

# Central Florida Connected Vehicles Initiative

Presented to:  
MetroPlan Orlando

April 24, 2020



# Overview



CV OVERVIEW



LOCAL CV INITIATIVES



PROJECT HIGHLIGHTS

# Connected Vehicles Definition

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The term **connected vehicles** refers to applications, services, and **technologies** that connect a **vehicle** to its surroundings

Connected vehicle technology will enable vehicles, roads & other infrastructure, and our smartphones to all communicate and share vital transportation information through advanced wireless communication technology



Photo Source: US DOT



# Connected Vehicles Overview

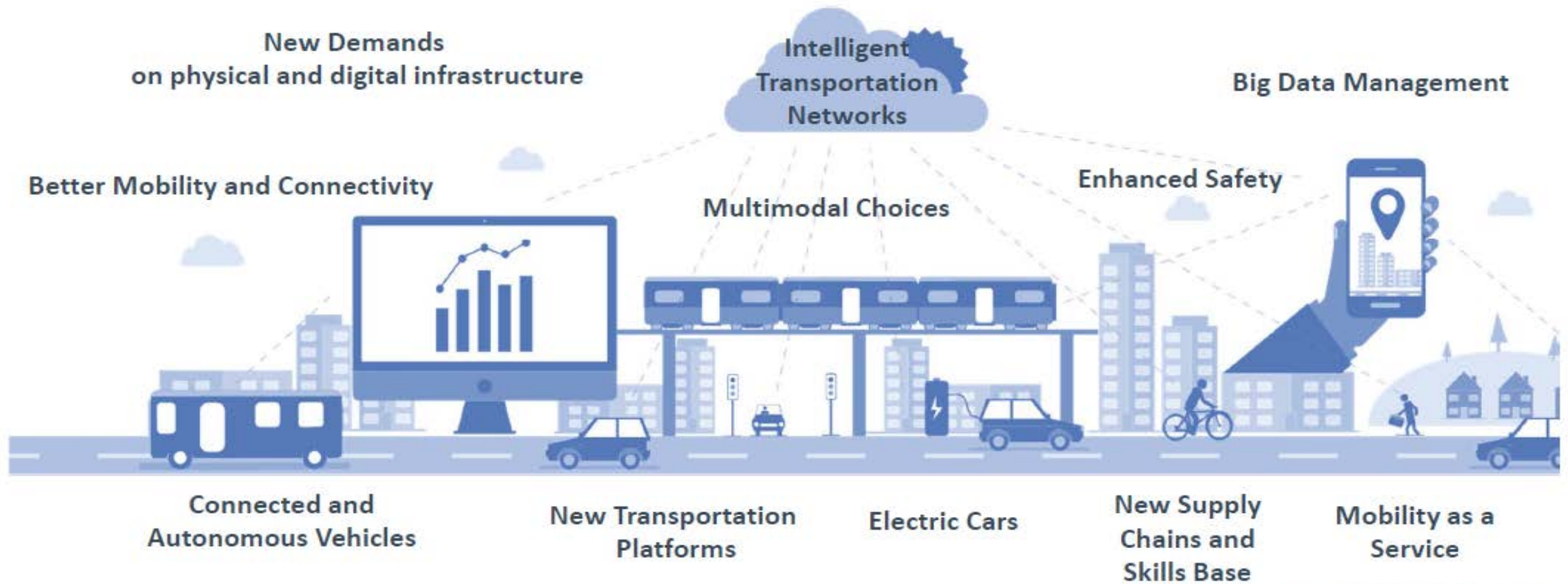
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## CV Technologies

- Hardware
- Software
- Testing



# A connected, digital world with smarter streets.





# Hardware

## Roadside Units (RSU)

- Wireless communication between the roadway infrastructure and the vehicles that are equipped with OBUs
- Communicates on the 5.9 GHz DSRC band or C-V2X to transmit and receive CV messages

## Integrated V2I Prototype (IVP) Hub / (Industrial Computer)

- A small form-factor computer
- Handles the processing of CV applications
- Allows the RSU to perform “radio” functions only

## On-board Units (OBU)

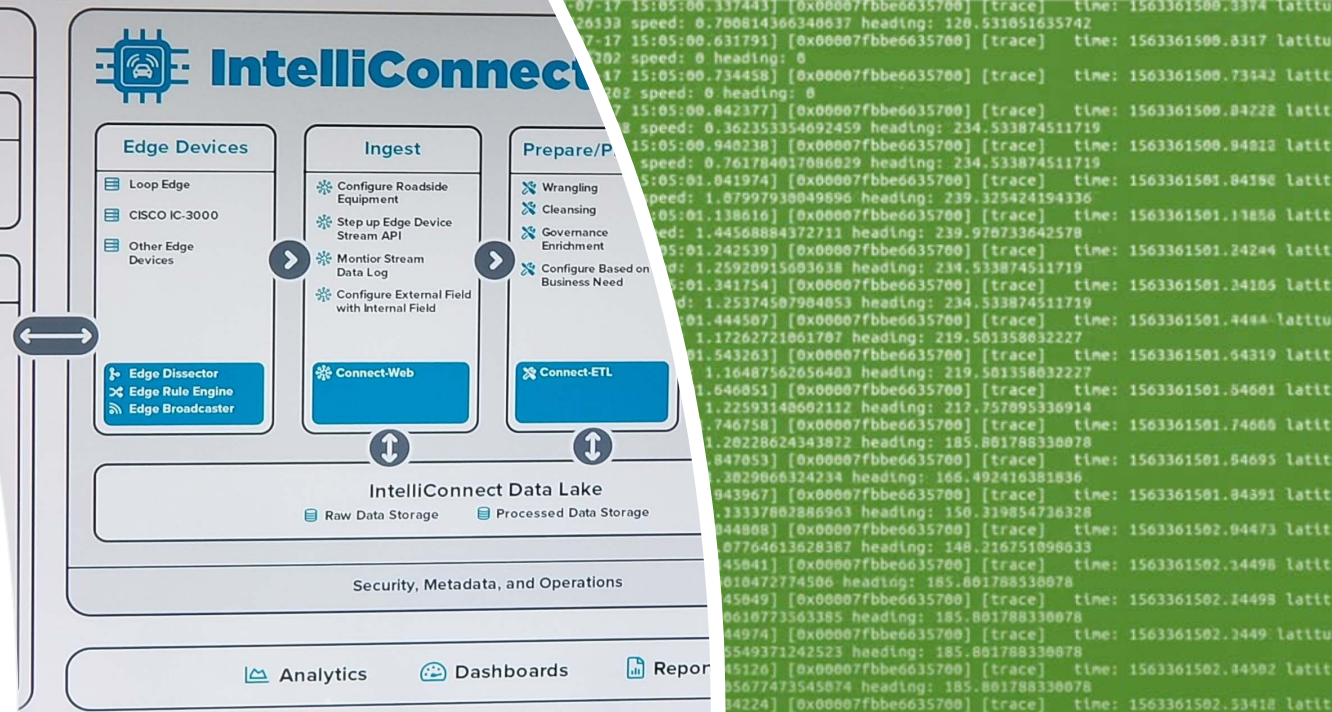
- Device installed on the motor vehicle to allow communication (transmitting/receiving) with other OBUs or RSUs having WAVE functionality

## Detection Devices

- Detect & notify of pedestrians/bicyclists

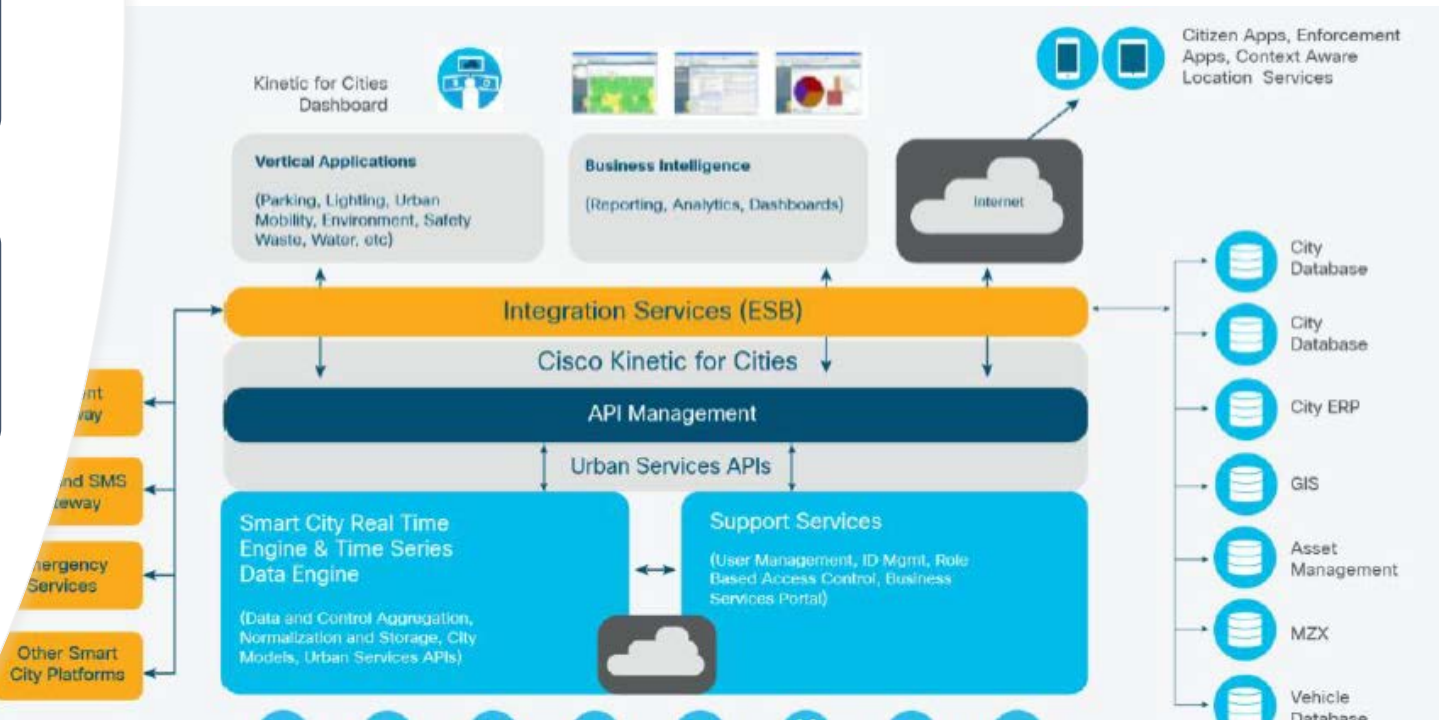


# CV Technologies (Software)



**CV Applications** Broadcasting Messages

**Platform for CV Central Management** Device Management  
Dashboards & Maps  
Alerts and Notifications

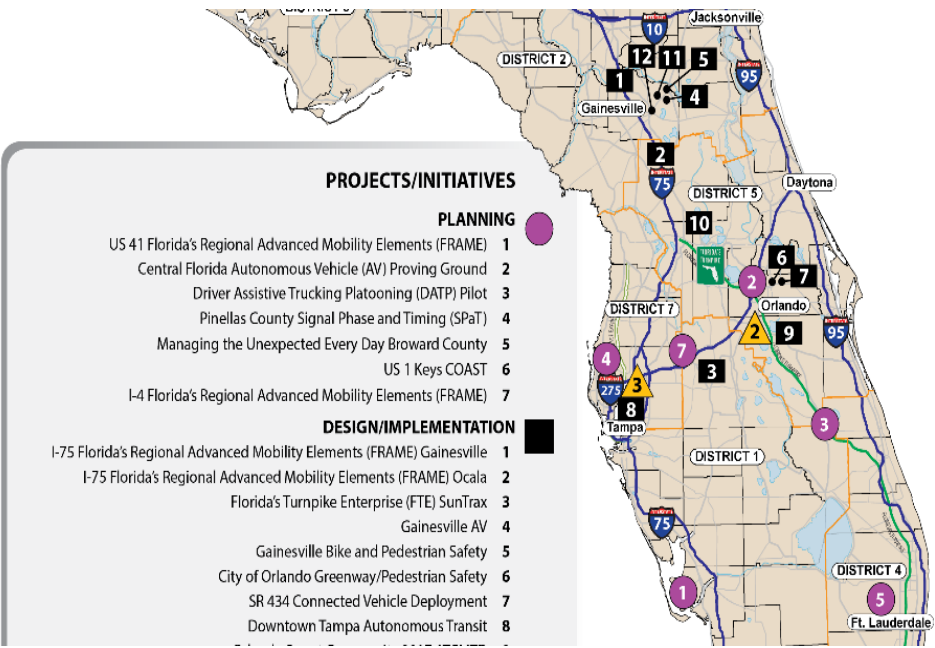




LOCAL CV  
INITIATIVES



# Central Florida



**PROJECTS/INITIATIVES**

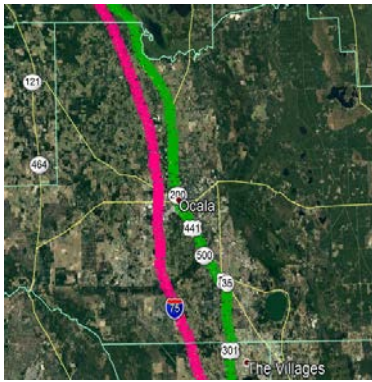
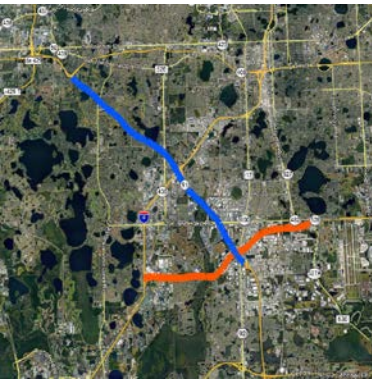
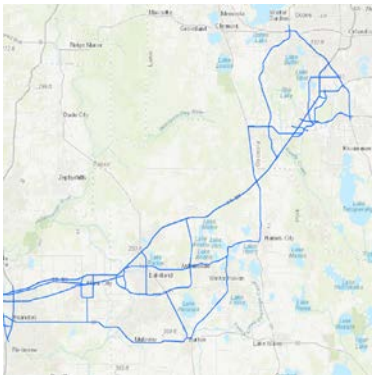
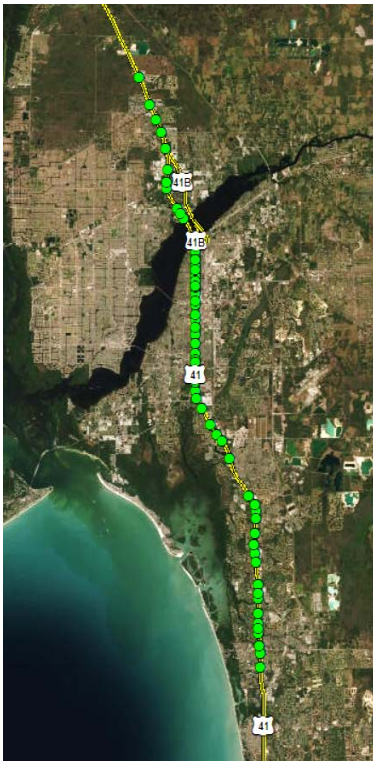
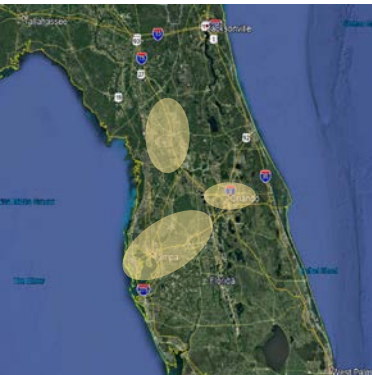
**PLANNING**

- US 41 Florida's Regional Advanced Mobility Elements (FRAME) 1
- Central Florida Autonomous Vehicle (AV) Proving Ground 2
- Driver Assistive Trucking Platooning (DATP) Pilot 3
- Pinellas County Signal Phase and Timing (SPaT) 4
- Managing the Unexpected Every Day Broward County 5
- US 1 Keys COAST 6
- I-4 Florida's Regional Advanced Mobility Elements (FRAME) 7

**DESIGN/IMPLEMENTATION**

- I-75 Florida's Regional Advanced Mobility Elements (FRAME) Gainesville 1
- I-75 Florida's Regional Advanced Mobility Elements (FRAME) Ocala 2
- Florida's Turnpike Enterprise (FTE) SunTrax 3
- Gainesville AV 4
- Gainesville Bike and Pedestrian Safety 5
- City of Orlando Greenway/Pedestrian Safety 6
- SR 434 Connected Vehicle Deployment 7
- Downtown Tampa Autonomous Transit 8

Planning  
 Design/Implementation  
 Operation



## Central Florida CV Initiatives

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### Project Highlights



FDOT D5 – I-75 FRAME



Florida's Turnpike Enterprise (FTE) –  
CV Pilot Project

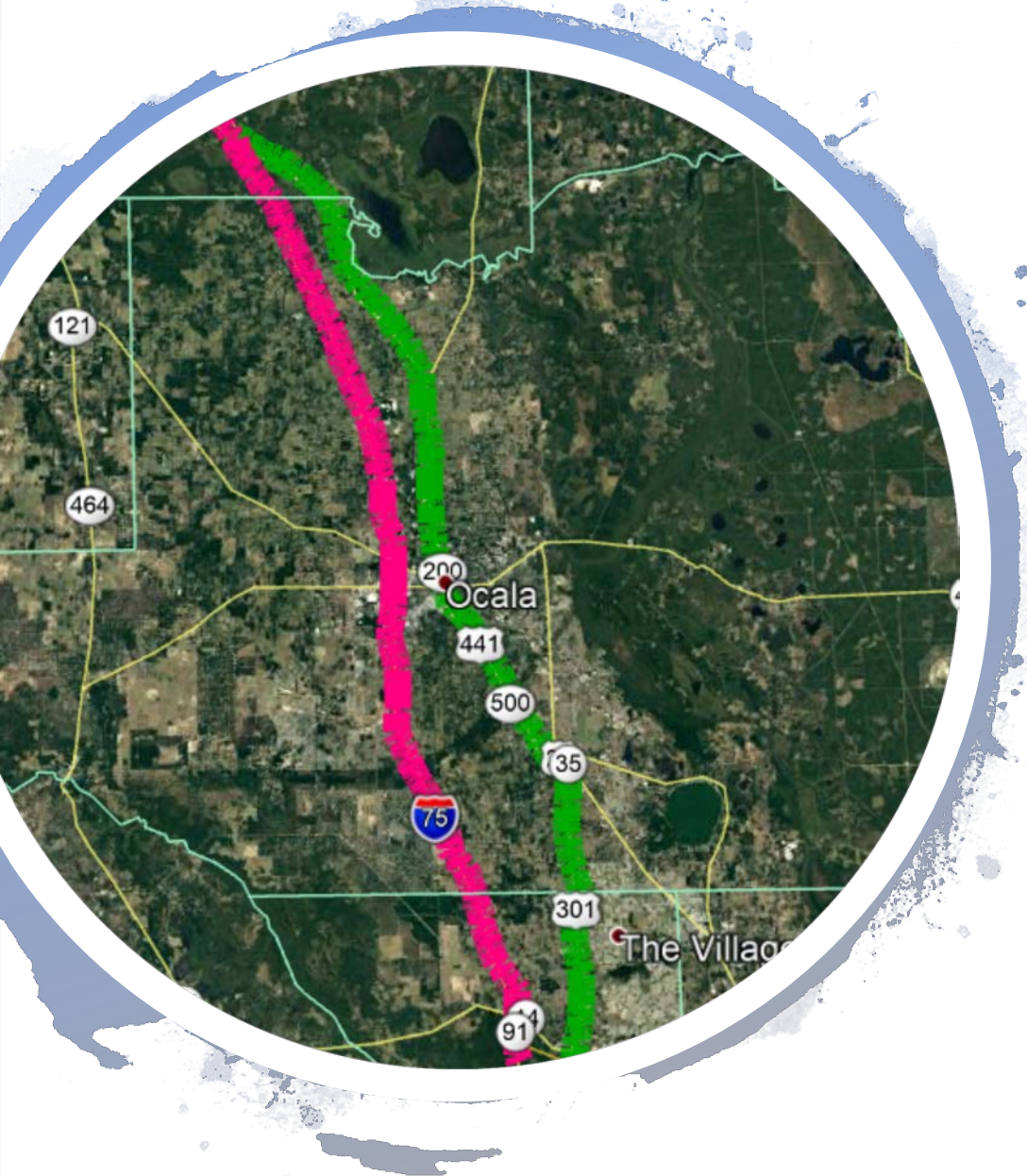


FDOT D1 – US 41 FRAME



FDOT CO – I-4 FRAME (includes D5,  
D1 and D7)

# I-75 FRAME



- **Location:** Marion & Sumter Counties along I-75 & US 301/441 from TPK to D5 Boundary
- **Elements:** Traffic Signals, 104 RSU's
- **Goal:** The purpose of this project is to implement CV technology and Signal Performance Metrics (SPM) in Sumter and Marion Counties  
Improve Safety & Mobility with the Deployment of CV Technology
- **Project:** System Manager Approach (Awarded to Metric Engineering)
  - Includes CV technology along I-75, US441 & US 301
  - Includes Signal Performance Measures
  - CV Applications include:
    - Signal Phase & Timing (SPaT)
    - Map Data Message (MAP)
    - Traveler Information Message (TIM)
    - Transit Signal Priority (TSP)
    - Emergency Vehicle Preemption (EVP)
- **Status – In Construction**
  - Production date: Jan. 2, 2019
  - Construction Awarded to InLine
  - Implementation planned for late 2020

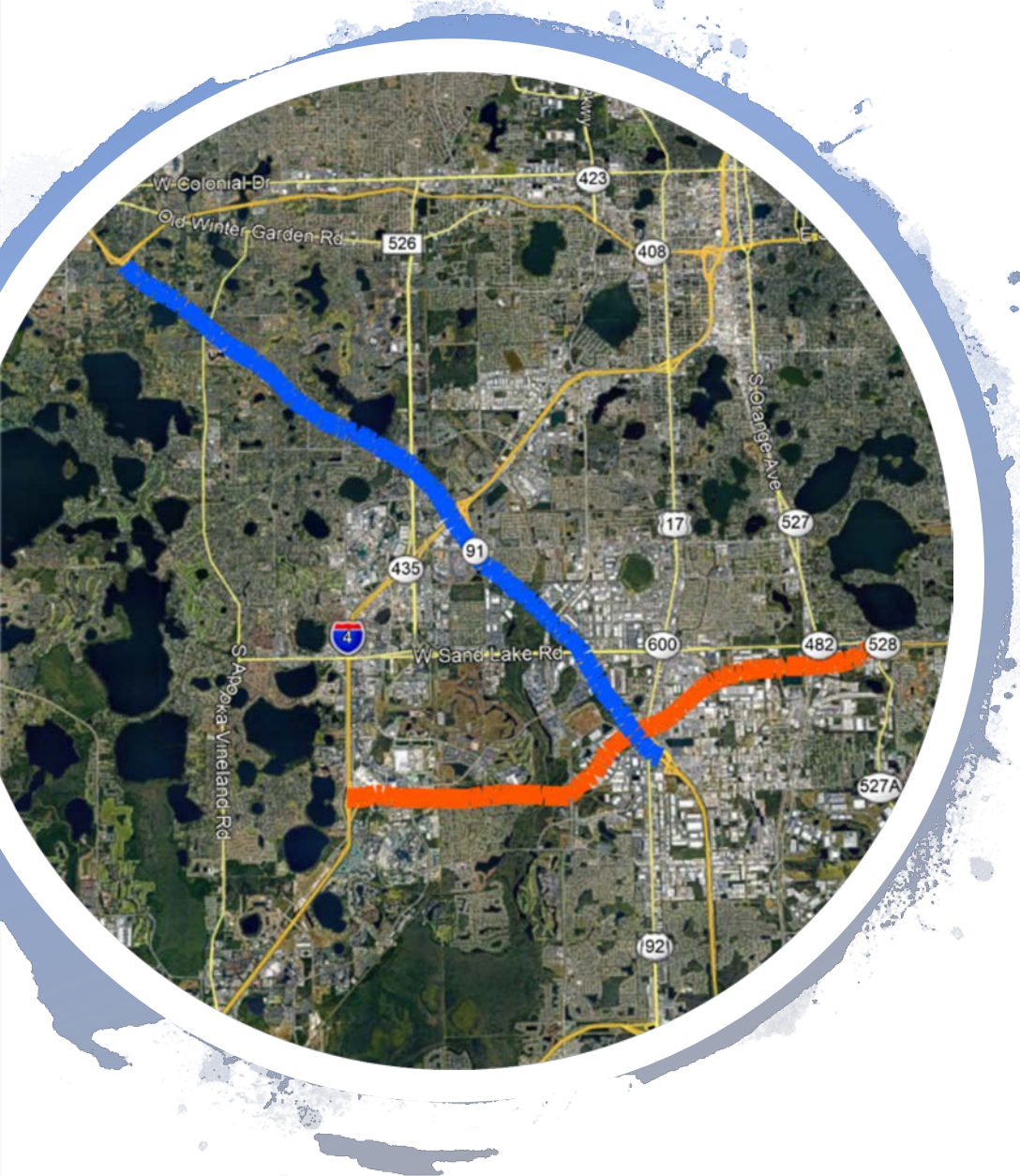




# I-75 FRAME CV Testing

- Coordination with CV Vendors
- Seminole County Lab
- Field Testing
- Interoperability Testing
- CV Application Testing
- Testing documents listed on:
  - [www.cflsmartroads.com](http://www.cflsmartroads.com)
  - Testing Matrix
  - Videos & Photographs
  - Lab Testing Documentation
- Current Efforts – April 2020 +
  - Security Credential Management System





# FTE CV PILOT

- **Location:** 20 Miles in Orange County
- **Elements:** TBD RSU's, TBD OBU's via Fleet vehicles
- **Goal:** To test the effectiveness of deployed CV Technology
- **Project:** Continuing Services Consultant Contract (Metric Engineering)
  - Includes CV Pilot along SR 528 and SR 91
  - CV Applications include:
    - Map Data Message (MAP)
    - Traveler Information Message (TIM)
    - Wrong Way Driving (WWD)
    - Curve Speed Warning (CSW)
- **Status:**
  - Design began April 2020
  - Construction TBD



<b>V2I Safety</b> Red Light Violation Warning Curve Speed Warning Stop Sign Gap Assist Spot Weather Impact Warning Reduced Speed/Work Zone Warning Pedestrian in Signalized Crosswalk Warning (Transit)	<b>Environment</b> Eco-Approach and Departure at Signalized Intersections Eco-Traffic Signal Timing Eco-Traffic Signal Priority Connected Eco-Driving Wireless Inductive/Resonance Charging Eco-Lanes Management Eco-Speed Harmonization Eco-Cooperative Adaptive Cruise Control Eco-Traveler Information Eco-Ramp Metering Low Emissions Zone Management AFV Charging / Fueling Information Eco-Smart Parking Dynamic Eco-Routing (light vehicle, transit, freight) Eco-ICM Decision Support System	<b>Mobility</b> Advanced Traveler Information System Intelligent Traffic Signal System (I-SIG) Signal Priority (transit, freight) Mobile Accessible Pedestrian Signal System (PED-SIG) Emergency Vehicle Preemption (PREEMPT) Dynamic Speed Harmonization (SPD-HARM) Queue Warning (Q-WARN) Cooperative Adaptive Cruise Control (CACC) Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG) Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE) Emergency Communications and Evacuation (EVAC) Connection Protection (T-CONNECT) Dynamic Transit Operations (T-DISP) Dynamic Ridesharing (D-RIDE) Freight-Specific Dynamic Travel Planning and Performance Drayage Optimization
<b>V2V Safety</b> Emergency Electronic Brake Lights (EEBL) Forward Collision Warning (FCW) Intersection Movement Assist (IMA) Left Turn Assist (LTA) Blind Spot/Lane Change Warning (BSWL/CW) Do Not Pass Warning (DNPW) Vehicle Turning Right in Front of Bus Warning (Transit)	<b>Road Weather</b> Motorist Advisories and Warnings (MAW) Enhanced MDSS Vehicle Data Translator (VDT) Weather Response Traffic Information (WxTINFO)	<b>Smart Roadside</b> Wireless Inspection Smart Truck Parking
<b>Agency Data</b> Probe-based Pavement Maintenance Probe-enabled Traffic Monitoring Vehicle Classification-based Traffic Studies CV-enabled Turning Movement & Intersection Analysis CV-enabled Origin-Destination Studies Work Zone Traveler Information		

# FTE Approach

## Task 1

- Task 1 – National & state of Industry Assessment
- Task 2 – Existing Operational Readiness Assessment
- Task 3 – Ready to Deploy CV applications Evaluation & Deployment Plan

<b>Partnerships</b> ✓ Universities ✓ Consultants ✓ Vendors	<b>Roadway Infrastructure</b> 
<b>Hardware, Software, Architecture</b> 	<b>Data – Formats, Sharing, Management</b> ✓ JSON, CSV, XML, Binary ✓ Processing at ITS Data Hub or TMC ✓ Data parsing and filtering

<b>SCMS</b> ✓ Proof-of-Concept ✓ USDOT 3 Pilots ✓ Policies, Standards/Requirements, Technical Challenges <small> <a href="https://www.fhwa.dot.gov/infocenter/2013/03/03/20130301.html">https://www.fhwa.dot.gov/infocenter/2013/03/03/20130301.html</a>  <a href="https://www.fhwa.dot.gov/infocenter/2013/03/03/20130301.html">https://www.fhwa.dot.gov/infocenter/2013/03/03/20130301.html</a> </small>	<b>Device Interoperability &amp; Metrics</b> ✓ Compliance with SAE J2735/2345, IEEE CV Standards, RSU 4.1 Specifications ✓ Most have performed interoperability testing or still are testing to ensure certain performance metrics ✓ Testing at TERL to ensure operability; Others will produce testing procedures, checklists
<b>Staffing &amp; KSAs</b> ✓ Staffing gaps identified from Questionnaires ✓ Agency Staffing suggestions by Project Phase ✓ Identified Training Opportunities, Webinars	<b>Operations &amp; Maintenance</b> Maintenance requirements unknown to most ✓ Some have software solution to monitor health of devices ✓ Preventative Maintenance Procedures to be developed ✓ Weekly checks with TMC for data verification

**Outcomes:**

- CV Deployment Motivation
- Agency Deployment Strategies
- Lessons Learned



# Evaluation of Staffing and CV Training Plan

Staffing by Project Phase

Staffing Matrix on Report Outlining Training and Educational Op

Project Phases	Positions Needed
Project Planning	• CV Program Project Manager
Plan Design	• Operations Manager
CV Device Specifications Development	• Software Programmer
Equipment Testing	• Database Administrator (DBA)
Software Development	• Network Engineer
Database Design	• Data Analyst
Procurement	• Purchasing Coordinator
Integration	• Senior ITS Technician
Deployment Testing	• ITS Technician
Operations and Maintenance (O&M)	• TMC Operators
	• External Resources (Consultants)

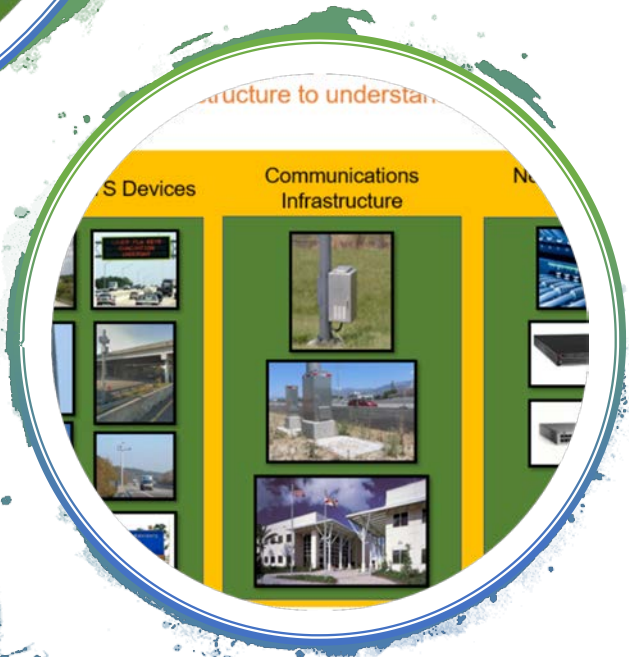
### CV Training Plan

Training Courses

Deployment Publications

- Webinars

✓ Concept Development	✓ Database Design
✓ CV Professional Training	✓ Cybersecurity
✓ Plan Design & CV Architecture	✓ CV Procurement
✓ CV Device & Specifications Development	✓ Design/Build/Test
✓ Equipment Testing	✓ Deployment and Installation
✓ Software Development	✓ Operations and Maintenance
	✓ Others



## FTE Approach

### Task 2

- Task 1 – National & state of Industry Assessment
- **Task 2 – Existing Operational Readiness Assessment**
- Task 3 – Ready to Deploy CV applications Evaluation & Deployment Plan

**Outcomes:**

- Recommendation for Best Practices
- Recommendation for Future Investments

### CV Application Definitions

#### Wrong Way Entry (V2I Safety)

When a wrong way driver is identified, drivers receive an immediate warning

- A wrong-way tolling customer will receive a violation warning from RSU in advance of entering ramp
- A TMC Operator will notify law enforcement and will send wrong-way message to selected RSUs to broadcast to drivers in the area
- *Reductions in fatalities, injuries, head-on collisions at entry/exit points, effectively controls reversible lanes*



#### Curve Speed Warning (V2I Safety) at Ramps

Alerts are provided to the driver who is approaching a curve that may be too high for safe travel through that curve. The application will collect vehicle data and available data to provide an appropriate advisory message/warning on the DVI.



### Map of CV Pilot Project



- CV A
- RSU Lo
- of # RSU



# FTE Approach

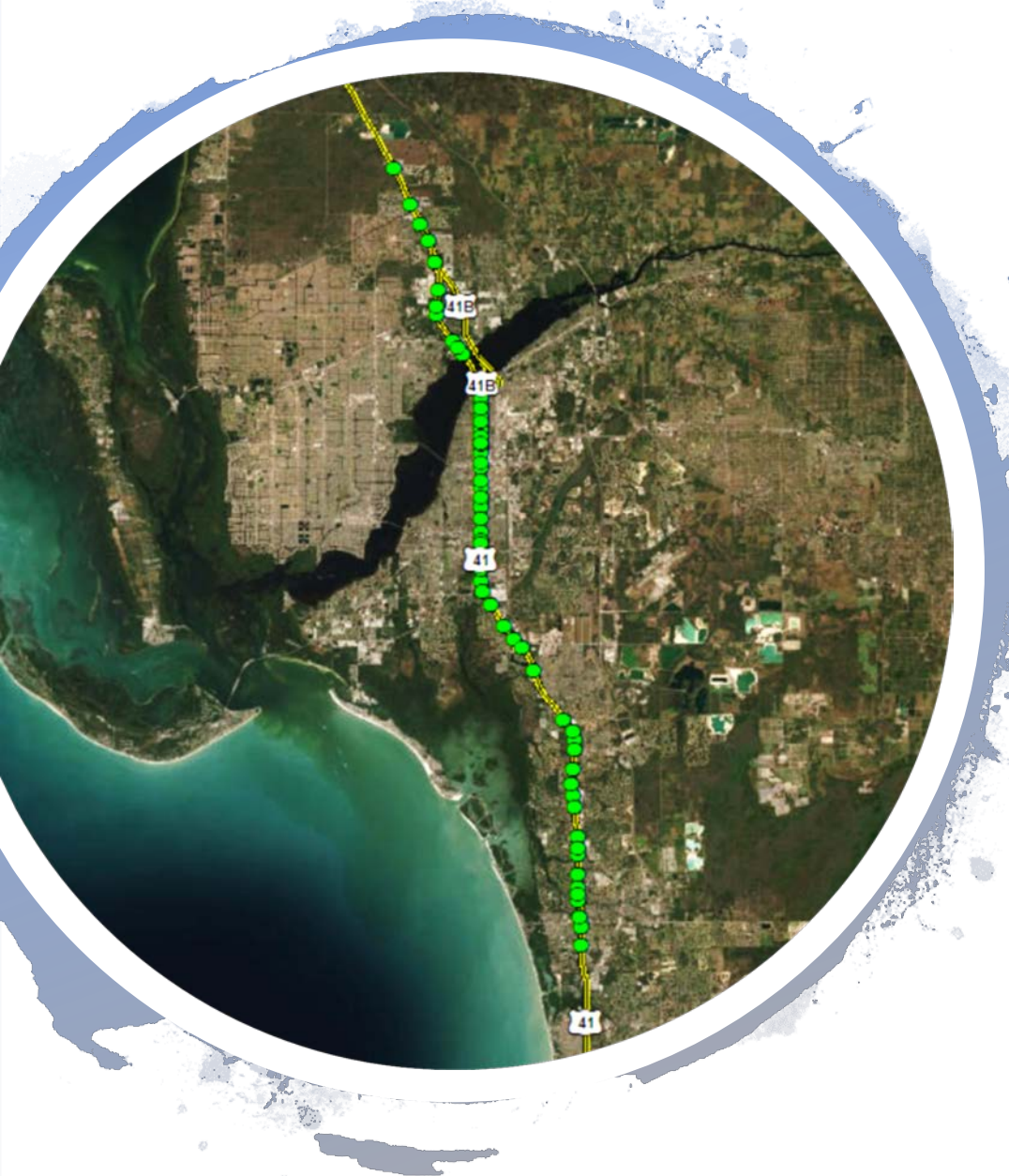
## Task 3

- Task 1 – National & state of Industry Assessment
- Task 2 – Existing Operational Readiness Assessment
- Task 3 – Ready to Deploy CV applications Evaluation & Deployment Plan

### Outcomes:

- Ready to Deploy Plan
- Determination of CV Apps, # Devices
- Recommendation on Evaluation of Effectiveness





# US 41 FRAME

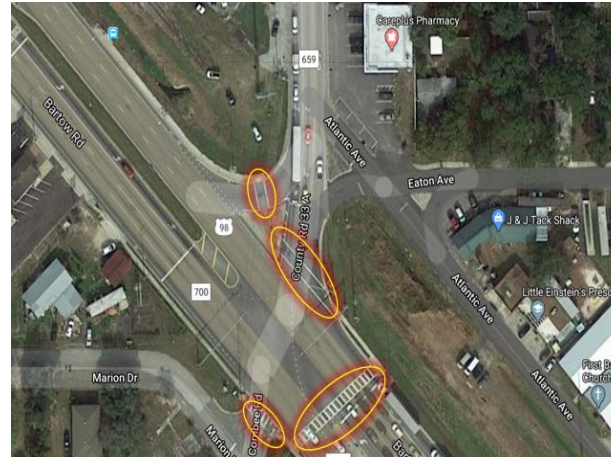
- **Location:** 34 Miles in Lee County
- **Elements:** 71 Traffic Signals, RSU's TBD
- **Goal:** Improve Safety & Mobility with the Deployment of CV Technology
- **Project:** System Manager Approach (Awarded to Metric Engineering)
  - Includes CV Pilot along US 98
  - CV @ 4 Intersections including Passive Pedestrian Detection
  - CV Applications include:
    - Signal Phase & Timing (SPaT)
    - Map Data Message (MAP)
    - Traveler Information Message (TIM)
    - Personal Safety Message (PSM)
- **Status** –
  - May 2020 US 98 CV Pilot



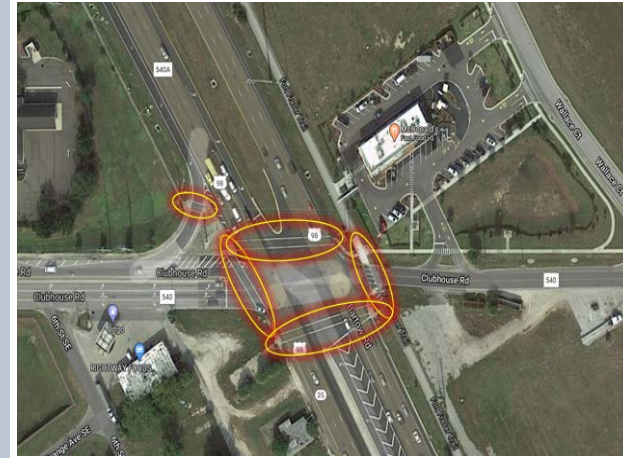
# FDOT D1 (US 41 FRAME)

## Research & Testing Phases

- Alternatives Analysis for Technologies
- Assessment of CV device capabilities
- Review of CV Applications for safety benefits
- Determining optimal locations for RSUs
- Systems Engineering Documentation



**US 98 @ Combee Road**



**US 98 @ Clubhouse Road**



### FOUR PROPOSED CV PILOT LOCATIONS

1. US 98 at CR540A
2. US 98 at Clubhouse Rd
3. US 98 at Autumnwood Grove Blvd
4. US 98 at Combee Rd

### CV APPLICATIONS

- Signal Phase & Timing (SPaT)
- Map Data Message (MAP)
- Traveler Information Message (TIM)
- Personal Safety Message (PSM)
- Transit Signal Priority (TSP)
- Emergency Vehicle Pre-emption (EVP)



# I-4 FRAME

- **Location:** Along I-4 and Arterials in District 1, 5 and 7
- **Elements:** TBD Traffic Signals, RSU's, OBU
- **Goal:** Implement Connected Vehicle (CV) technology and Automated Traffic Signal Performance Metrics (ATSPM) for freeway management systems and arterial management systems in Hillsborough, Polk, Osceola, and Orange Counties
- Improve Safety & Mobility with the Deployment of CV Technology
- **Project:** System Manager Approach (Awarded to Metric Engineering)
  - Includes CV Pilot along I-4
  - Cellular Vehicle-to-Everything (C-V2X) and Dedicated Short Range Communication (DSRC)
  - Security Credential Management System (SCMS)
  - Automated Traffic Signal Performance Measures (ATSPM) & Timing (SPaT)
  - Map Data Software Development
  - CV Applications include:
    - Signal Phase Message (MAP)
    - Traveler Information Message (TIM)
    - Personal Safety Message (PSM)
- **Status** – In Design





# CAV Benefits

- Smart Mobility & Pedestrian Safety
- Travelers receive Traveler Information Messages (weather, upcoming collisions, diversions, etc.)
- Reduction in incidents
- Emergency & Transit Vehicle Benefits
- Data Acquisition: motorist awareness from trends analysis
- Benefits for the Disabled
- Drivers can arrive quickly, safely
- Car Sharing & Mitigation of Environmental Impacts
  - Travel behavior changes, self-parking, smart routing, eco-driving, reducing emissions, (NO<sub>x</sub>, SO<sub>x</sub>, and CO<sub>2</sub>), reduction in fuel consumption
- Intangibles – Quality of life



# CV Training

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- Connected Vehicle Professional Training
- The NEXT Education
  - 4 Days, Online
  - CV technology
    - Software, Hardware, Communication, Standards
- Online Testing
- CVP Certification



Connected Vehicle Professional  
Certification Program



# Questions

