

# Exploring the Technological Developments Related to V2V and V2I

*Examples of Realizing CV Technology*

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February 28, 2022



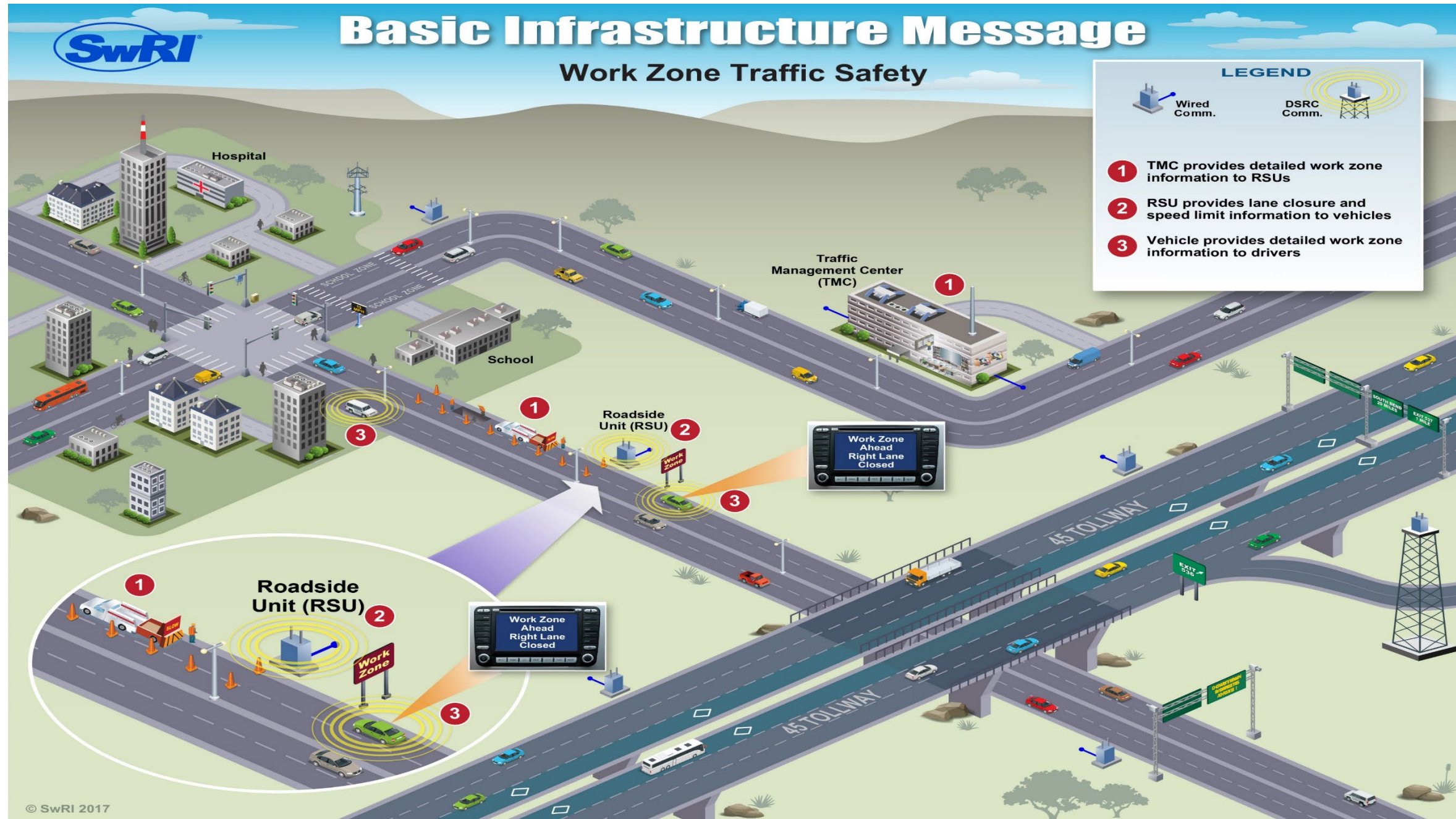
# Connected Vehicle Technologies: Speakers Perspective

- Conducting Connected Vehicle R&D since 2006
- Standards Development
- Consulting
- Tech Development
- Pilot Deployments
- Independent Test & Evaluation
- Developed >25 unique on-road and off-road Automated Vehicle platforms since 2008 (most use some variant of CV to operate)

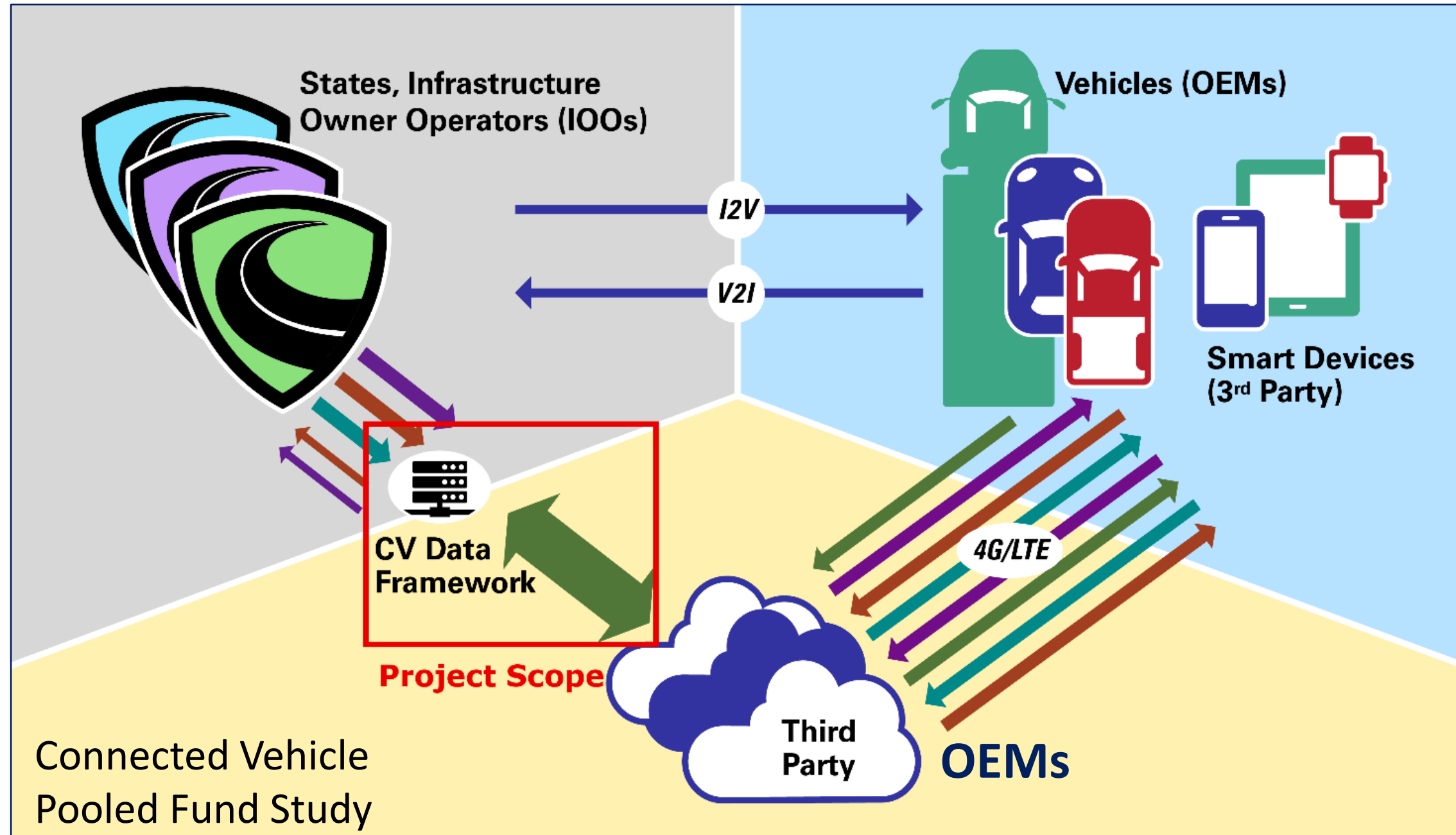




# Connected Vehicle Pooled Fund Study

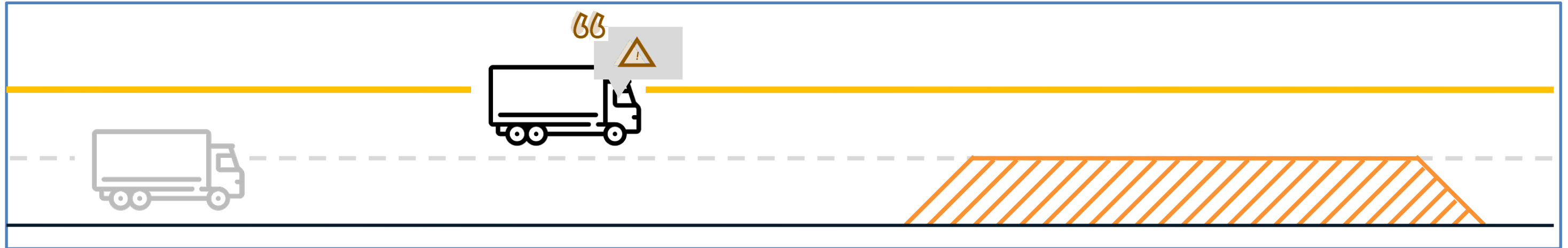


# Using Third Parties to Deliver I2V





# Connected Work Zones



Cab View

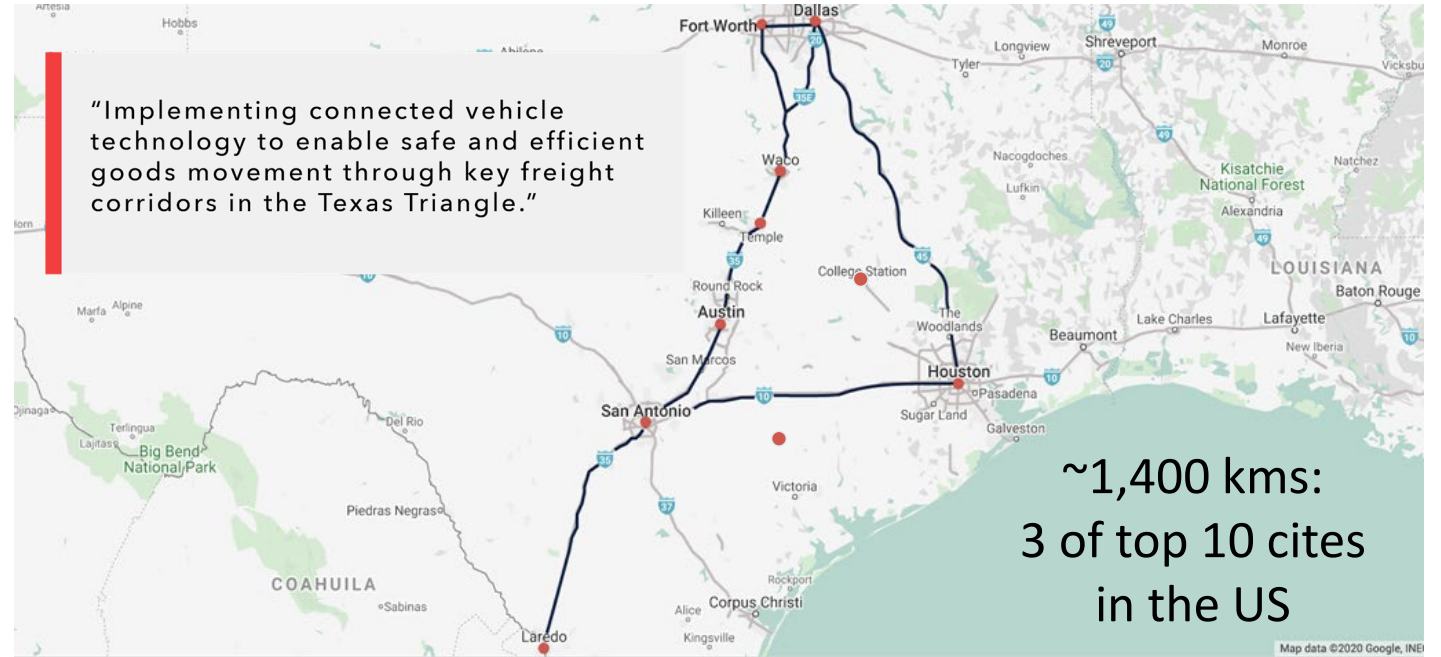
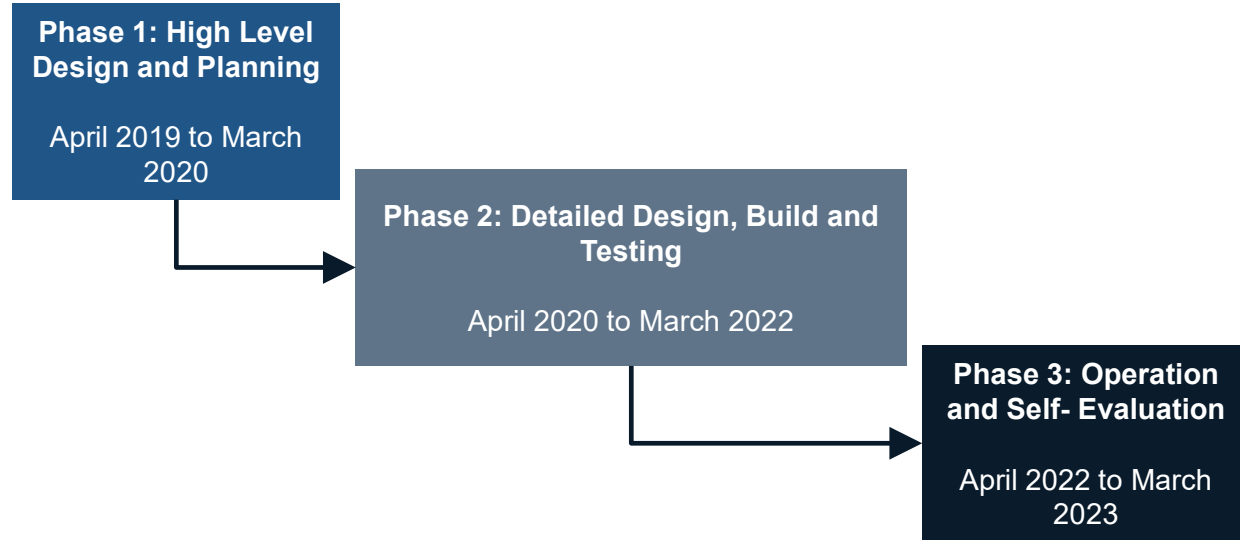


TMC Operator



# Texas Connected Freight Corridors

Improve safety and efficiency of freight movement around Texas including Freight signal priority



Highlighted applications are prioritized for development

Work Zone Warning	Queue Warning	Wrong-Way Drivers	Advanced Traveler Information System (ATIS)
Road Weather Warning	Truck Signal Priority	Truck Parking Availability	Bridge Height Warning
Emergency Electronic Brake Light (EEBL)	Pedestrian & Animal Warning	Eco-Dynamic Routing	Border Wait Times

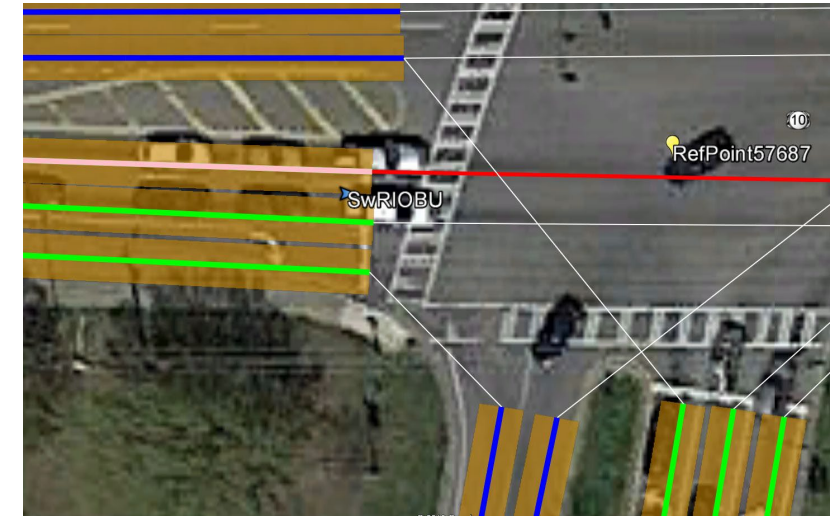


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# SPaT Deployment Tools & Support

- Georgia DOT's ~1,000 unit RSU (roadside unit) deployment in Atlanta metro area (6M people)
- Infrastructure and in-vehicle support tools
- MAP data validation and consistency checks
- RSU siting, survey, integration and testing support

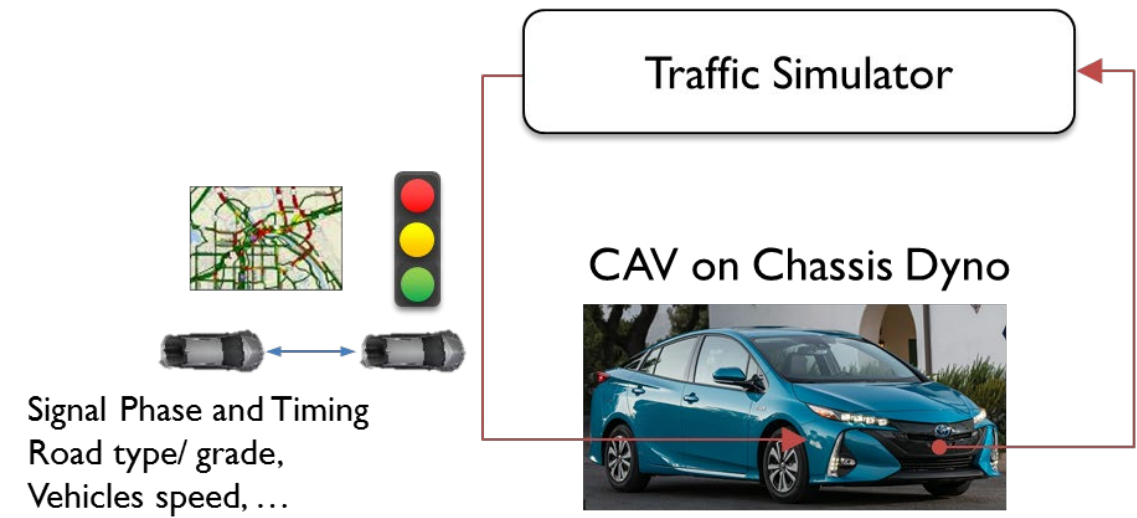


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# CV Technology for Improved Fuel Efficiency

- Goal of reducing vehicle energy consumption by at least 20%
- Leverage connectivity, automation, and model predictive control
- Traffic simulator feeds HIL simulation



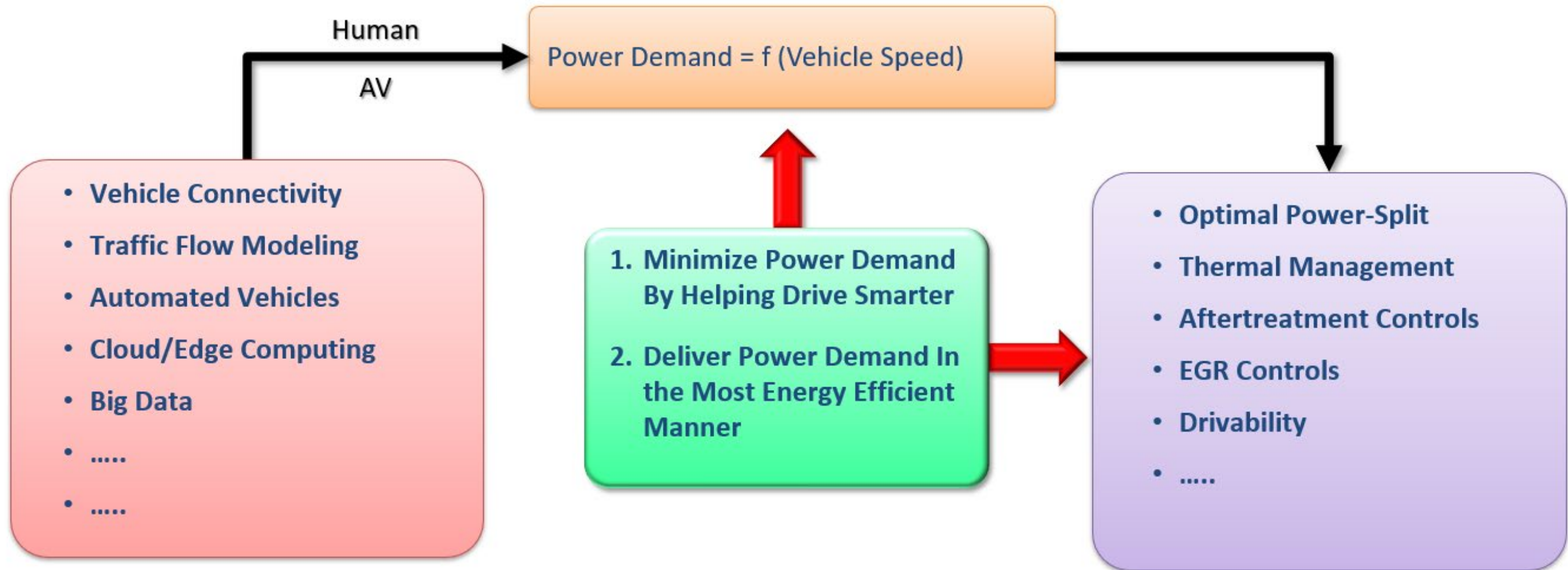
Co-optimized Vehicle & Powertrain Control

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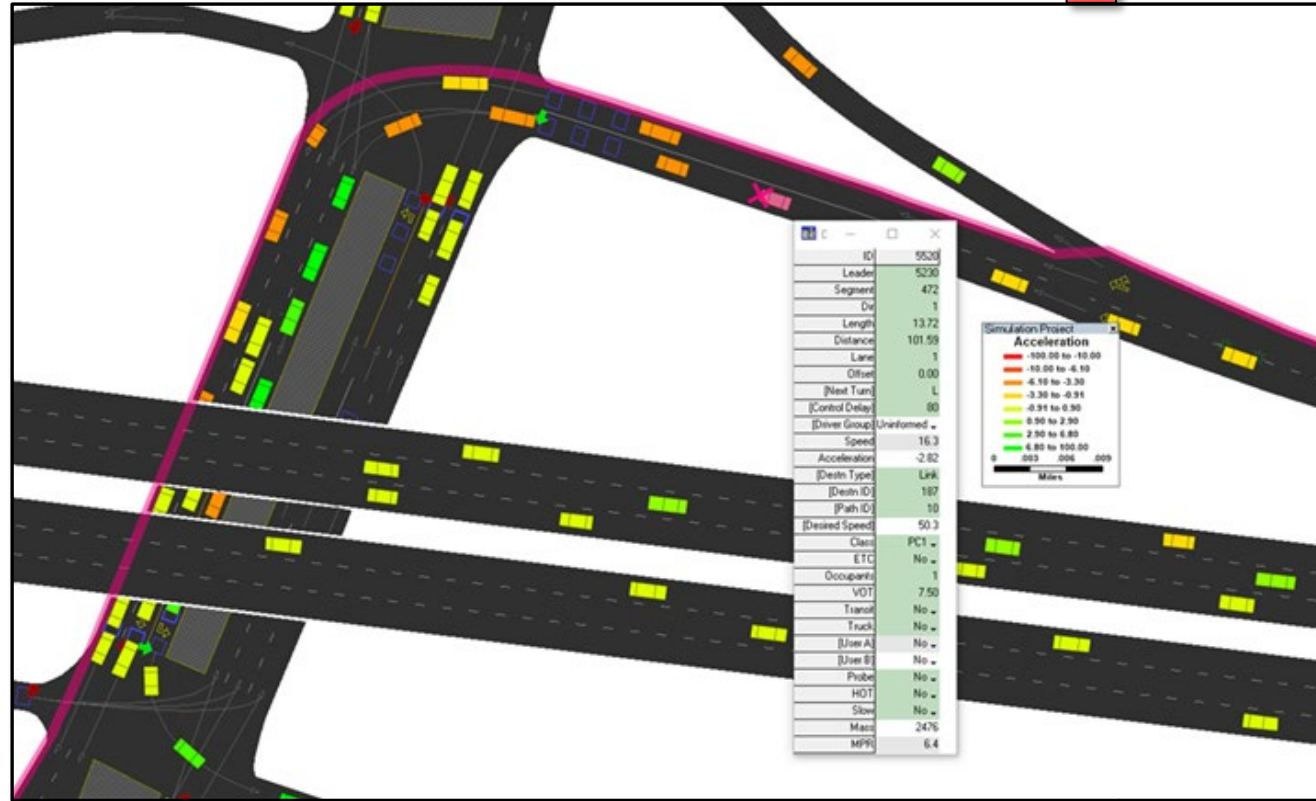


# Using CV to Improve Fuel Economy, Reduce Emissions

Leverage connected information streams (V2V, V2I and V2X) and automation to improve energy efficiency and performance of powertrain



# Connected Powertrain



The Ego Vehicle (Red)  
Interacting With Traffic in the Simulator

The Development Vehicle  
Mounted on The Hub Dynamometer



# ARPA-E Connected Powertrain Results

- **Next-Generation Energy Technologies for Connected and Automated on-Road Vehicles**
- Initial 3-year program funded by ARPA-E ended 2020
- Demonstrated energy consumption reduction of 20% on Toyota Prius Prime
- No powertrain hardware changes
- No compromise in emissions, safety or drivability
- Program Extended in 2021 for 3 more years (using Honda for vehicles)

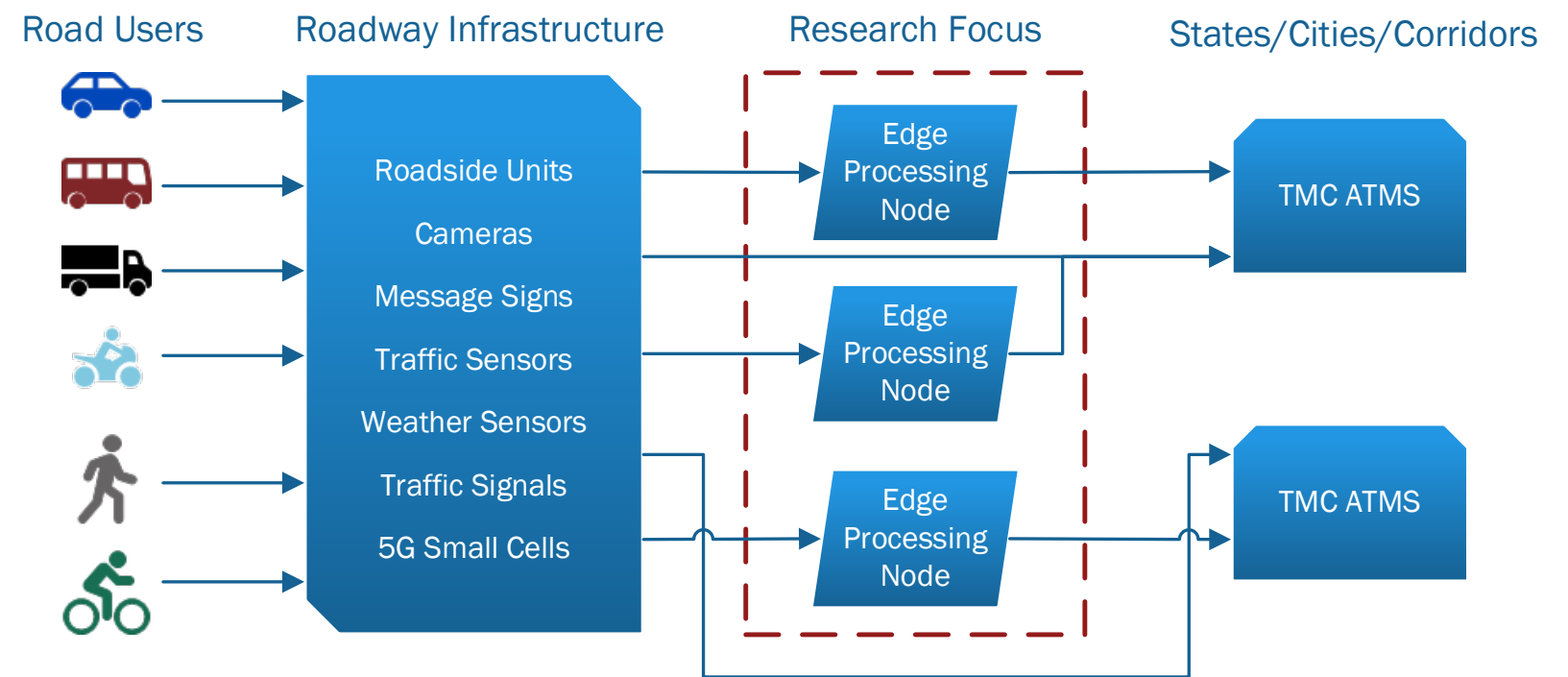


# EDGE-CV: Solving the “massive data” problem

Technical Objective: to evaluate technologies to develop an EDGE-CV Data Platform to integrate edge computing with centralized processing to handle CV data at scale

## ■ Technical Approach:

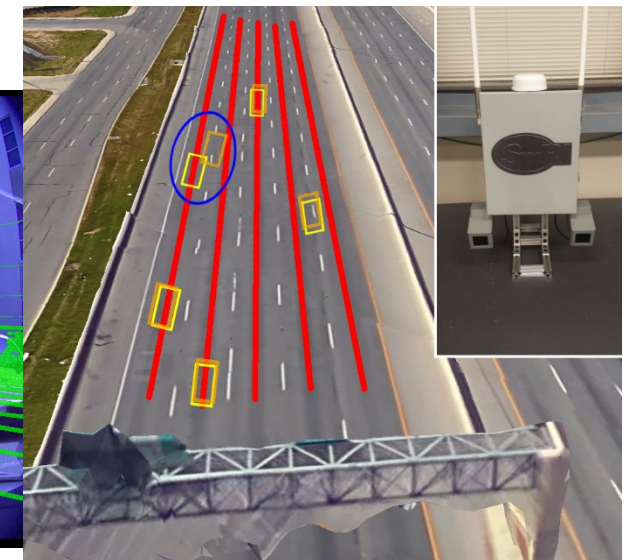
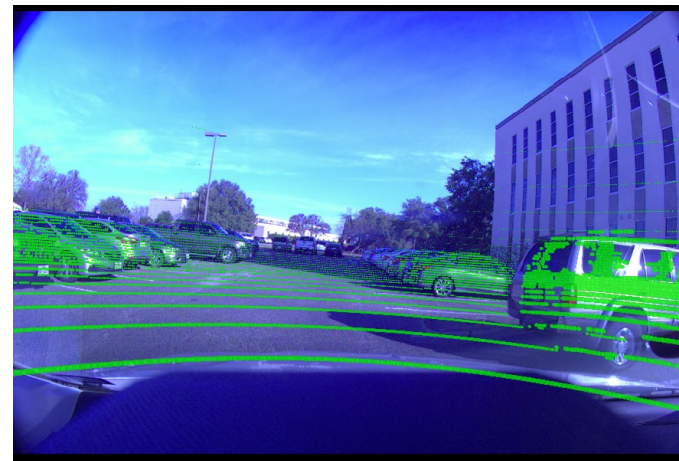
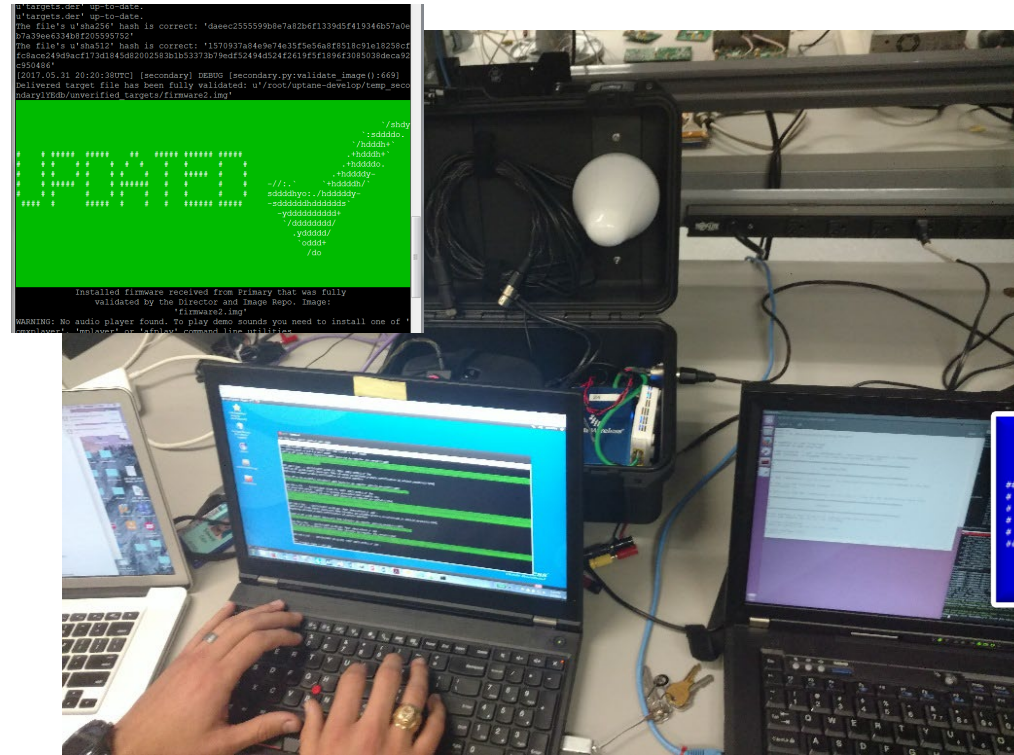
- Establish the CV Simulation Environment
- Evaluate Tools & Prototype EDGE-CV Data Platform
- Establish the ATMS testing environment
- Test the EDGE-CV Data Platform with an ATMS environment





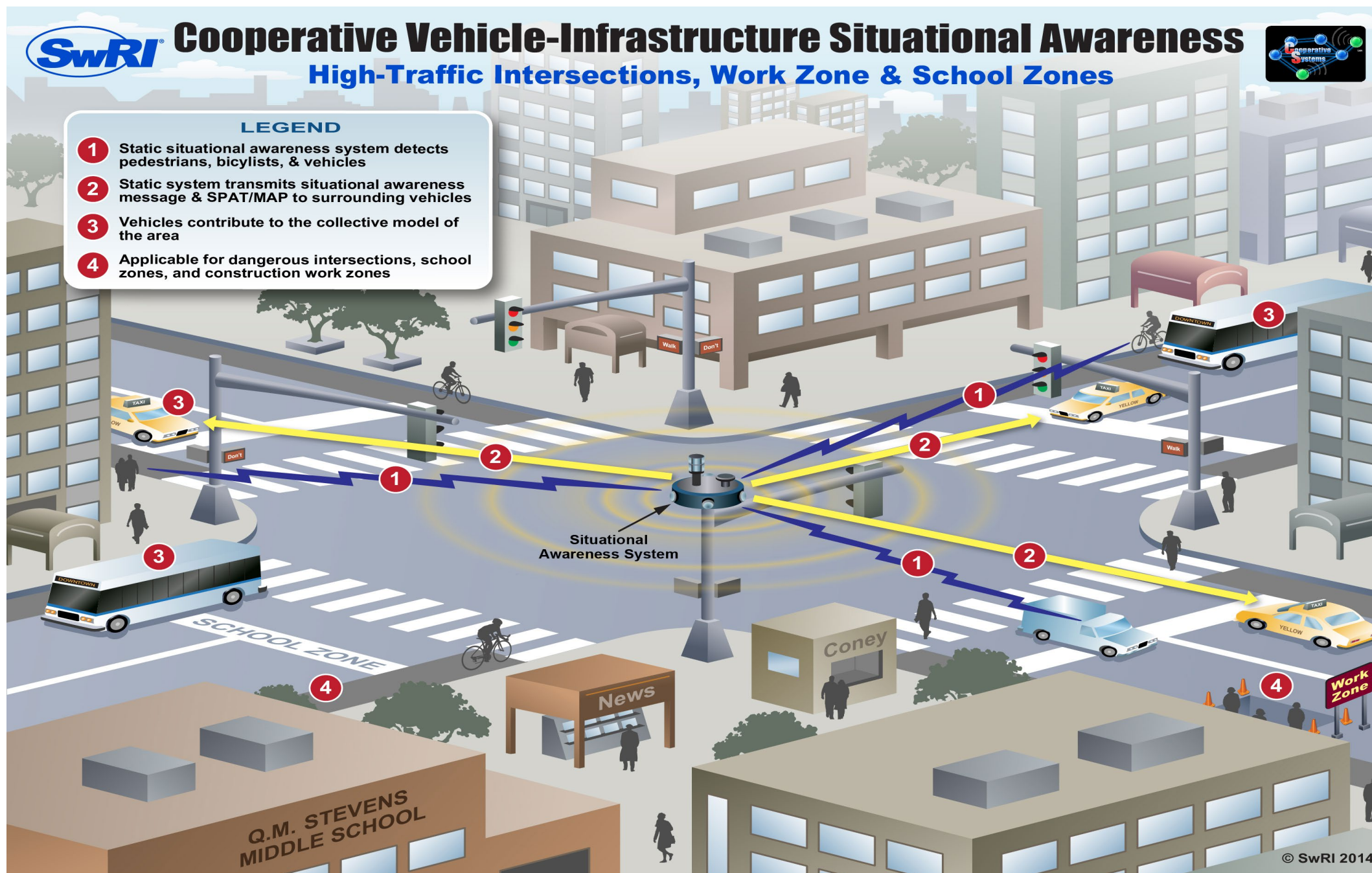
# Connected Vehicle Security / Misbehavior

- Security:
  - Compromise-resilient software over-the-air update security protocol
  - Deployed reference implementation on embedded ECUs and DSRC radios
- Misbehavior identification (including adversarial learning):
  - Existing CV security processes cannot guard against erroneous data
  - Leverage sensor-equipped vehicles and infrastructure to validate CV message data
  - Develop methods to ensure or revoke trust





# Situational Awareness for Connected Vehicles



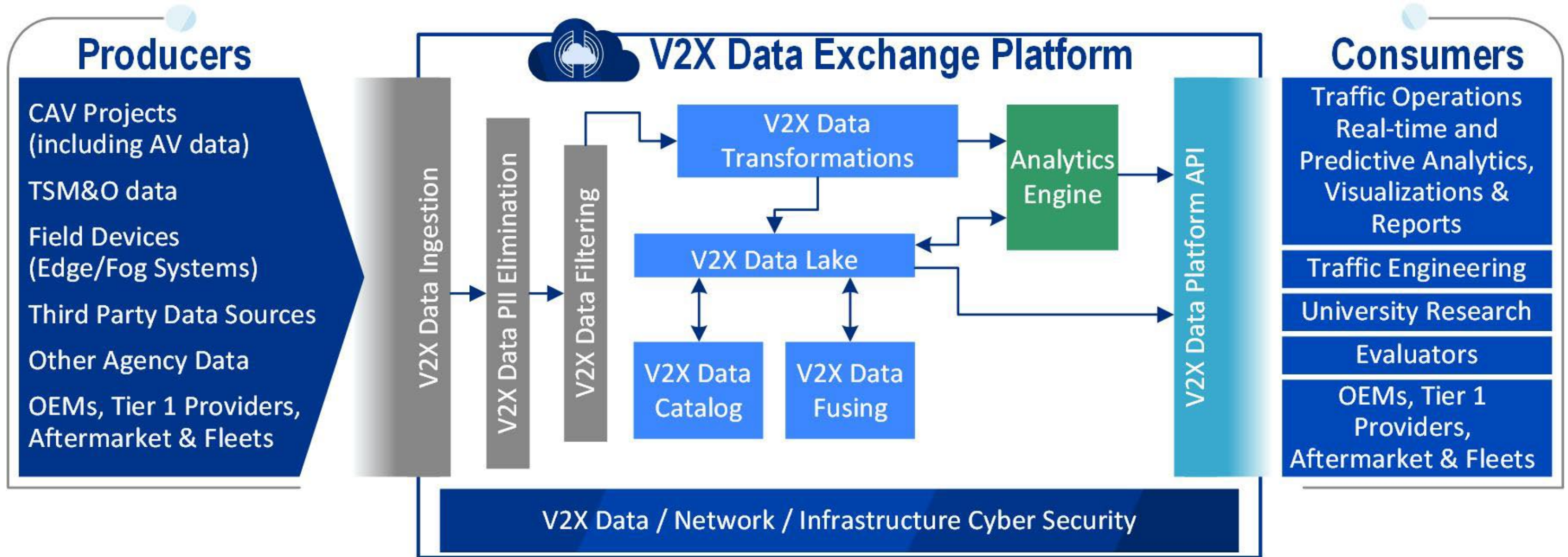


# Florida DOT V2X Data Exchange Platform

- Development of a statewide data exchange program in Florida that ingests high-volume, high-velocity data from diverse transit sources.
- Will facilitate real-time detection and notification of actionable conditions as well as historical analysis to support future initiatives.
- Cloud-based / Fog-based data analytics and reporting platform
- Consume data from numerous sources
- Provide access to variety of consumers



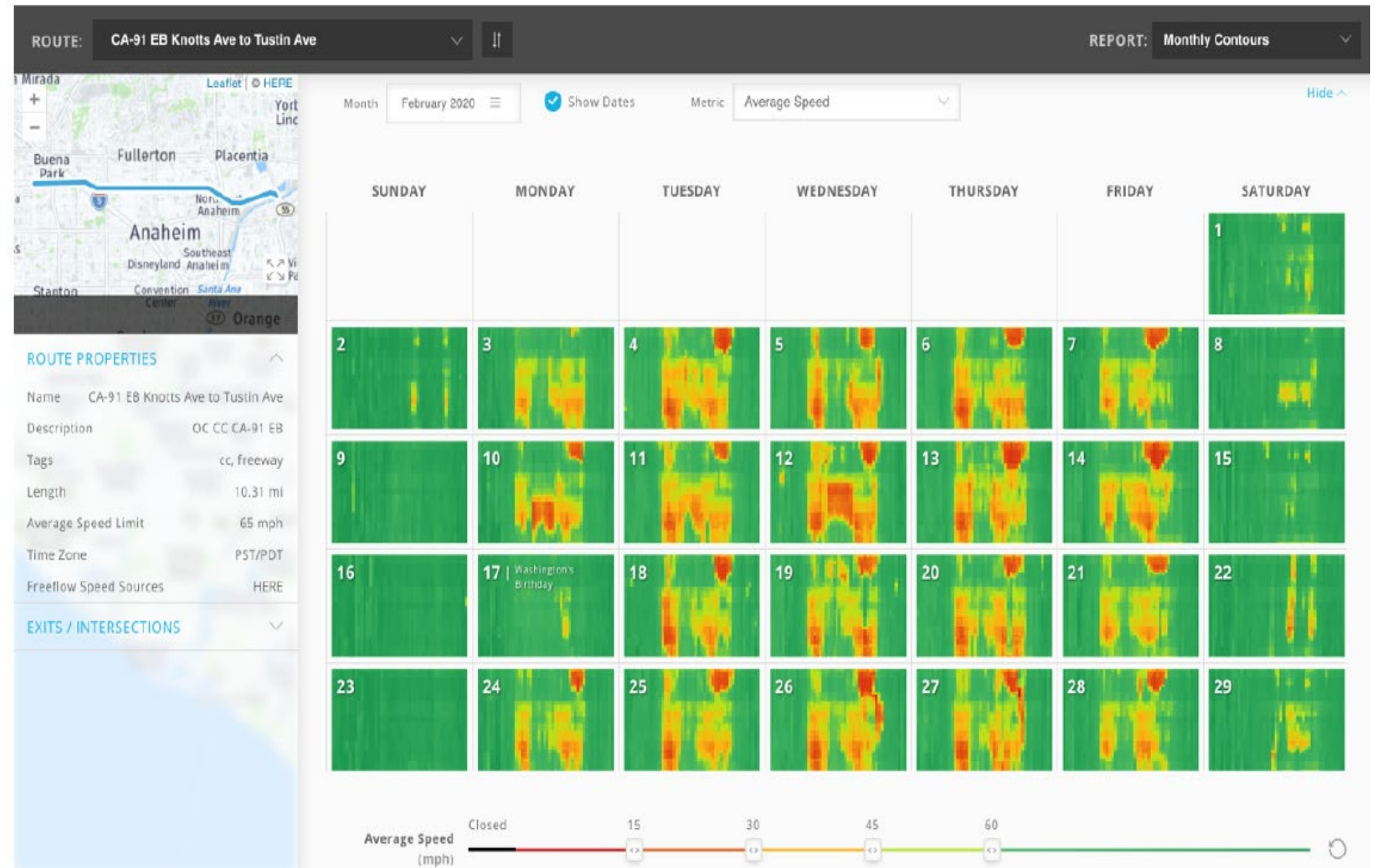
# Florida DOT V2X Data Exchange Platform





# V2X Platform: Types of Results

- Provides “predictions” as well as “actuals”
- Will be “government” owned so it may be reused many places at no development cost
- Under development





# Questions ?

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