Orlando, FL

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2024 TRANSPORTATION SYMPOSIUM

Connected & Automated Vehicle (CAV) Best Practices

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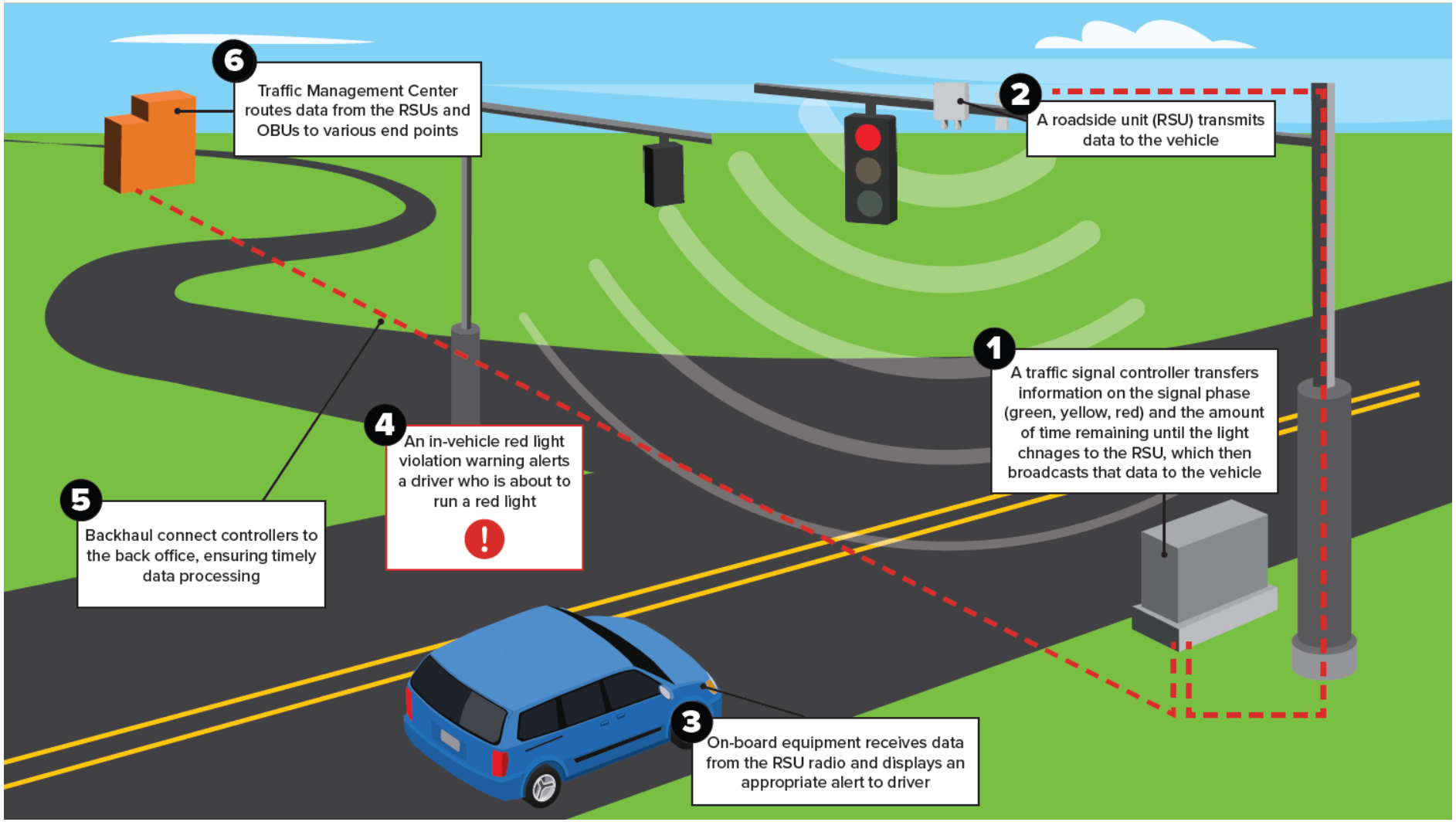
FDOT

Objectives:

- Overview of FDOT's CAV Program
- CAV Deployment Considerations
- Example Best Practices

What is Connected Vehicle?



System Components

1. Traffic Signal Controller (arterial deployments)
2. Roadside Unit (RSU)
3. Onboard Unit (OBU)
4. Direct 5.9 GHz Communication:
   - C-V2X
   - DSRC (phasing away)
5. Communication/back haul to RTMC/TMC
6. Traffic Management Center

Why CAV?
- CAV Program Supports Target Zero

Target Zero focuses on influencing change in specific behaviors ***before a crash occurs.***

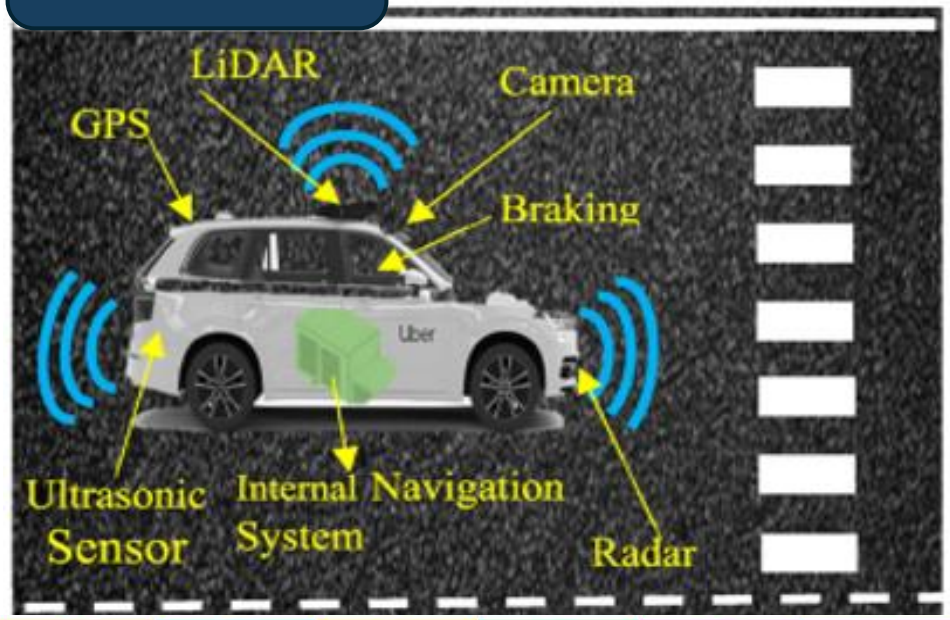
CAV Program is a tool in FDOT's toolbox to prevent crashes.

Influence driver awareness with situational alerts to avoid crashes.

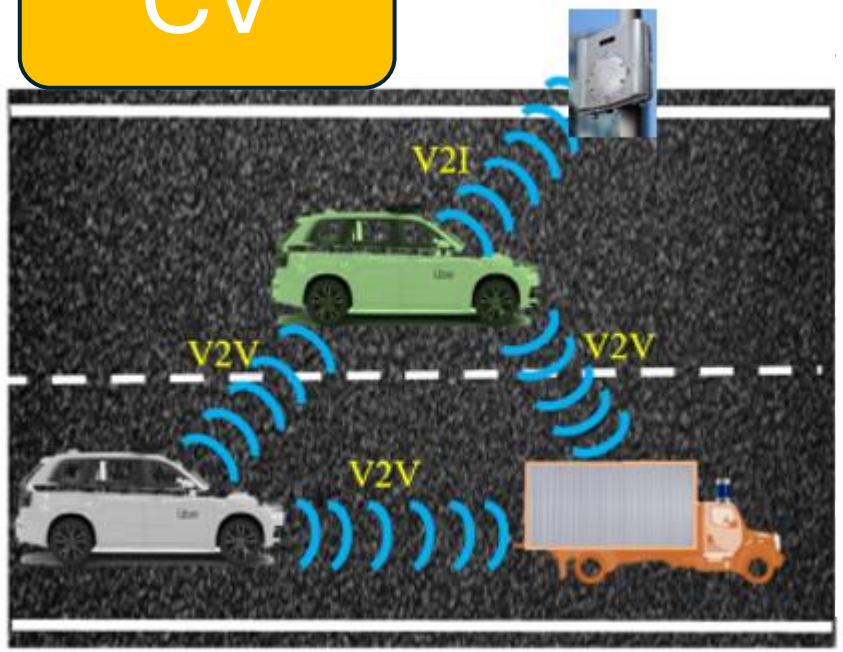
TARGET ZERO
FATALITIES & SERIOUS INJURIES

What is Connected and Automated Vehicles (CAV)?

AV



CV



V2V -Vehicle to Vehicle
V2I -Vehicle to Infrastructure

MESSAGE SET	
Basic Safety Message	BSM
Signal Phase and Timing Message	SPaT
Map Data	MAP
Traveler Information Message	TIM
Signal Request Message	SRM
Signal Status Message	SSM

Applications

EVP	TSP	TIM

Example from an FDOT Project

Roadside Unit (RSU)

V2X

V2X

Vehicle-to-Everything (V2X) Communication

V2X

Caution

Distance: 31.998768,
Bearing: 226.971924,
Speed: 0.04000

OK

On-board Unit (OBU)

Vehicle with (OBU)

Pedestrian with Smartphone ped safety application

Gainesville, FL

What Is Vehicle-to-Everything (V2X) Communication?

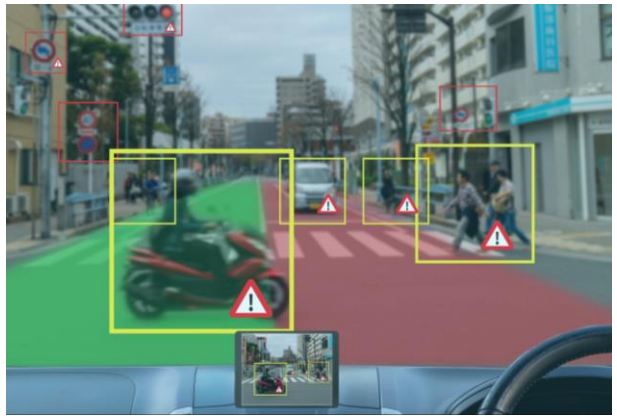
V2X provides the communication technologies for CAV.

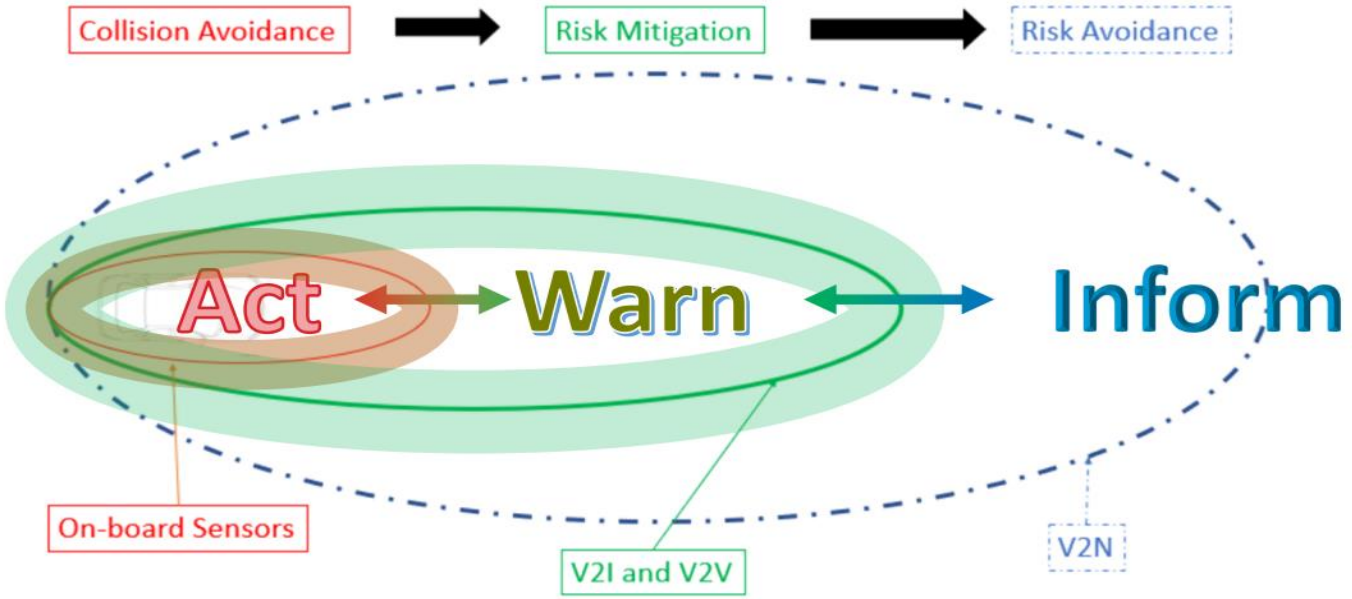
Direct short-range (=Sidelink)

- Vehicle-to-Vehicle (V2V)
- Vehicle-to-Pedestrian (V2P)
- Vehicle-to-Infrastructure (V2I)

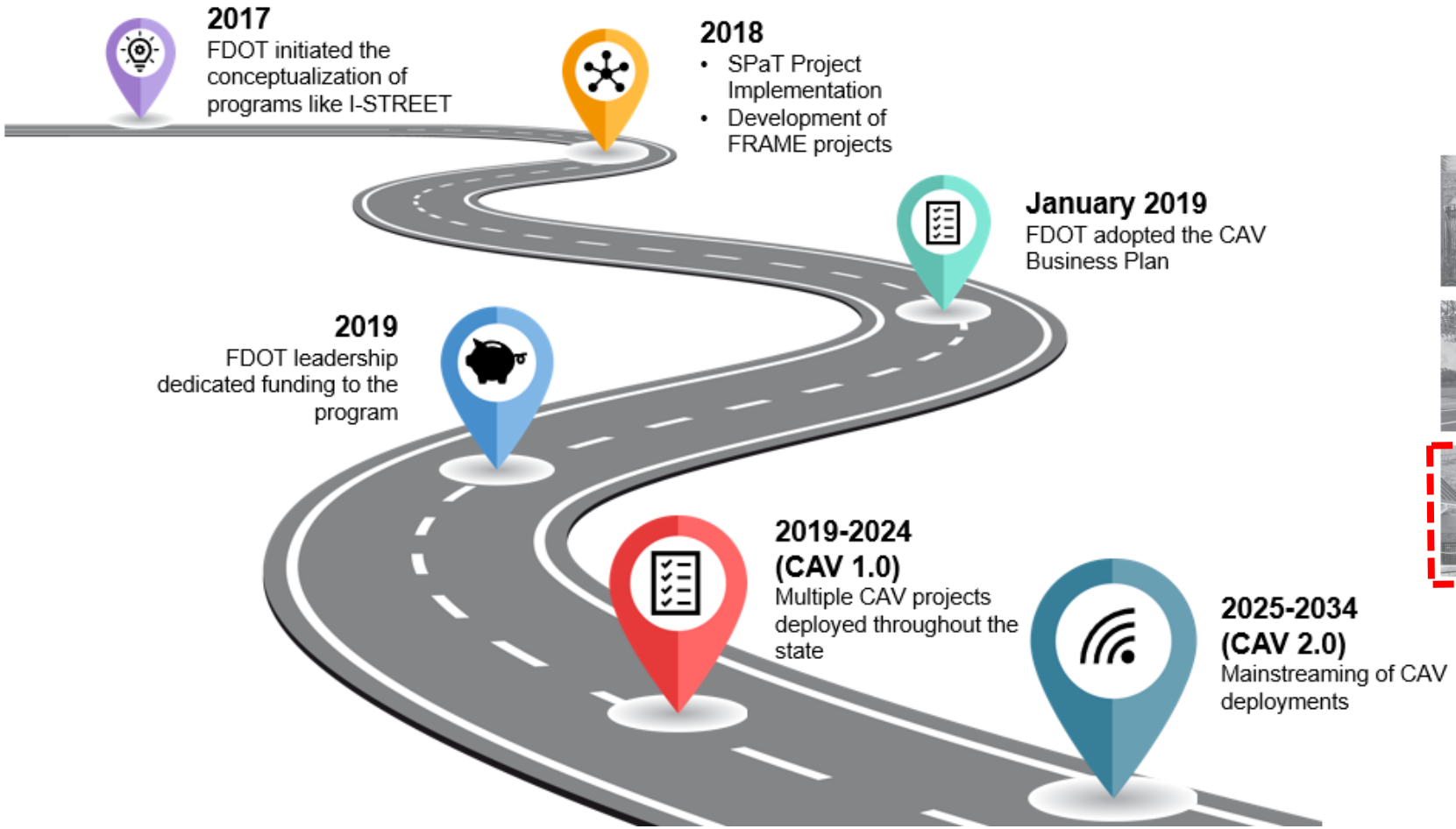
Network (=Up/Downlink)

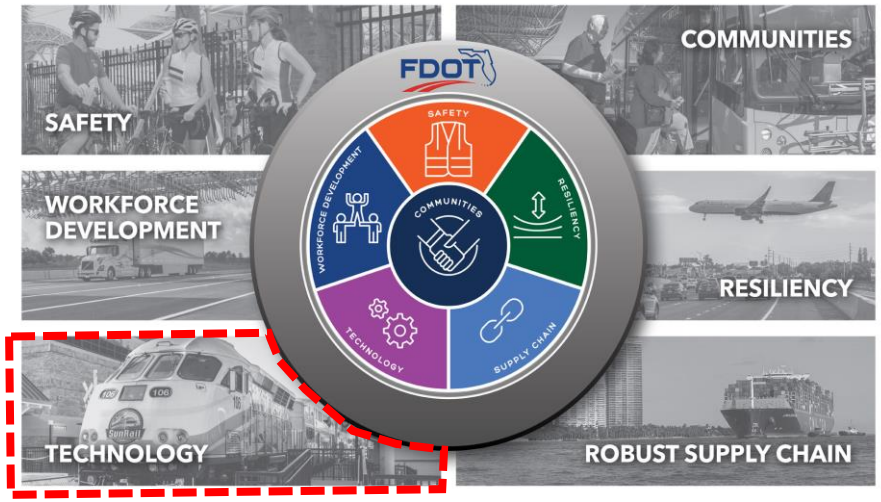
- Traffic Information
- Emergency Services
- Fleet Management





CAV Implementation Roadmap





How Many CAV Projects in Florida?

Projects/Initiatives

♦ Statewide Project/Initiative

FDOT Led Projects

Partner Agency Led Projects

Legacy/Retired

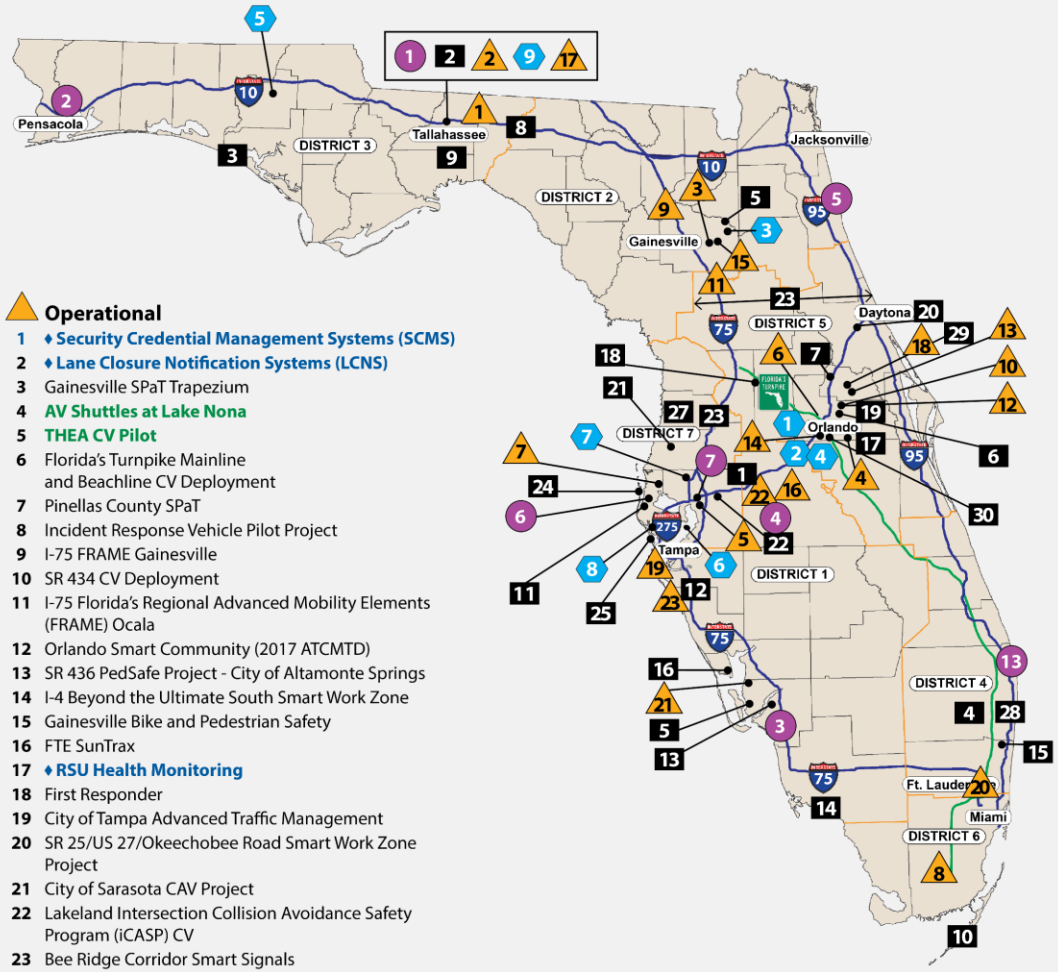
1 Near Miss Identification Safety System (N-MISS)
2 I-4 Active Work Zone
3 Gainesville AV Shuttle
4 Osceola County CV Signals
5 CAV Projects (ATMA)
6 Downtown Tampa Autonomous Transit
7 HART AV
8 AV Shuttle at PSTA
9 ♦ Smart Signals Dashboard

Planning

1 CV Bike Safety Pilot Deployments
2 Escambia and Santa Rosa County CAV
3 SW I-75 FRAME
4 District 1 CV Master Plan
5 Smart St. Augustine
6 Pinellas SR 60 West Coast Smart Signal Corridor Project
7 Connected Vehicle Priority and Preemption System (CVPP)

Design/Implementation

1 I-4 FRAME (2019 ATCMTD)
2 US 90 SPaT Tallahassee
3 US 98 Smart Bay
4 SR-710/Beeline Hwy- CAV Freight
5 US 41 FRAME
6 State Road 423 Freight Signal Priority
7 Lake Mary Boulevard CV Project
8 I-10 Smart Road Ranger
9 ♦ V2X Data Platform
10 Florida Keys Connecting Overseas to Advance Safe Travel (Florida Keys COAST) Pilot Project
11 Pinellas County Smart Community (2020 ATCMTD)
12 Sarasota County – SR 780 Fruitville Rd and US-41 Tamiami Trail
13 LeeTran US 41 Transit Signal Priority
14 Collier Countywide Connected Traveler Information System (CTIS)
15 Train Vehicle Crash Avoidance Pilot Project
16 SR 29 Wildlife Detection
17 Bluetooth to RSU Conversion in Orange and Osceola Counties
18 CV Smart Signal - Lake County
19 "Just on the Phone" Reference Application
20 SR-40 ITS Safety Deployment
21 Pasco County SMART US-19
22 Hillsborough County Connected Vehicle Priority and Preemption System
23 I-75 and I-95 Queue Warning System
24 City of Clearwater Pedestrian Warning System
25 City of St Petersburg Smart Signal Corridor Project
26 South I-75 FRAME
27 District 7 Integrated Corridor Management
28 SR-869/SW 10th Street Connector TSM&O SWZ
29 U.S. 17-92 Connected Vehicle Deployment
30 Ped/Safe II U.S. 441/State Road 50



Operational

1 ♦ Security Credential Management Systems (SCMS)
2 ♦ Lane Closure Notification Systems (LCNS)
3 Gainesville SPaT Trapezium
4 AV Shuttles at Lake Nona
5 THEA CV Pilot
6 Florida's Turnpike Mainline and Beachline CV Deployment
7 Pinellas County SPaT
8 Incident Response Vehicle Pilot Project
9 I-75 FRAME Gainesville
10 SR 434 CV Deployment
11 I-75 Florida's Regional Advanced Mobility Elements (FRAME) Ocala
12 Orlando Smart Community (2017 ATCMTD)
13 SR 436 PedSafe Project - City of Altamonte Springs
14 I-4 Beyond the Ultimate South Smart Work Zone
15 Gainesville Bike and Pedestrian Safety
16 FTE SunTrax
17 ♦ RSU Health Monitoring
18 First Responder
19 City of Tampa Advanced Traffic Management
20 SR 25/US 27/Okeechobee Road Smart Work Zone Project
21 City of Sarasota CAV Project
22 Lakeland Intersection Collision Avoidance Safety Program (iCASP) CV
23 Bee Ridge Corridor Smart Signals

As of 10/25/2024

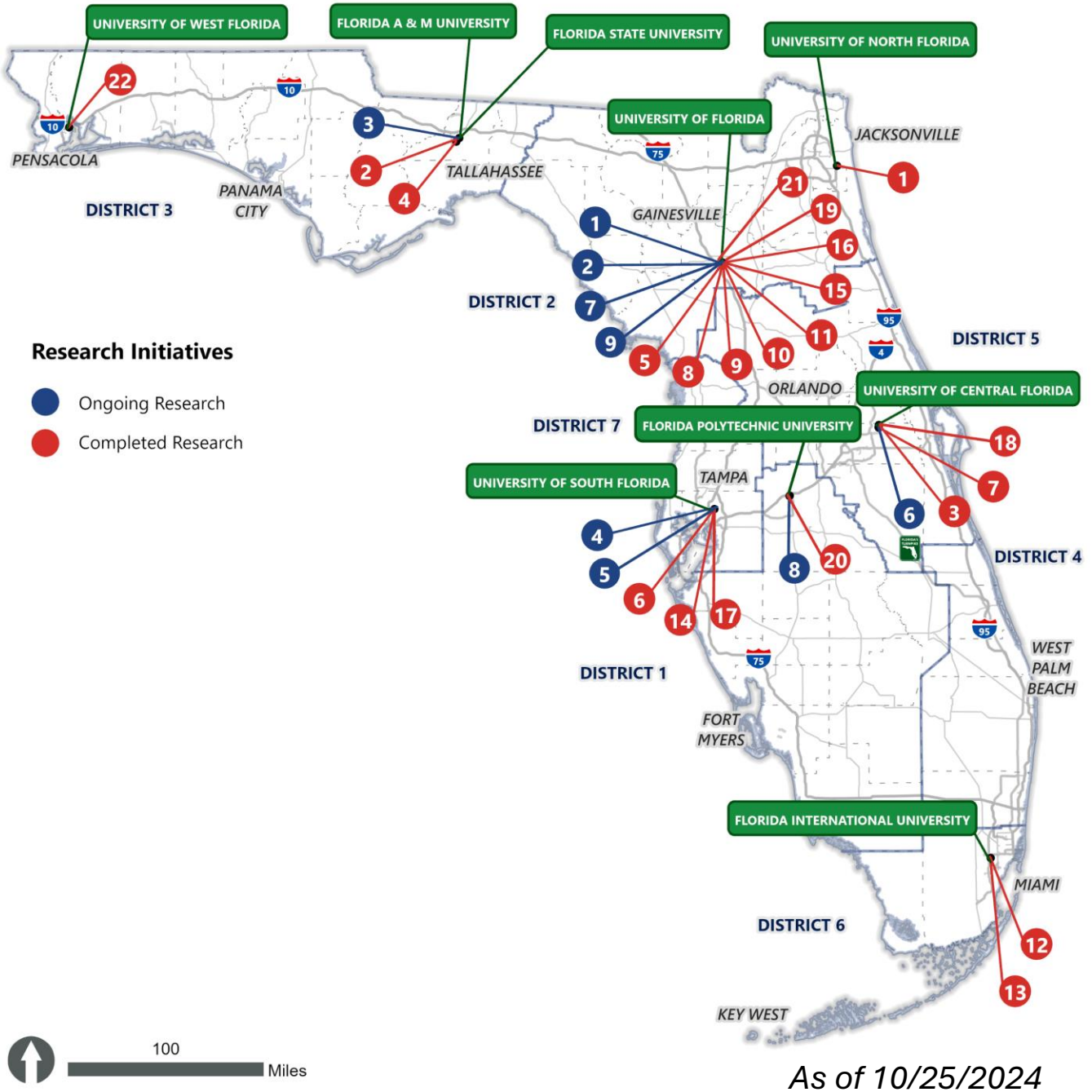
How Many CAV Research Projects in Florida?

9

On-going *Projects*

22

Completed *Projects*



As of 10/25/2024

CAV 1.0 (2019 - 2025) Overview

Regional Integrated CAV Projects

- *I-75 FRAME*
- *I-4 FRAME*
- *US 41 FRAME*

Signal Phase and Timing (SPaT)

- *Tallahassee SPaT*
- *Gainesville SPaT Trapezium*
- *Pinellas County SPaT*
- *Keys COAST*
- *Smart Bay*
- *SR 710 and SW10th Street*

Statewide Projects

- *V2X Data Exchange Platform*
- *Security Credential Management System*
- *RSU Health Monitoring System*

Local Agency Partnership Programs

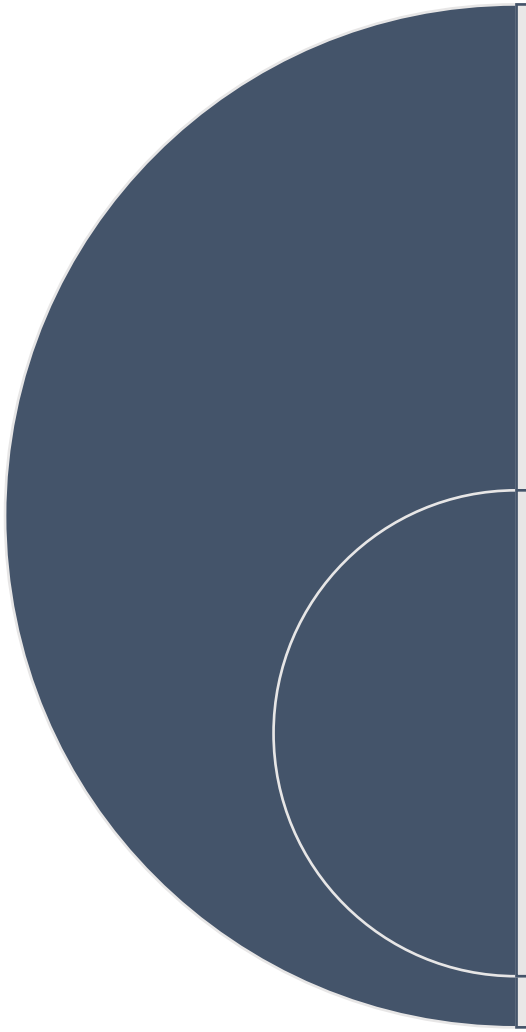
- *Technology Application Partnership with Local Agencies (TAPs-LA)*

USDOT V2X Deployment Plan

What does the plan mean for FDOT?

*The DOT has established milestones and targets in each of the goal areas **as a call-to-action among all V2X stakeholders** working towards the vision of this Plan.*

CAV Strategic Plan Early Overview



The ***mission*** of FDOT's CAV Program is to drive the seamless integration of CAVs into Florida's transportation system, synergizing with FDOT's overarching objective of elevating safety and facilitating efficient mobility for both people and goods.

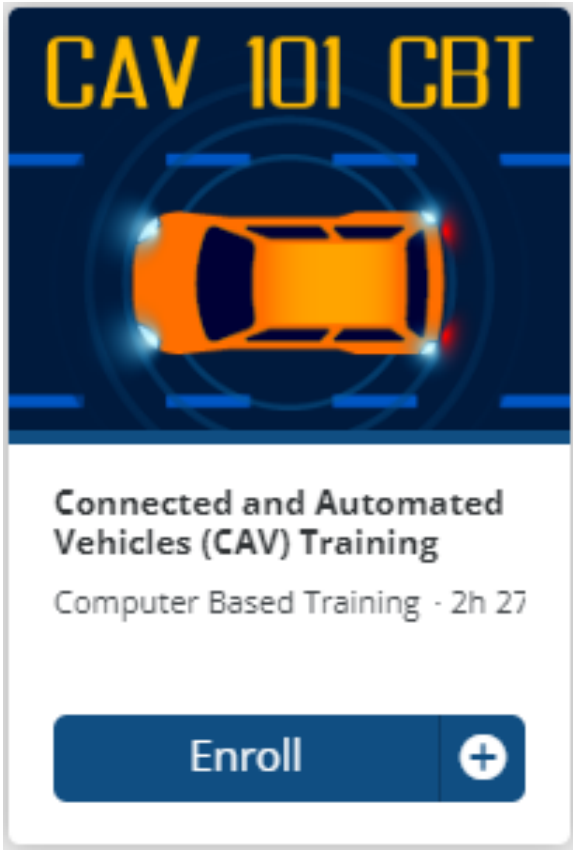
The ***vision*** of FDOT's CAV program is to *accelerate Florida's journey towards congestion-free and fatality-free roadways by mainstreaming CAV technologies into the state's transportation system.* FDOT will continue with ongoing implementation, operation, and maintenance of CAV infrastructure by leveraging lessons learned and best practices. FDOT aims to remain a national leader in the adoption of CAV technology to serve Florida's road users.

Strategic Plan (2025-2034) Focus Areas

- National CAV Program Alignment
- Continued Evaluation, Testing, and Demonstration
- Education, Outreach and Partnerships
- Communications Technology and Applications Implementation
- Main-Streaming
- Infrastructure Preparedness for ADS and AV

How does FDOT Support CAV Training and Workforce Development?

FDOT Learning Curve: https://learningcurve.myabsorb.com/#/catalog/dc3a39b4-ea81-4ea9-8f39-3abf1b1dfba2



Additional trainings are available on:

- V2X DEP
- RSU HMS
- SCMS

CAV Deployment, Operations and Maintenance Considerations

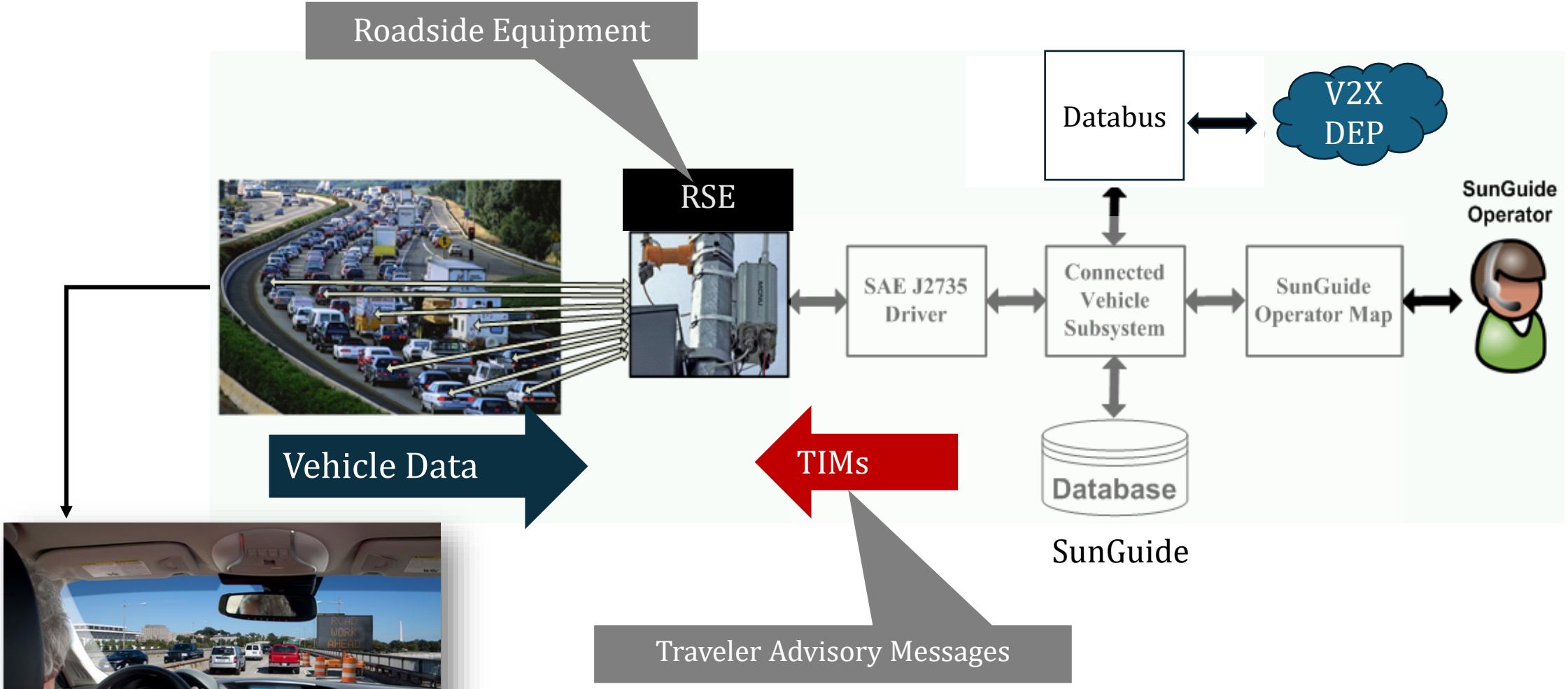
What is an RSU and OBU?

Roadside Units (RSU)

Onboard Units (OBU)

Connected Vehicle Systems in Traffic Operations

RSEs are the collection points for connected vehicle data



TIMs are rough equivalents to DMS messages

Developmental Specifications

1. Update the current outdated contents in the FDM.
2. Provide guidance for projects that already includes CV systems.
3. More guidance for the designers are provided in the *"Lessons Learned and Best Practices Document"*.
4. Shared with the Districts for feedback and insights.

Dev681CVRSE - Connected Vehicle Roadside Equipment

Dev995CVRSE - Connected Vehicle Roadside Equipment Materials

FCC certified

Enrolled into statewide SCMS certified

Capable of remote firmware updates

Capable of data sharing with FDOT V2X Data Exchange platform and SunGuide®

Compliant with SAE J2735 and J2945 standards

C-V2X RSUs

Basis of Payment

CAV Planning Steps Considerations

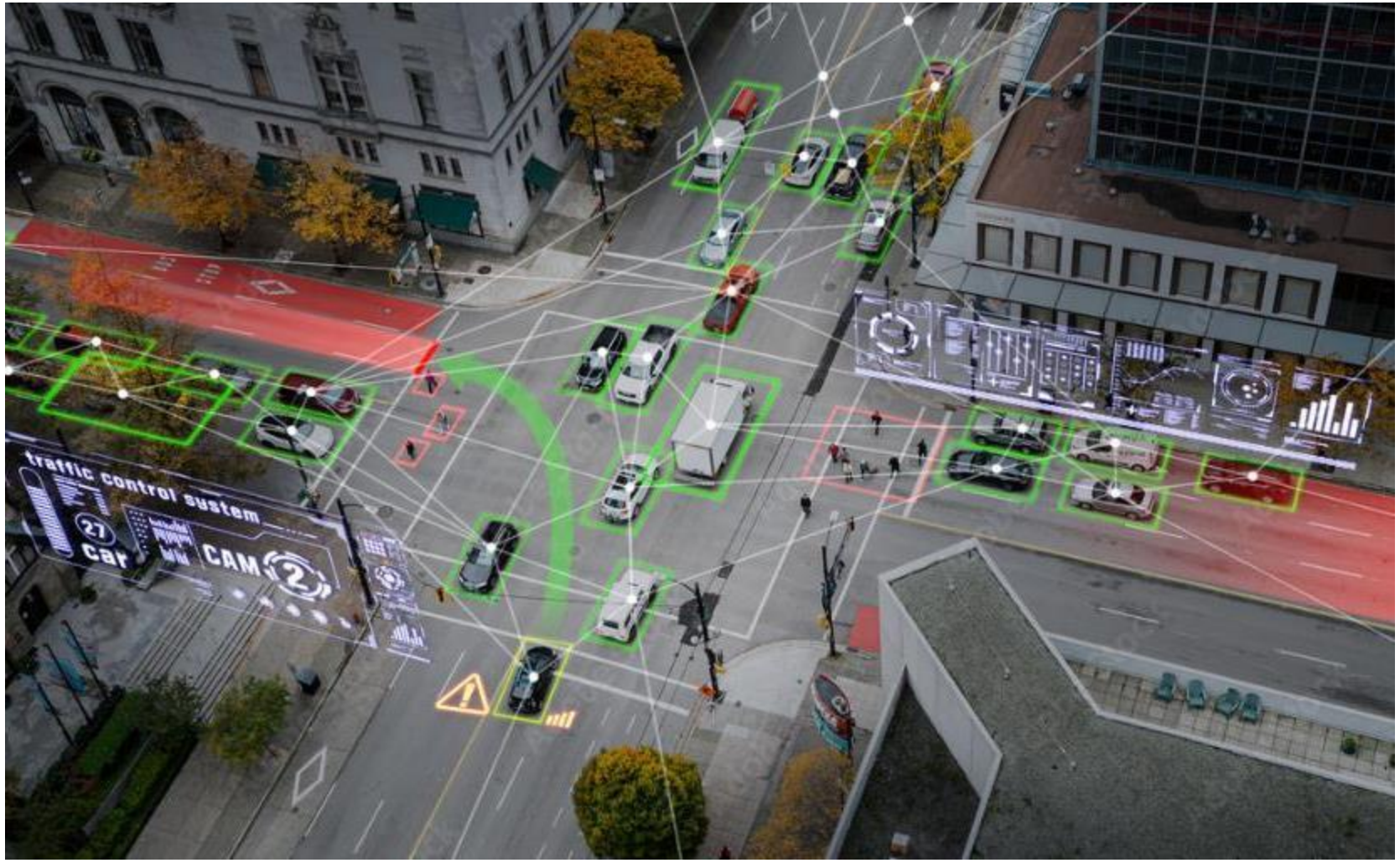
Planning

- Establish Goals and Objectives
  - Long Range Transportation Plans
  - ITS/TSMO Master Plans
  - Projects
- Tie outcomes to applications
- Obtain Stakeholder Buy-in
- FDOT or local agency maintenance agreement
- **Plan integration needs:**
  - FCC site registration
  - SCMS certificate support
  - V2X DEP integration
- **Local agency coordination for network access**

CAV Design Steps Considerations

Design

- Contracting Method
- Freeway systems:
  - Physical support infrastructure and connectivity should be already in place
- Arterial systems:
  - Controller type
  - Controller firmware version
  - Cabinet space
  - Connectivity to the TMC
- Network configuration specifics
- FCC site registration data collection



CAV Implementation Considerations in Construction and O&M

Construction

- Systems integration – **Who?**
- Project acceptance testing
- Burn-in period

Operation and Maintenance

- Hardware and software needs
- On-going maintenance of the accurate MAP
- Keep the FCC site registration up-to-date
- Network configuration and trouble-shooting
- Software licensing
- Monitor the status of the devices and data flow

Test Plan for Project Acceptance

Contractor to develop and submit to the Engineer for consideration and approval

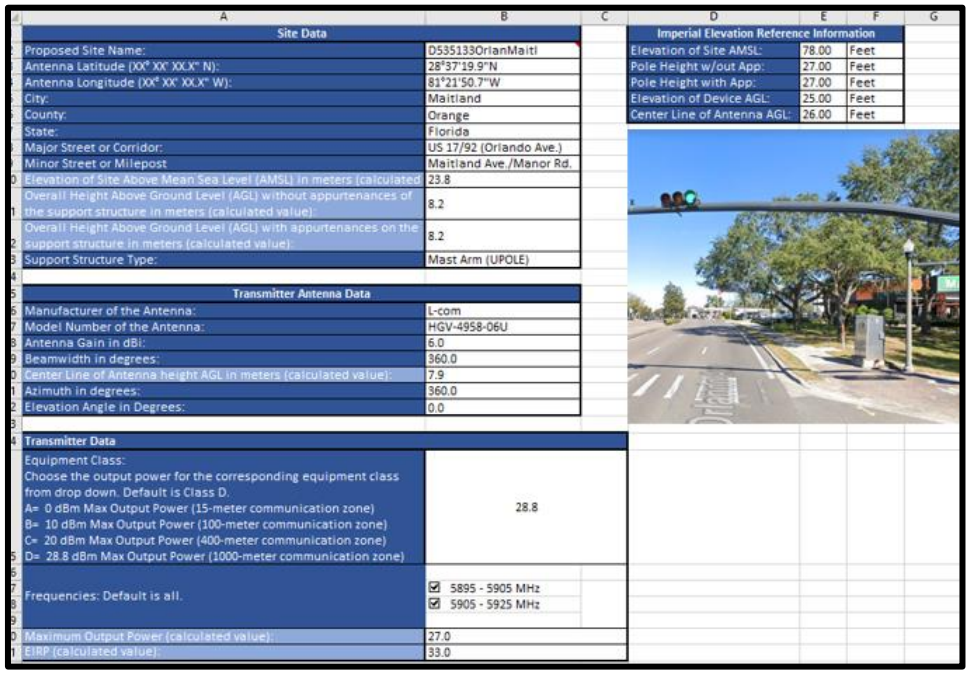
1. Verify physical construction and wiring
2. Verify proper voltages for all power supplies and related power circuits
3. Verify that the power LEDs on roadside equipment illuminates
4. Log in to CV equipment and verify access UI
5. Verify the configuration of CV equipment network interfaces
6. Confirm the RSU can communicate with the FDOT SCMS
7. Verify RSU broadcasts to and from vehicles equipped with an OBU capable of message display
8. Verify local functionality of CV applications

FCC Site Registration - Process

- ***Central Office supports District, regional and local agencies***
- ***Collect field information and provide to CO using a template***
- ***CO Submits in the FCC system***
- ***FDOT provides build-out dates within one year of registration approval***

Site Registration Update Criteria

- ***Height is increased***
- ***RSU is relocated more than 10-ft from its original location***
- ***RSU equipment, e.g., antenna, has changed***



Site Data	
Proposed Site Name:	D535133OrlanMaiti
Antenna Latitude (XX° XX' XX.X" N):	28°37'19.9"N
Antenna Longitude (XX° XX' XX.X" W):	81°21'50.7"W
City:	Maitland
County:	Orange
State:	Florida
Major Street or Corridor:	US 17/92 (Orlando Ave.)
Minor Street or Milepost	Maitland Ave./Manor Rd.
Elevation of Site Above Mean Sea Level (AMSL) in meters (calculated	23.8
Overall Height Above Ground Level (AGL) without appurtenances of the support structure in meters (calculated value):	8.2
Overall Height Above Ground Level (AGL) with appurtenances on the support structure in meters (calculated value):	8.2
Support Structure Type:	Mast Arm (UPOLE)

Transmitter Antenna Data	
Manufacturer of the Antenna:	L-com
Model Number of the Antenna:	HGV-4958-06U
Antenna Gain in dBi:	6.0
Beamwidth in degrees:	360.0
Center Line of Antenna height AGL in meters (calculated value):	7.9
Azimuth in degrees:	360.0
Elevation Angle in Degrees:	0.0

Transmitter Data	
Equipment Class: Choose the output power for the corresponding equipment class from drop down. Default is Class D. A= 0 dBm Max Output Power (15-meter communication zone) B= 10 dBm Max Output Power (100-meter communication zone) C= 20 dBm Max Output Power (400-meter communication zone) D= 28.8 dBm Max Output Power (1000-meter communication zone)	28.8
Frequencies: Default is all.	☑ 5895 - 5905 MHz ☑ 5905 - 5925 MHz
Maximum Output Power (calculated value):	27.0
EIRP (calculated value):	33.0

Imperial Elevation Reference Information		
Elevation of Site AMSL:	78.00	Feet
Pole Height w/out App:	27.00	Feet
Pole Height with App:	27.00	Feet
Elevation of Device AGL:	25.00	Feet
Center Line of Antenna AGL:	26.00	Feet

Link to the ULS: [ULS License - Intelligent Transportation Service (Public Safety) License - WQBS407 - Florida, State of (fcc.gov)]

SCMS Enrollment Process

1 NEW PROJECTS STARTS HERE

Project Initiation

District and **CO** coordinates to ensure SCMS requirements and scope included in project scope/ procurement package

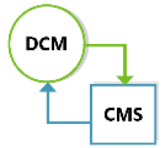
PROCUREMENT

2 ENROLLMENT PREPARATION

District TSM&O submits project info to CO CAV and requests SCMS enrollment

1. FDOT selects contractor/devices vendor for providing RSUs/OBUs. District TSM&O communicates the project SCMS support need and the device providers for the project.
2. CO CAV will approve the addition/removal of the device vendor as provisioner for a requesting District
3. CO confirms the number of devices to be enrolled
4. CMS Manager/ ISS contacts project Device Configuration Manager (DCM)/device vendor and establishes Attestation and enrollment protocol and requirements
5. It is vendors responsibility to meet requirements and complete Attestation and enrollment with technical support from CMS Manager

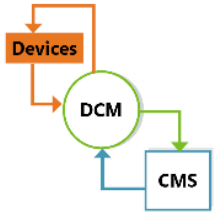
3 ENROLLMENT



DCM facilitates download of Enrollment certs for each device

1. Provisioner ensures to use the serial number embedded on the devices to use as the enrollment serial number.
2. Provisioners ensures to tag devices for the Districts they are intended for and enroll devices in the correct District project.

4 PROVISIONING



DCM faciliates download of Production certs for each device

5 DEPLOY, TEST & ACCEPT

Contractor installs devices

1. District TSM&O verifies the EE enrolled properly with accurate PSID and SSP permission by logging into the Device Management Dashboard.
2. District TSM&O verifies the EEs have been enrolled with the accurate serial number for future tracking and maintenance

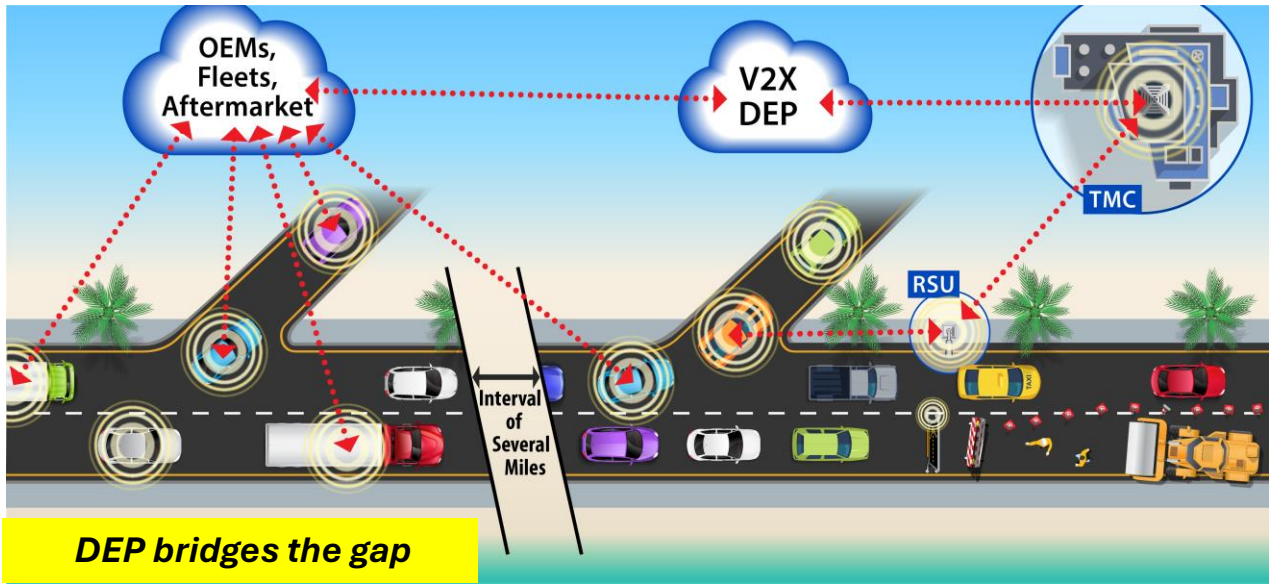
6 PROJECT COMPLETE

1. Districts continue to monitor health and status of the devices.
2. Districts are responsible for accurate count of devices within the District boundary

SCMS Technical Working Group

- Representation from each District to tackle the day-to-day technical items.
- Developed training modules including short video training on various functions of the platform.
- Get in touch with the District TSM&O staff

Vehicle-to-Everything Data Exchange Platform (V2X DEP) Integration



RSU requirement

RSUs should be capable of forwarding received messages, filtered by channel and/or PSID to **multiple target destination IP/port (UDP) combinations.**

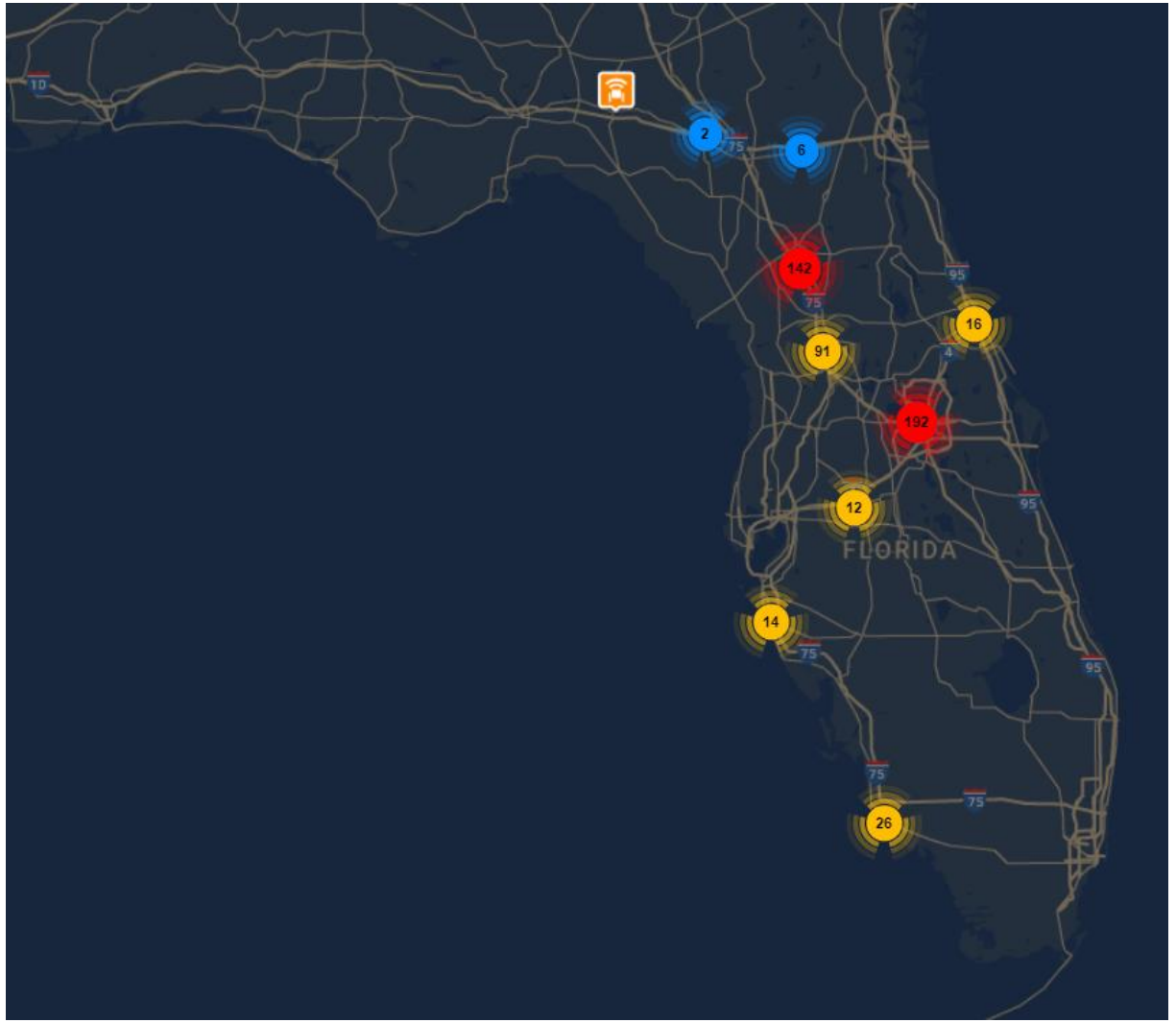
RSU Health Monitoring System

Project Objectives:

1. Provide holistic management of health monitoring and status of RSUs
2. Distribute alerts and other important information to district systems

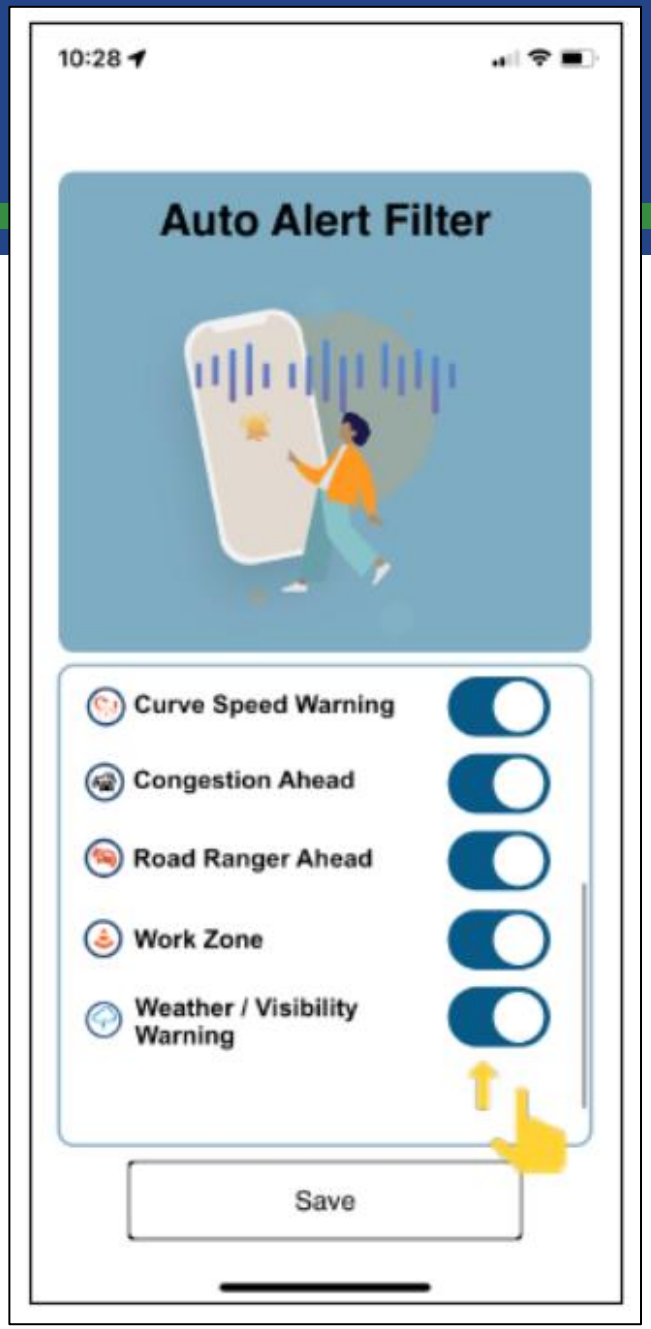
Operational Status

- Healthy
- Unhealthy
- Communication Error



FL511 Smartphone Application Enhancement

- Connected Vehicle Messages through FL511
  - Low Hanging Fruit to start leveraging CV technology benefits while OEMs work to increase penetration of equipped vehicles.
  - Allows safety related TIM messages to be provided to the public now using the FL511 Mobile Application in unequipped vehicles.



Thank you!


ZERO FATALITIES
& SERIOUS INJURIES
ON FL ROADWAYS
EVERYONE
HAS SOMETHING
TO GET HOME TO
FDOT
TARGET
ZERO

Contact Us

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