Hollywood, FL

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2024 TRANSPORTATION SYMPOSIUM

Connected & Automated Vehicle (CAV) Best Practices

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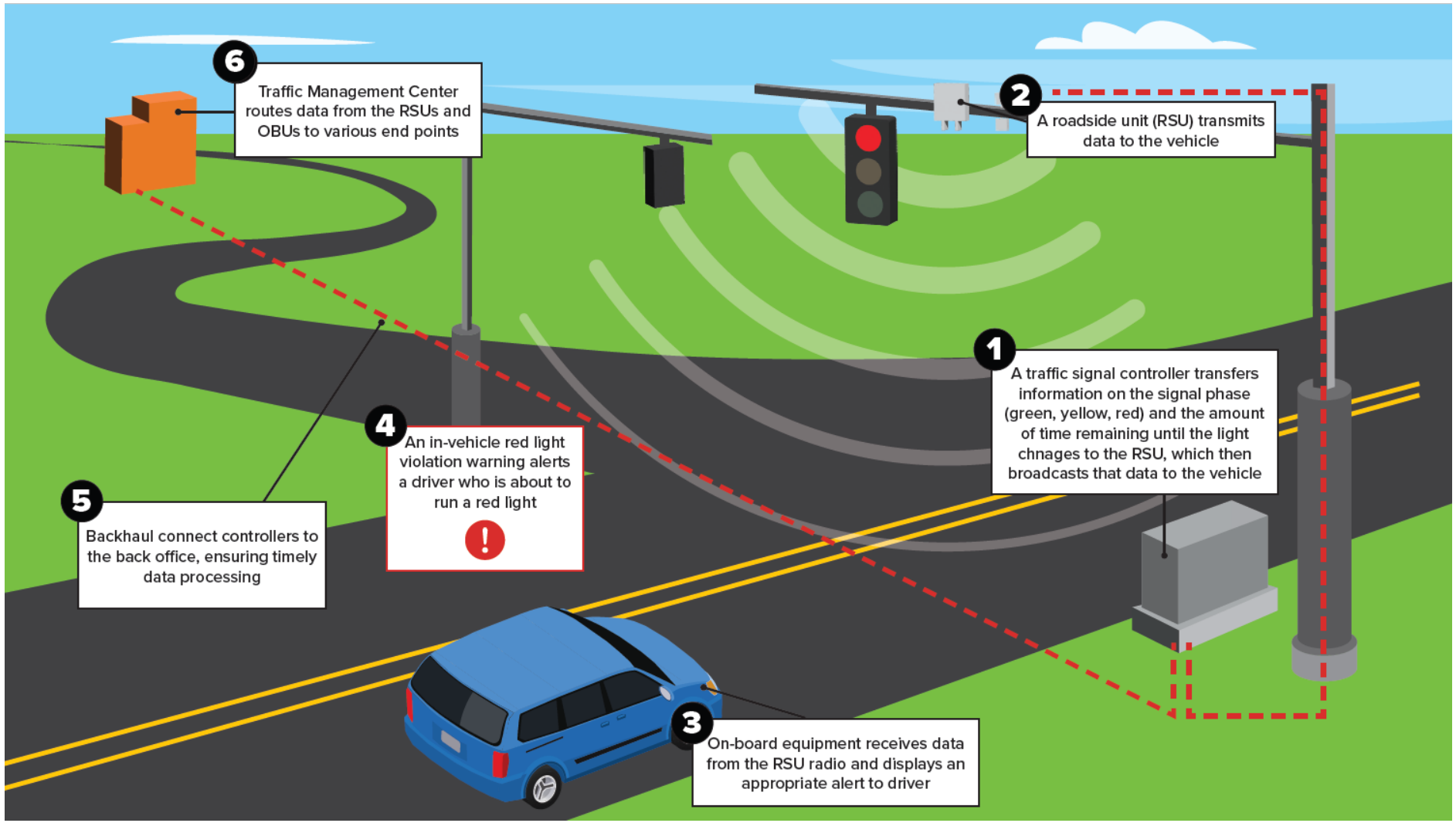
FDOT

Objectives:

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

What is Connected Vehicle?

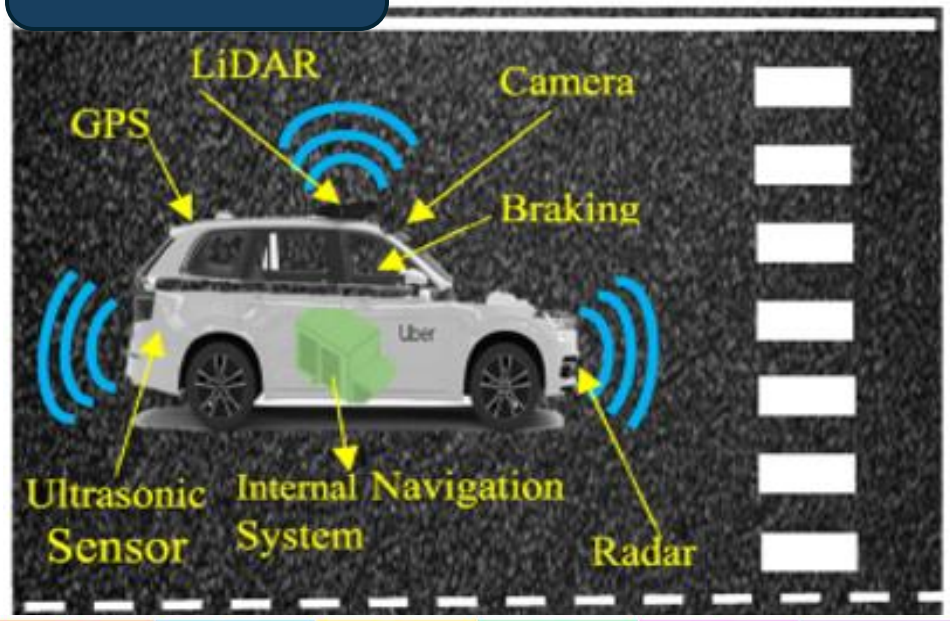


System Components

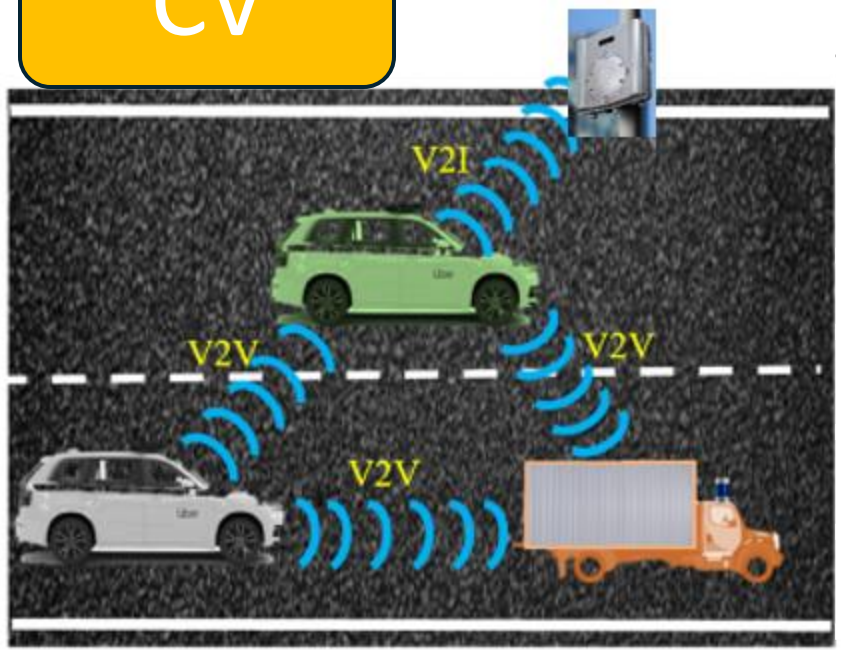
1. Traffic Signal Controller (arterial deployments)
2. Roadside Unit (RSU)
3. Onboard Unit (OBU)
4. Direct 5.9 GHz Communication:
   - C-V2X
   - DSRC (phasing away)
5. Communication/back haul to RTMC/TMC
6. Traffic Management Center

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

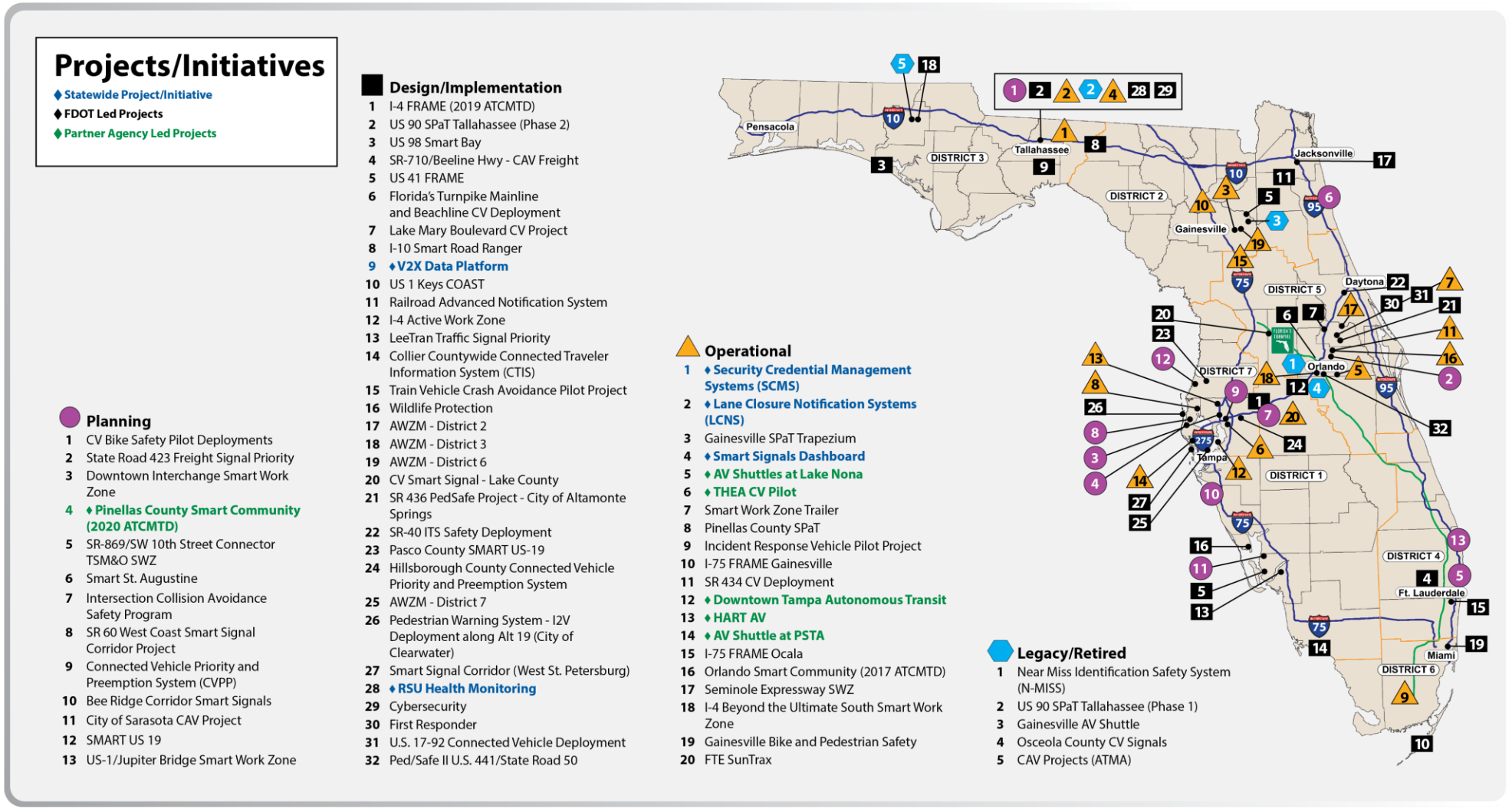
On-board Unit (OBU)

Vehicle with (OBU)

Pedestrian with Smartphone ped safety application

Gainesville, FL

How Many CAV Projects in Florida?



How Many CAV Research Projects in Florida?

5

On-going *Projects*

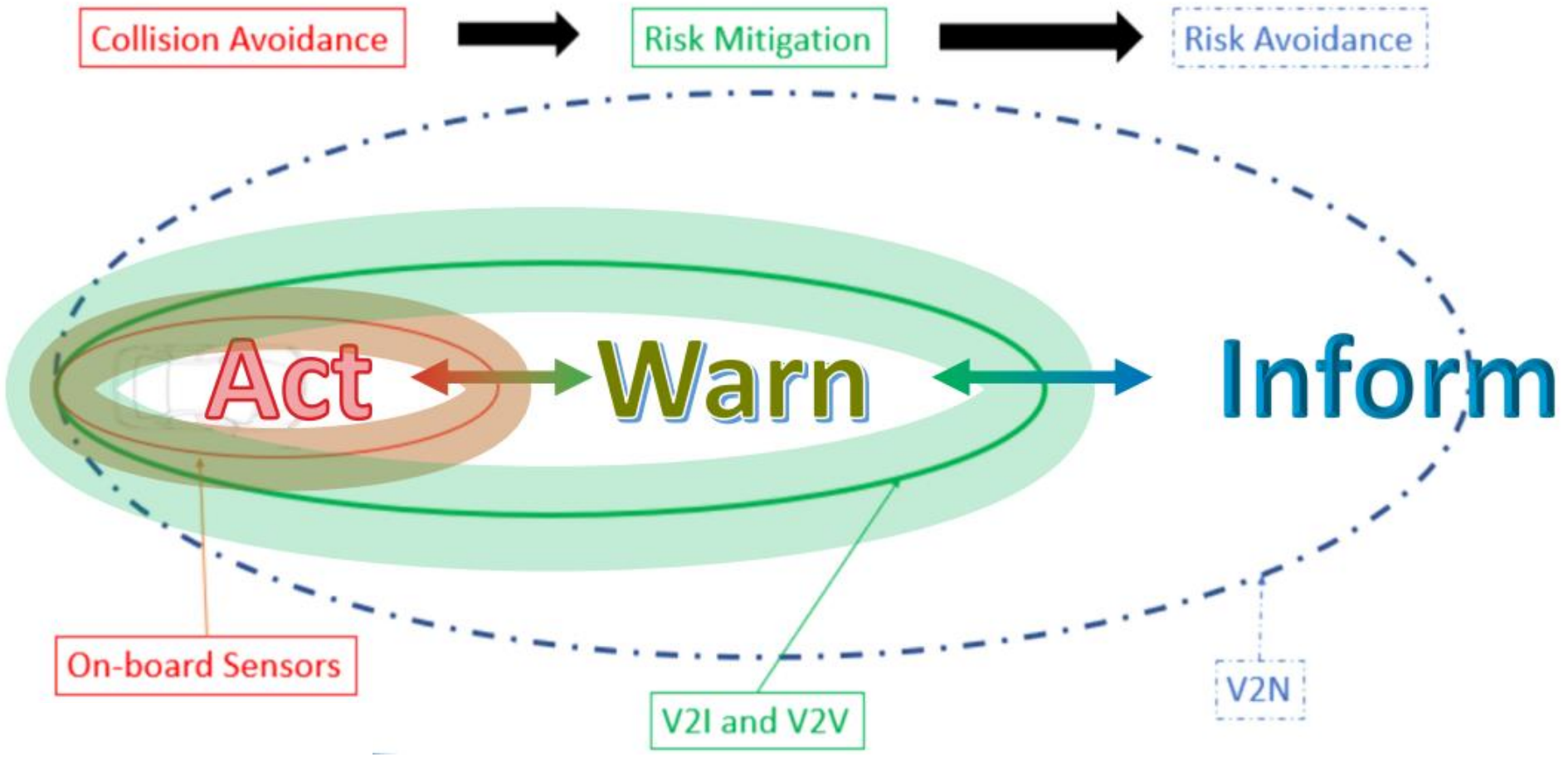
16

Completed *Projects*

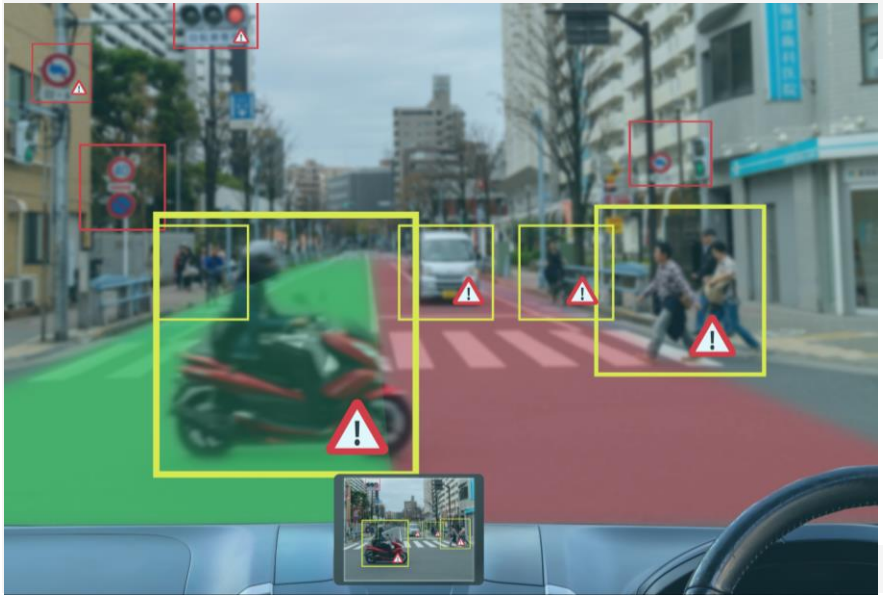
What Is Vehicle-to-Everything (V2X) Communication?

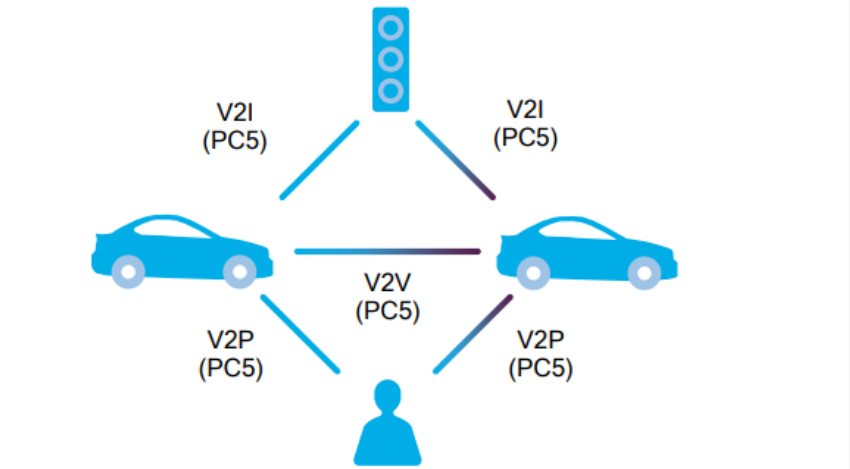
V2X provides the communication technologies for CAV.

- **V2N:** Vehicle-to-Network
- **V2I:** Vehicle-to-Infrastructure
- **V2V:** Vehicle-to-vehicle



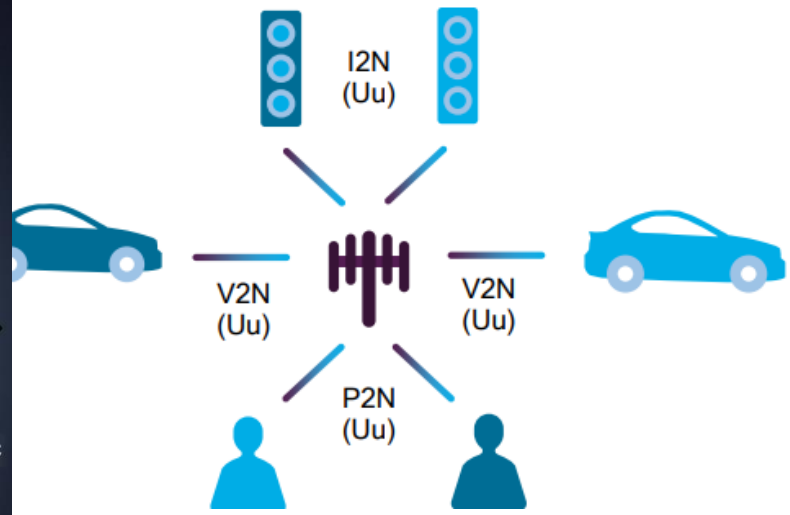
How Does Cellular Vehicle-to-Everything (C-V2X) Work?





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

What is the Guiding Principle of FDOT's CAV Program?

CAV Business Plan Vision drives, towards **Target Zero** with a **fatality-free** roadway network and a **congestion-free** transportation system using **CAV technologies**

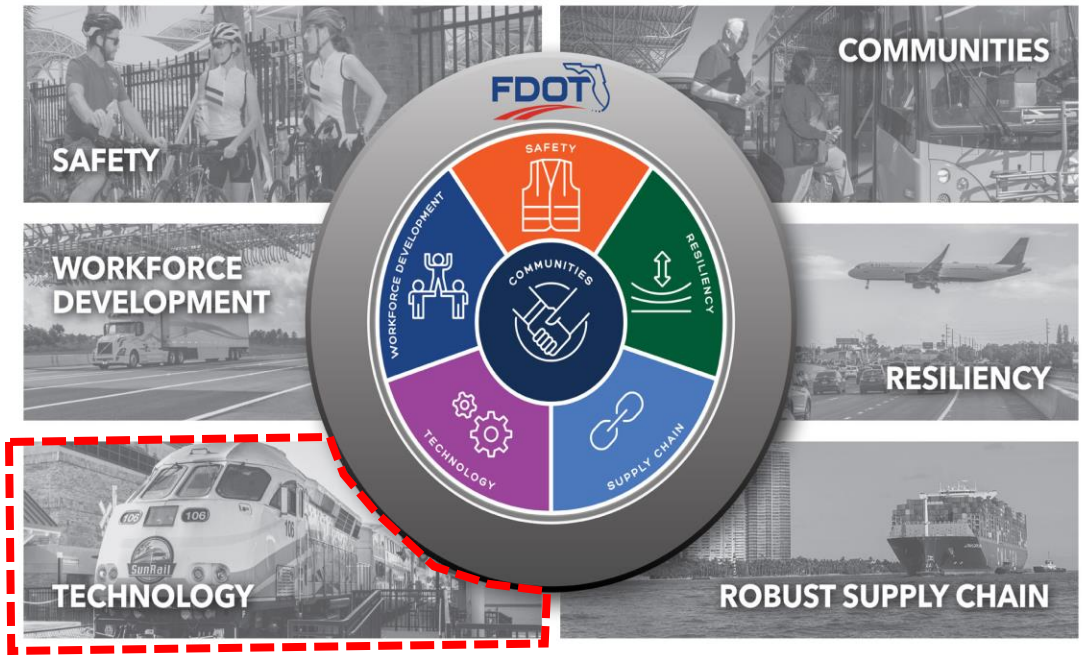
2017
FDOT initiated the conceptualization of programs like I-STREET

January 2019
FDOT adopted the CAV Business Plan

2019-2025
Multiple CAV focused projects deployed throughout the state

2018
The US 90 SPaT was FDOT's first connected vehicle project and one of the first in the nation

2019
FDOT leadership dedicated funding to the program



- FDOT's CAV Business Plan
- TSM&O Strategic Plan, Florida Transportation Plan and State Highway Safety Plan
- Follows National V2X Deployment Plan

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

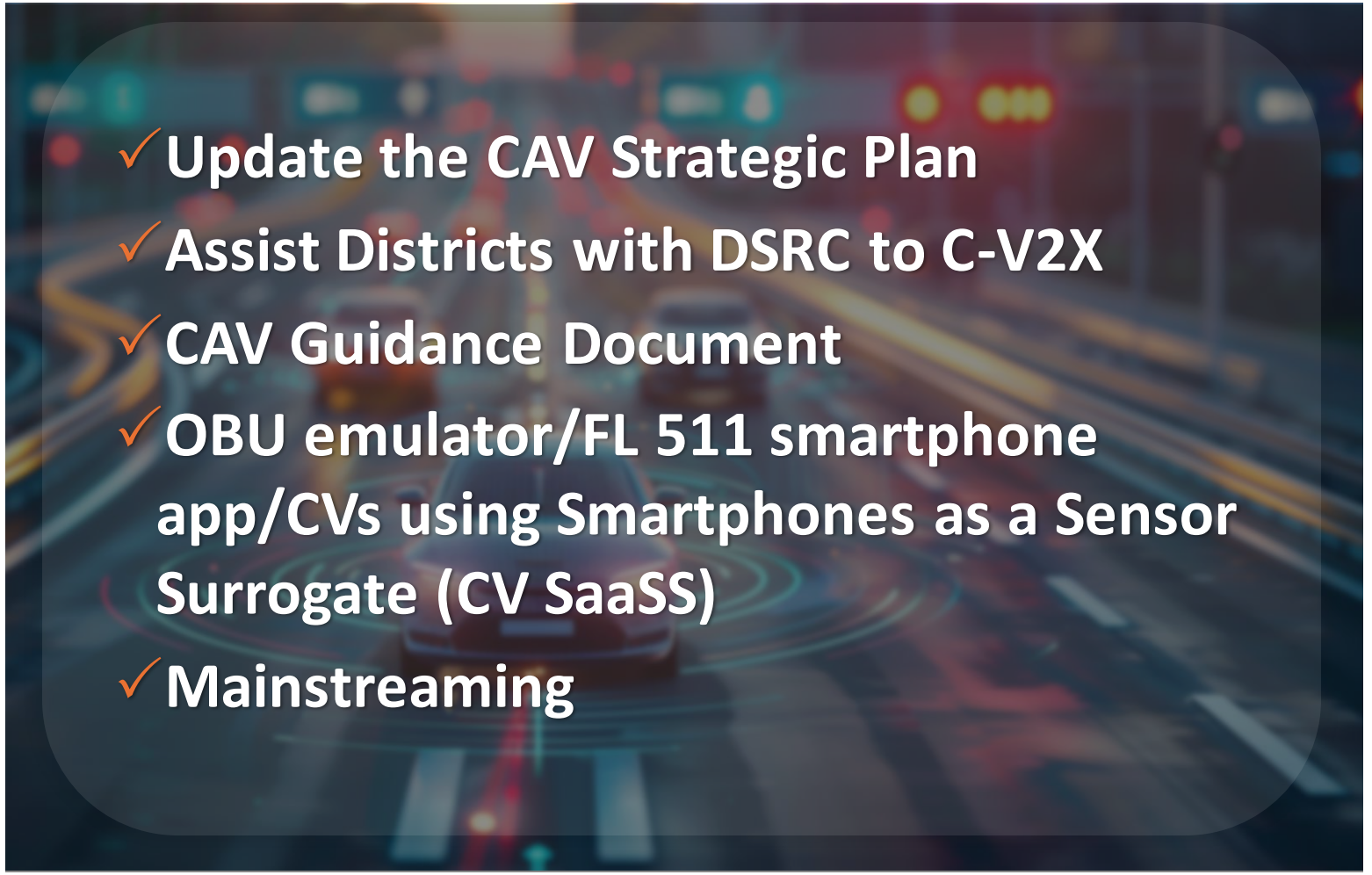
- *V2X Data Exchange Platform*
- *Security Credential Management System*
- *RSU Health Monitoring System*

Local Agency Partnership Programs

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

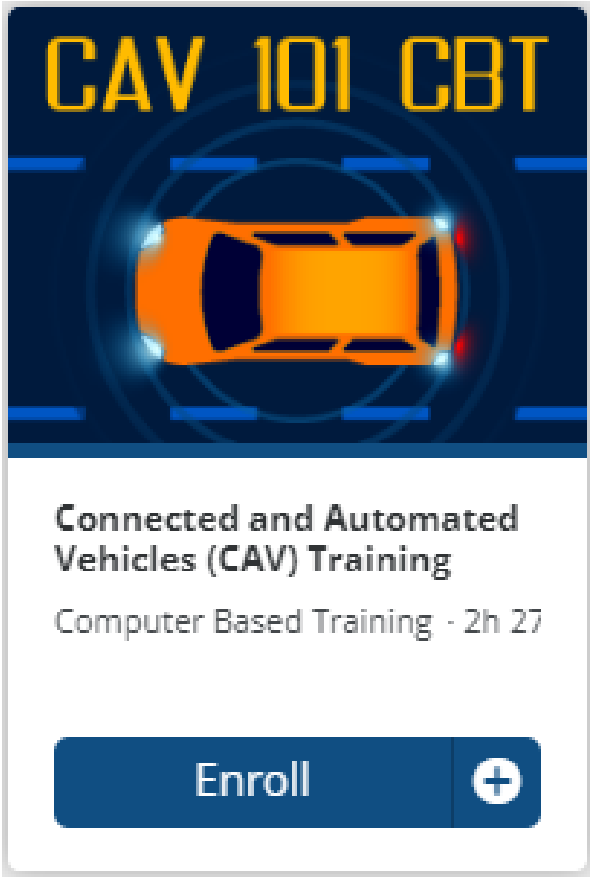
CAV 2.0 (2026-2030)

- Mainstreaming
- AV infrastructure readiness
- Projects included in the 10-year TSM&O Cost Feasible Plan



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 Considerations

What is an RSU and OBU?

Roadside Units (RSU)

Onboard Units (OBU)

RSU Developmental Specification- DvSpec681

Planning | Design | Construction | Operations

- *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*

OBU Requirements and Considerations

- ***Cellular Connection Required***
- ***Enrolled in Statewide SCMS System***
- ***Installation Method Consideration***
- ***Plan for Operations and Maintenance***
- ***Early Engagement with Stakeholder***
- ***Applications with Requirements***

Planning | Design | Construction | Operations

What are the Considerations?

Planning

- *Applications needed*
  - *Commonly used ones are TSP, EVP*
- *Freeway or arterials*
- *Local agency coordination for network access*
- *FDOT or local agency maintenance agreement*
- *Fleet support*
- *Plan integration needs:*
  - *FCC site registration*
  - *SCMS certificate support*
  - *V2X DEP integration*

Design

- *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 for certificate top off*
- *FCC site registration data collection*

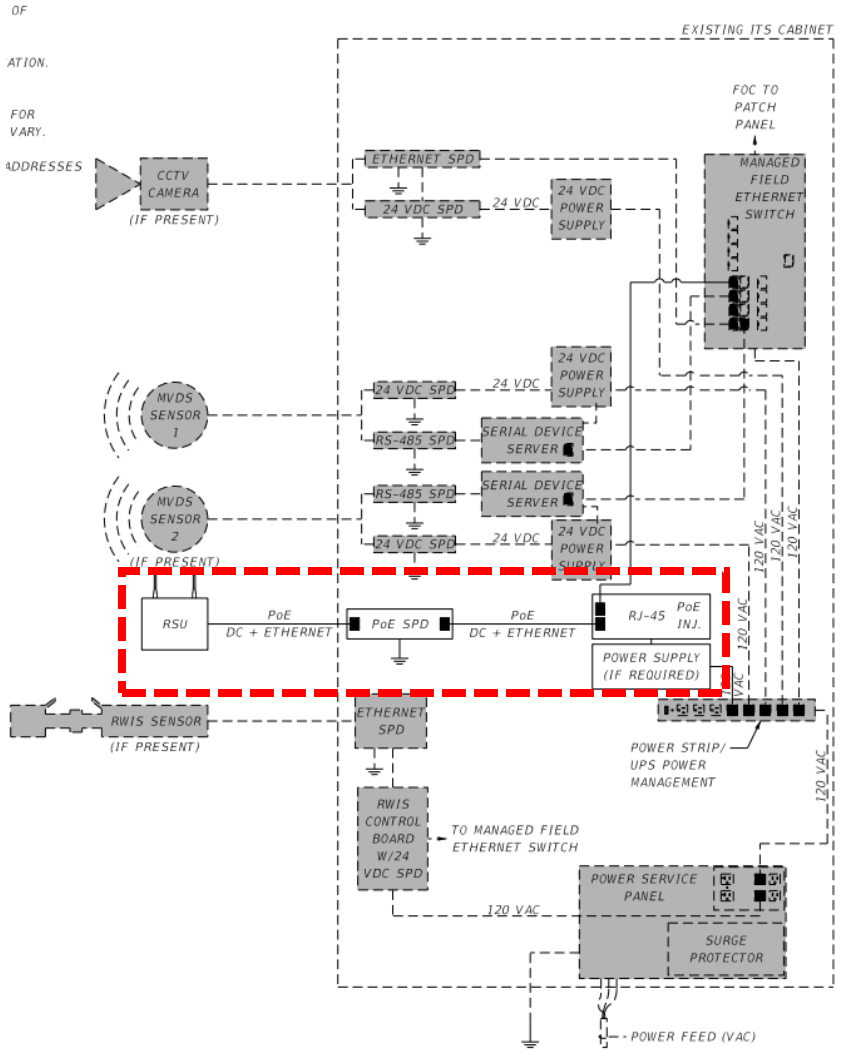
Construction

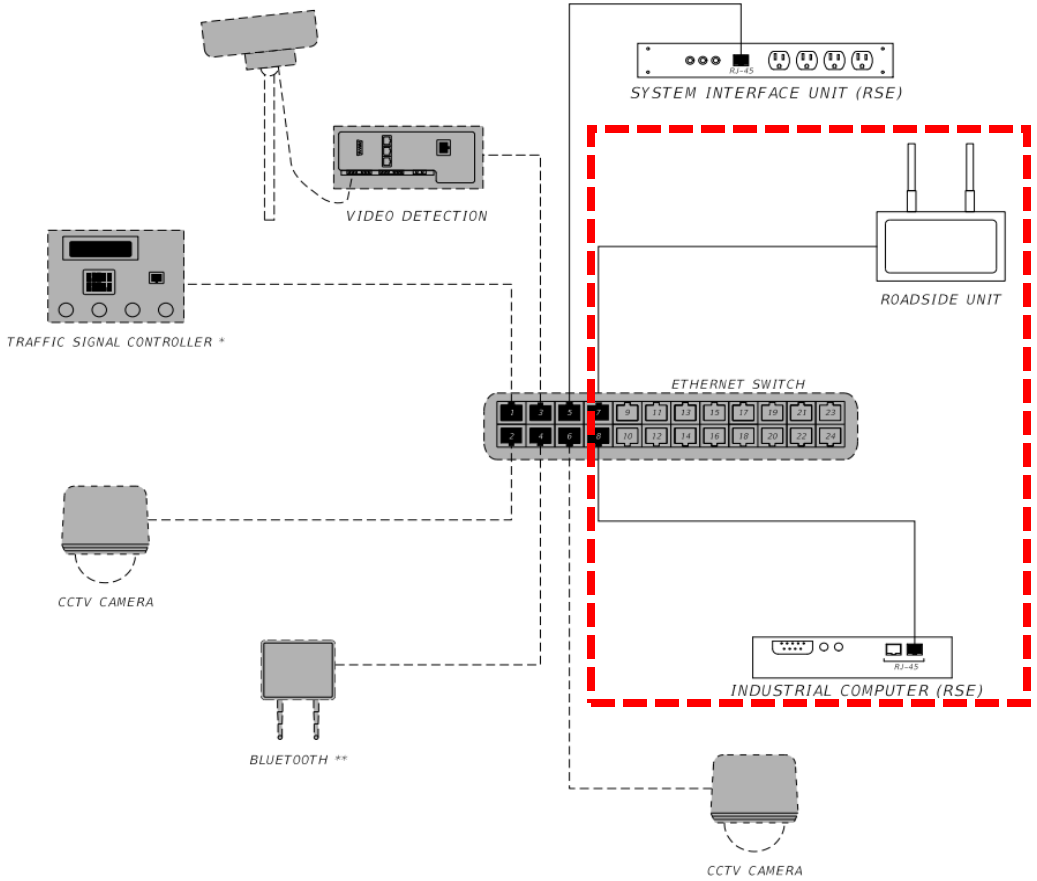
- *Systems integration*
- *Project acceptance testing*
- *Burn-in period*

Operation and Maintenance

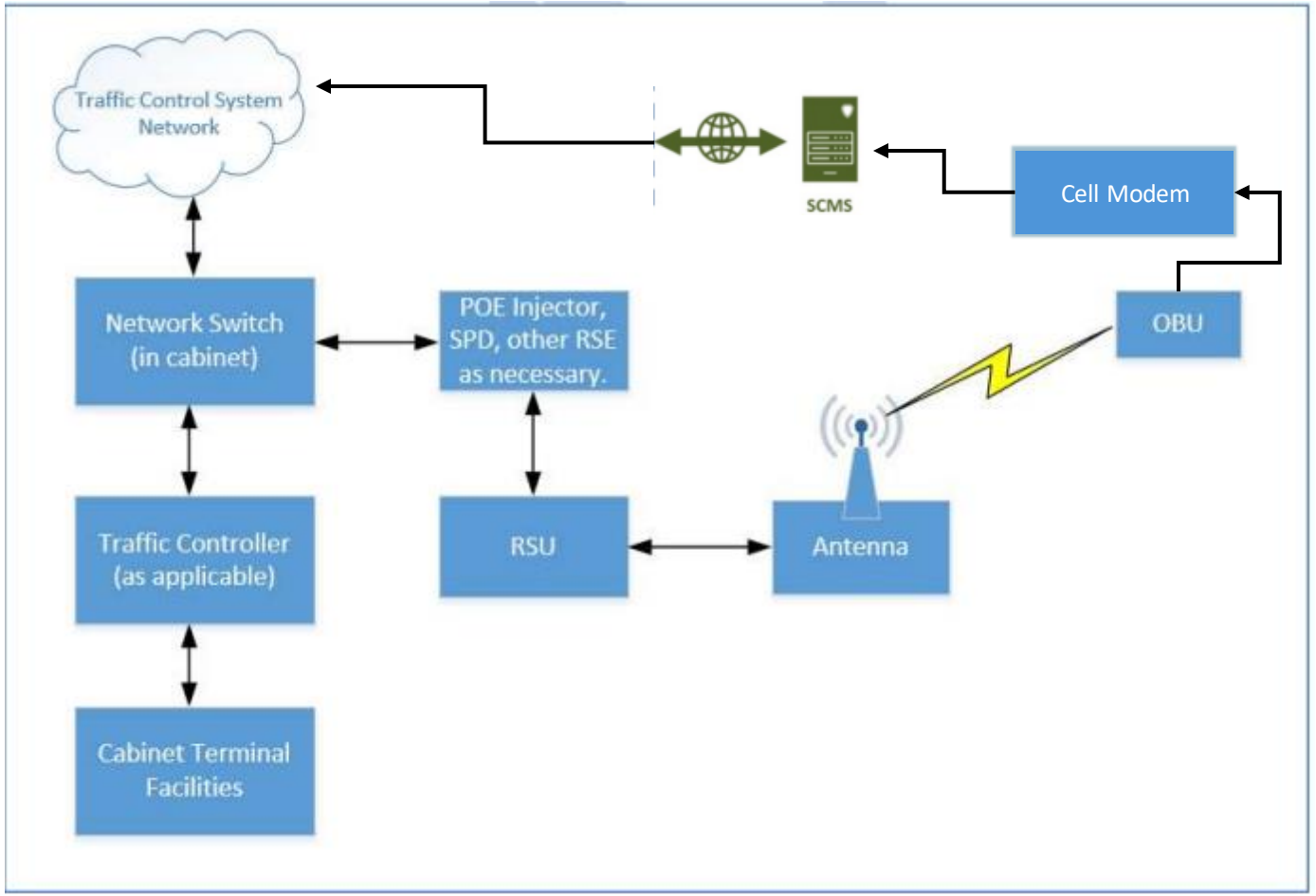
- *On-going maintenance of the accurate MAP*
- *Keep the FCC site registration up-to-date*
- *Network configuration and trouble-shooting*
- *Software licensing*
- *Monitor the status of the devices and data flow*

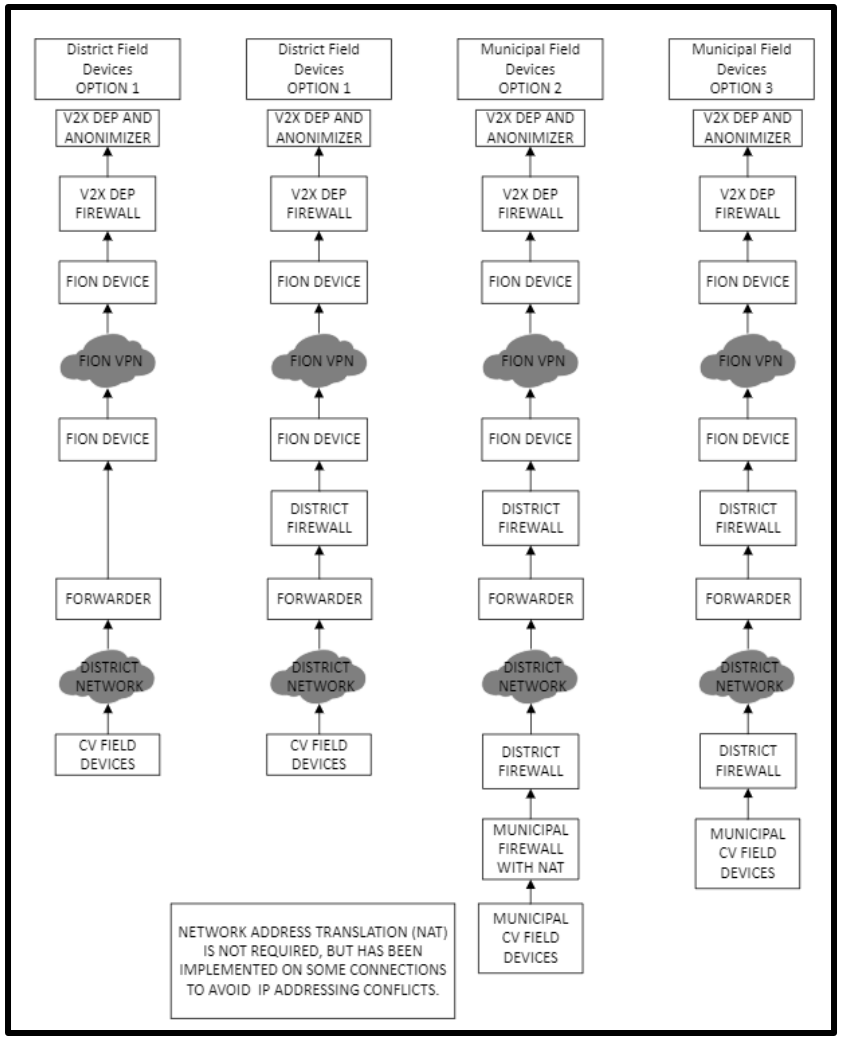
Freeway and Arterial Deployment – Typical Plan





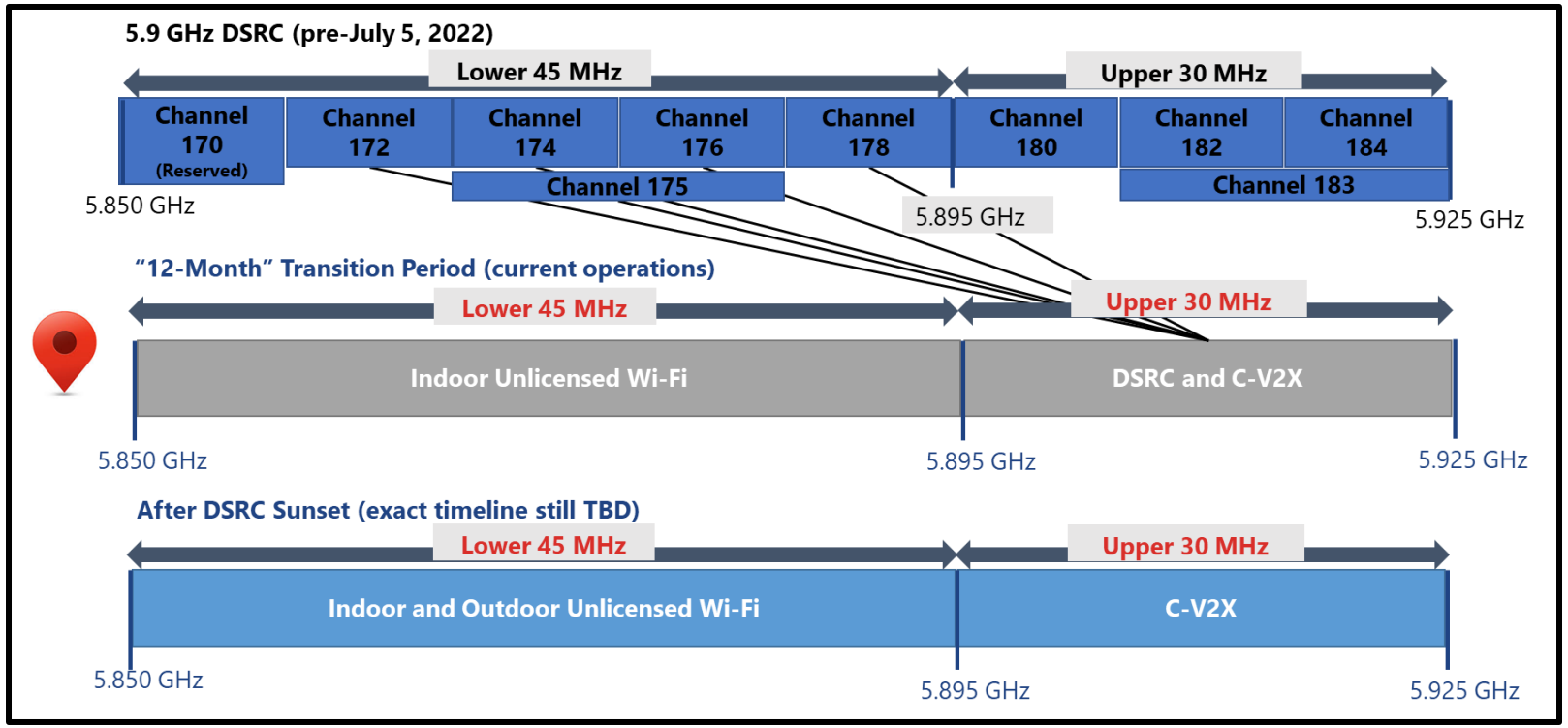
Typical Architecture and Data Flow





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***



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

Planning | Design | Construction | Operations

FCC Site Registration Update Criteria

Update site registration, if:

- ***Height is increased***
- ***RSU is relocated more than 10-ft from its original location without height increase***
- ***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)

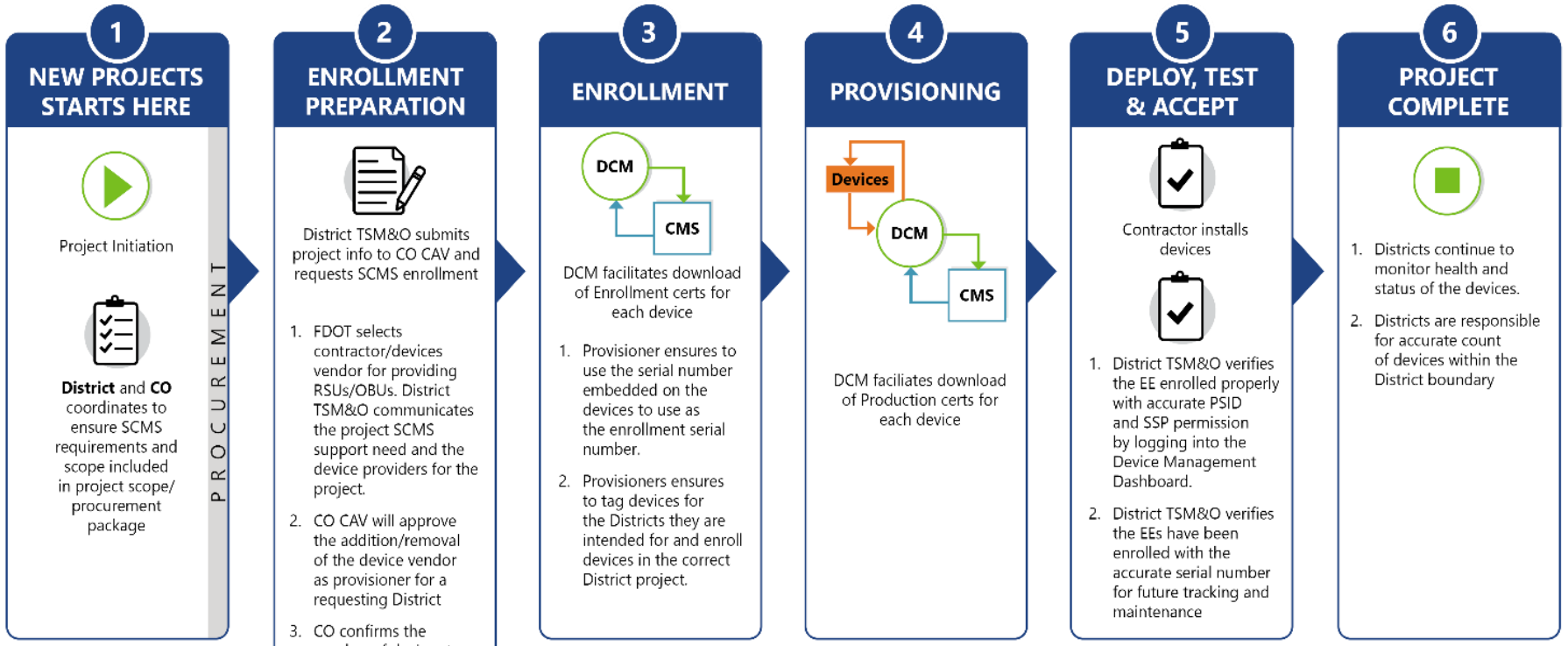
Transmitter Antenna Data	
Manufacturer of the Antenna:	L-com
Model Number of the Antenna:	HGV-4958-06U
Antenna Gain in dBi:	6.0
Beamwidth in degrees:	360.0
Center Line of Antenna height AGL in meters (calculated value):	7.9
Azimuth in degrees:	360.0
Elevation Angle in Degrees:	0.0

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

Planning | Design | Construction | Operations

SCMS Enrollment Process



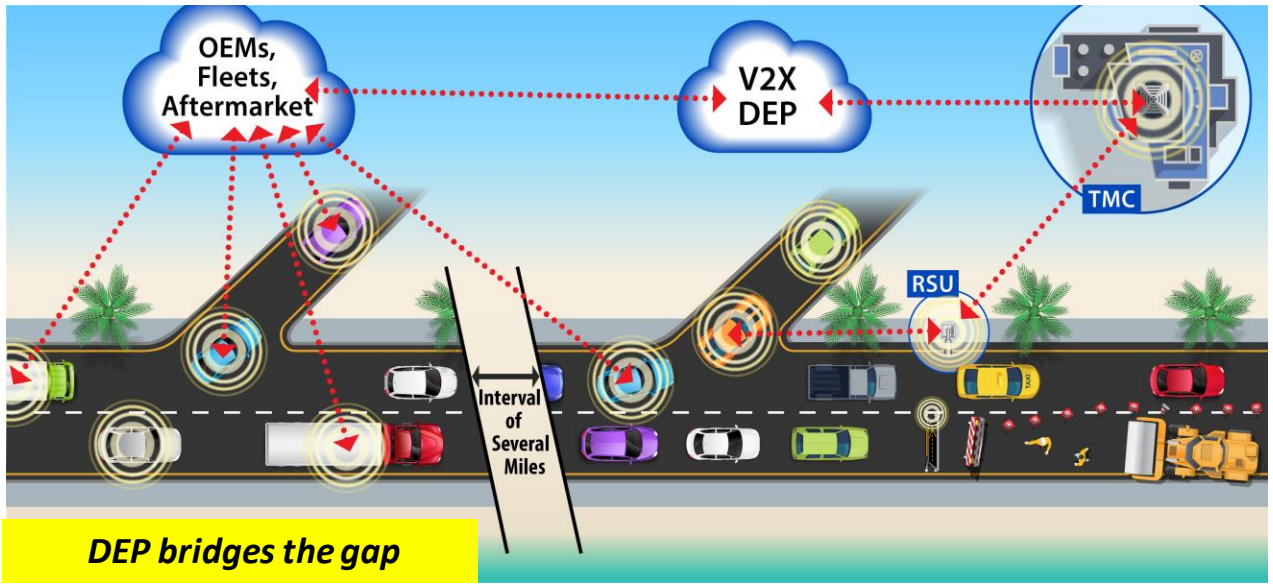
Planning | Design | Construction | Operations

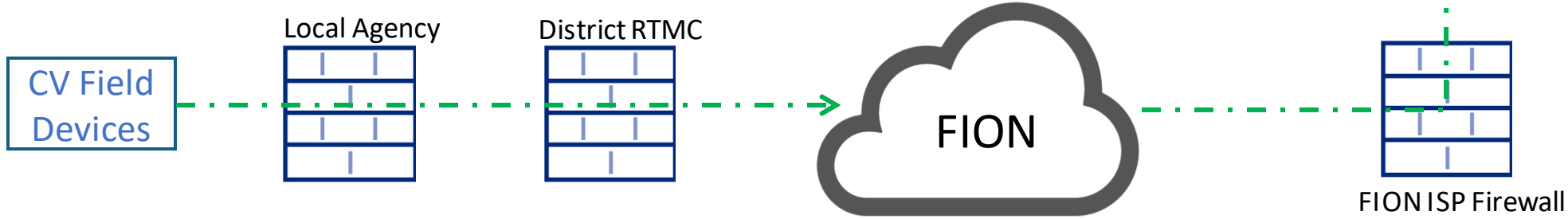
SCMS Technical Working Group

- 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

Planning | Design | Construction | Operations





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

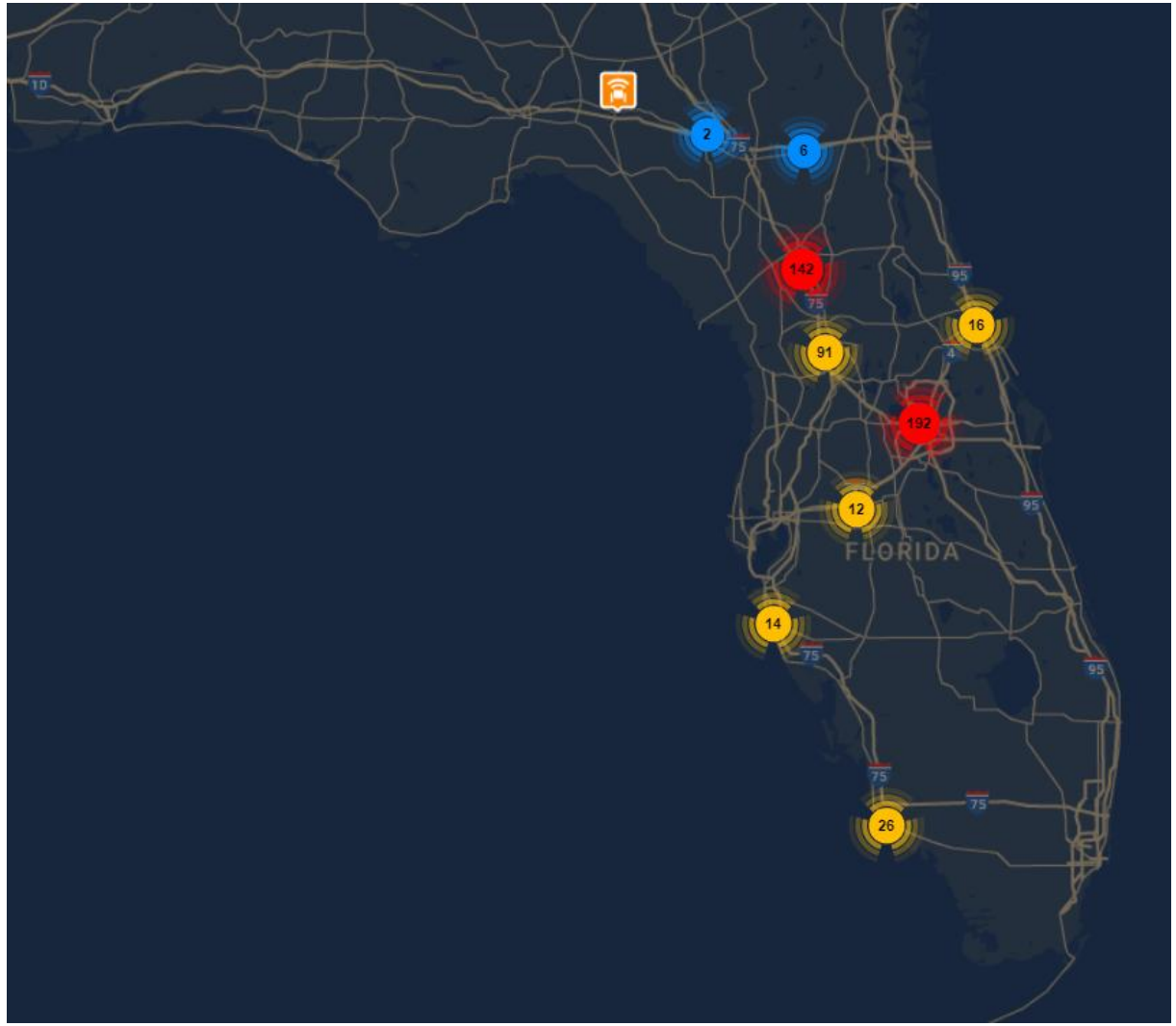
Planning | Design | Construction | Operations

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



Test Plan

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

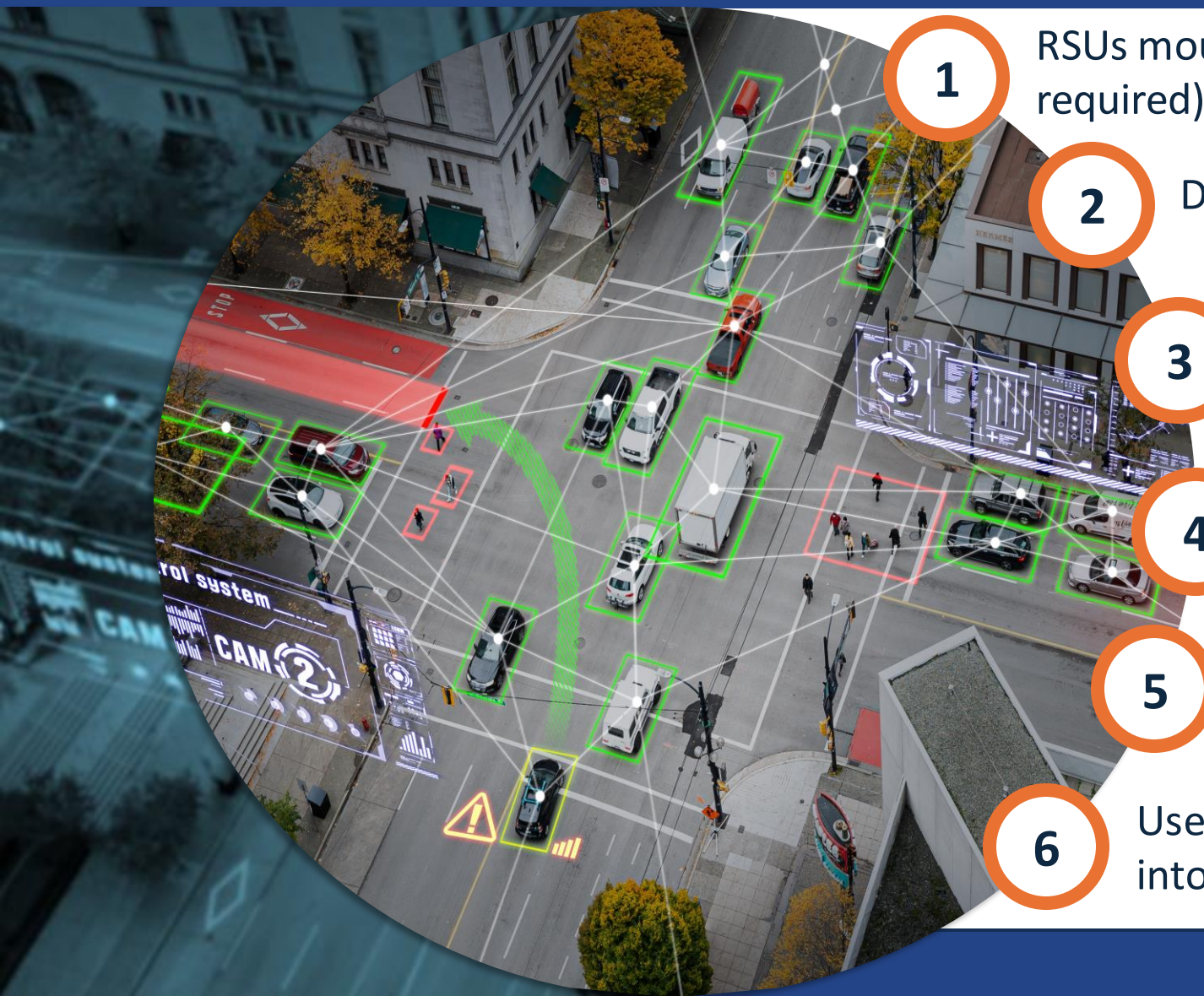
1. Verify physical construction and wiring
2. Verify proper voltages for all power supplies and related power circuits
3. Verify that the power LEDs on roadside equipment illuminates
4. Log in to CV equipment and verify access UI
5. Verify the configuration of CV equipment network interfaces
6. Confirm 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

Example Best Practices

Best Practices -
Stakeholder Engagement & Network Access Coordination

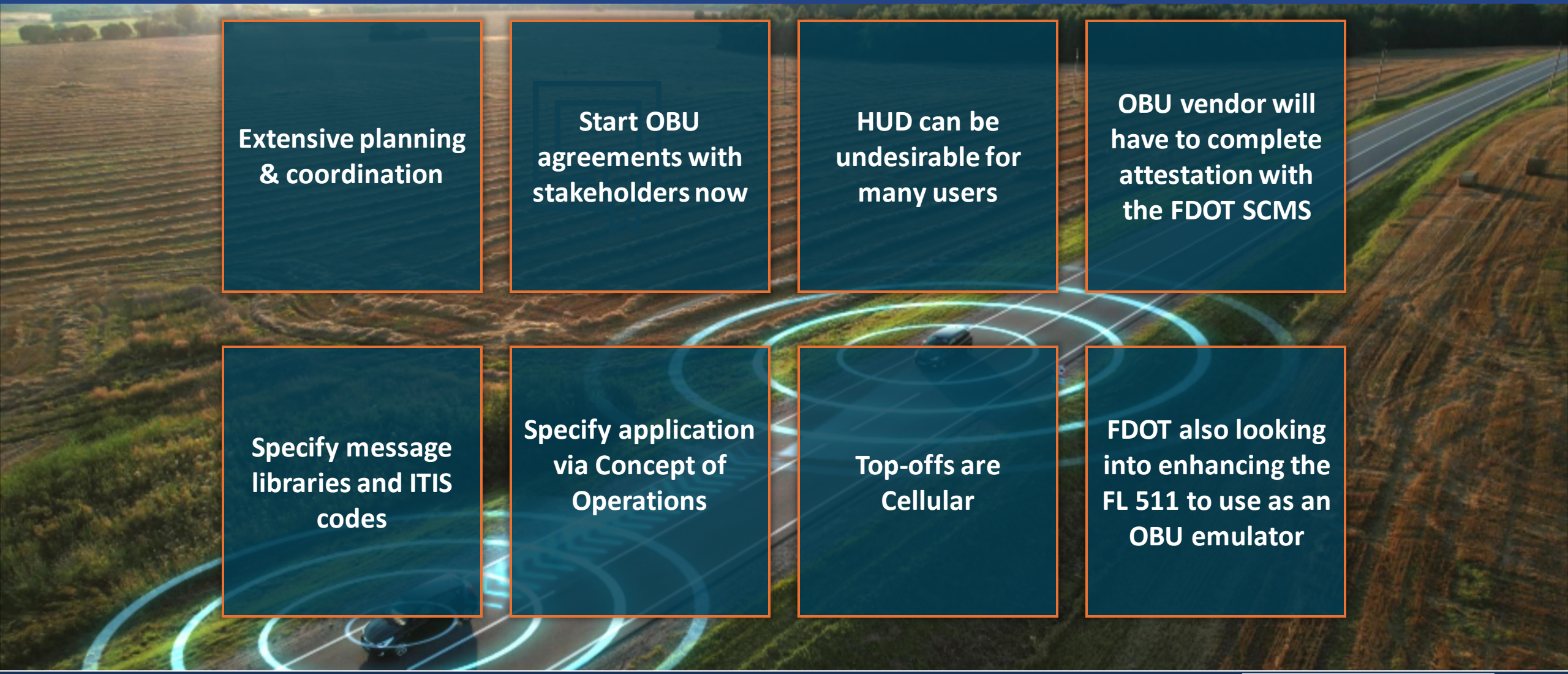
- ***Engage stakeholders early***
- ***Use plain English***
- ***Coordinate network changes and firewall updates***
- ***Perform a full network analysis alongside the local agency***
- ***Operations and maintenance agreement/MOU between all parties***

Best Practices
RSUs



1. RSUs mounted on vertical support also works (i.e., less MOT required)
2. Data forwarding to multiple end points/multicast
3. Support NTCIP 1218, complementary technology and FDOT's SCMS PSID Profile
4. Ensuring proper grounding for lightning protection
5. If not on the FDOT's IPL, work with TERL for device permitting/certification
6. Use the serial ID on the device for enrolling into the SCMS and other places

Best Practices
OBUs



- Extensive planning & coordination
- Start OBU agreements with stakeholders now
- HUD can be undesirable for many users
- OBU vendor will have to complete attestation with the FDOT SCMS
- Specify message libraries and ITIS codes
- Specify application via Concept of Operations
- Top-offs are Cellular
- FDOT also looking into enhancing the FL 511 to use as an OBU emulator

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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