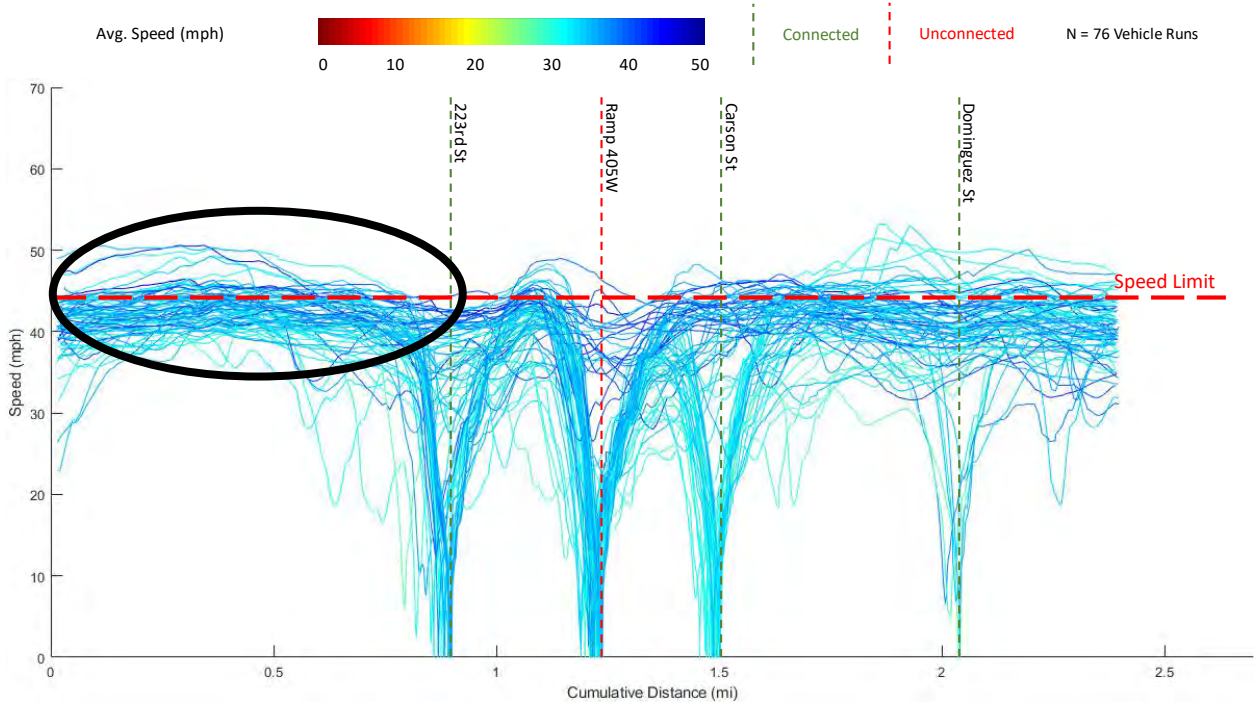
Alameda St Northbound

Baseline



Travel direction

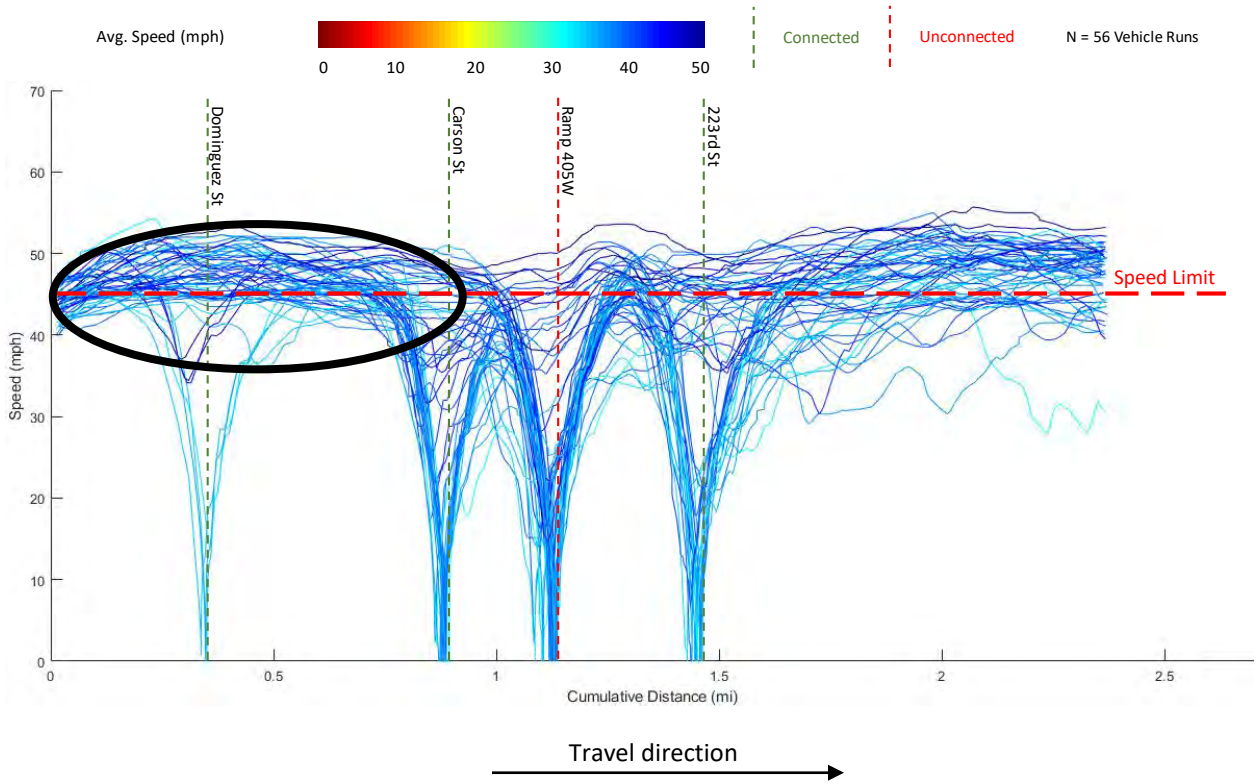
Eco-Drive



Travel direction

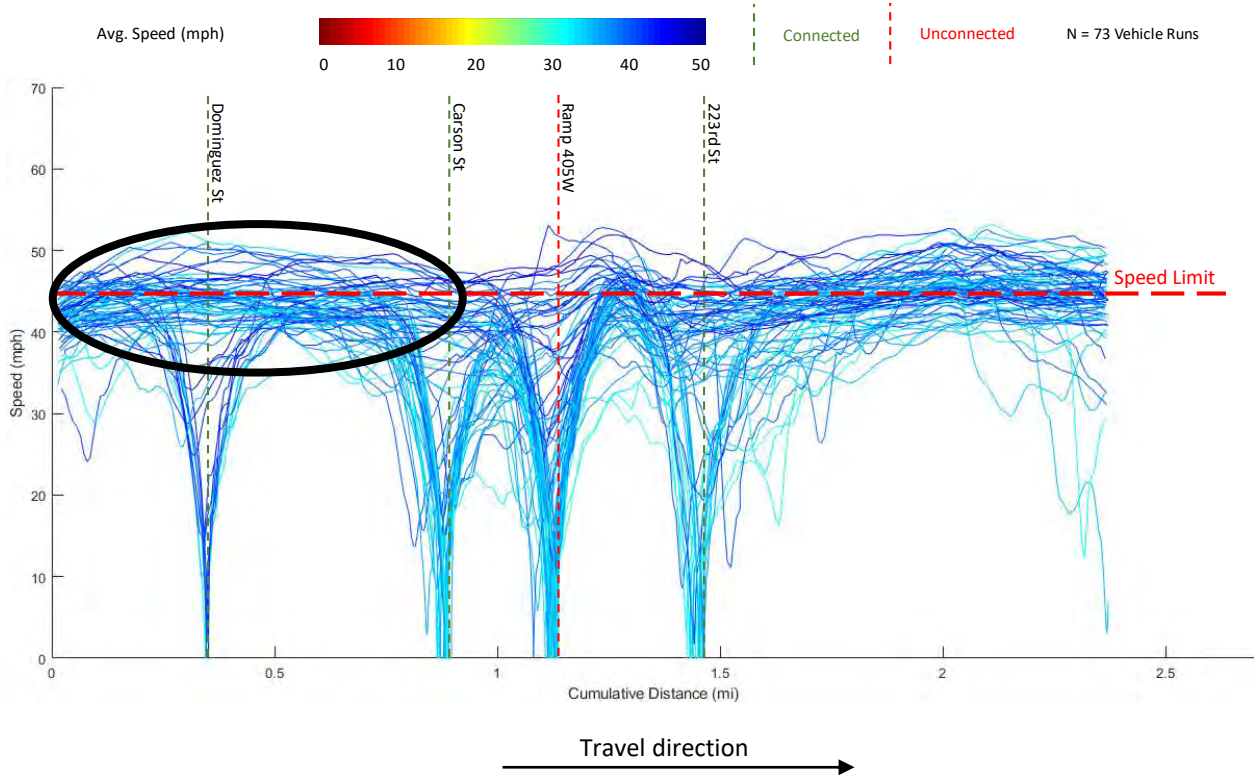
Alameda St Southbound

Baseline



Travel direction

Eco-Drive



Travel direction

Conclusions

Connected eco-driving system can be implemented as an on-board application or a mobile application

- The connectivity with roadway infrastructure is critical
- Thus, industry-agency partnership is essential

Eco-Drive can help Class 8 trucks achieve significant fuel savings on signalized corridors

- 6% to 15% in this study, depending on corridor characteristics
- More work is needed to understand fuel savings potential under other operational scenarios

Eco-Drive can also provide other co-benefits.

- Travel time reduction through avoiding stops at intersections
- Safety improvement through better compliance with roadway speed limit

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Speaker information

Thank you

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