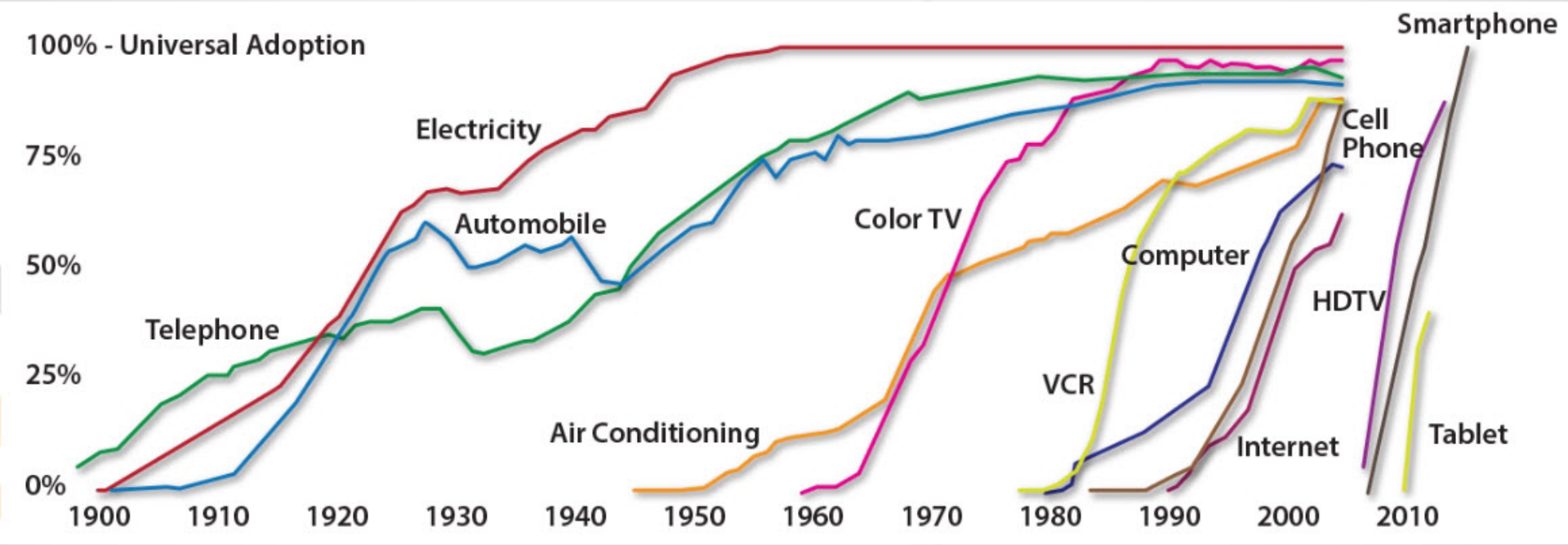
TRB – Managed Lanes

Innovative (and Potentially Disruptive) Technologies

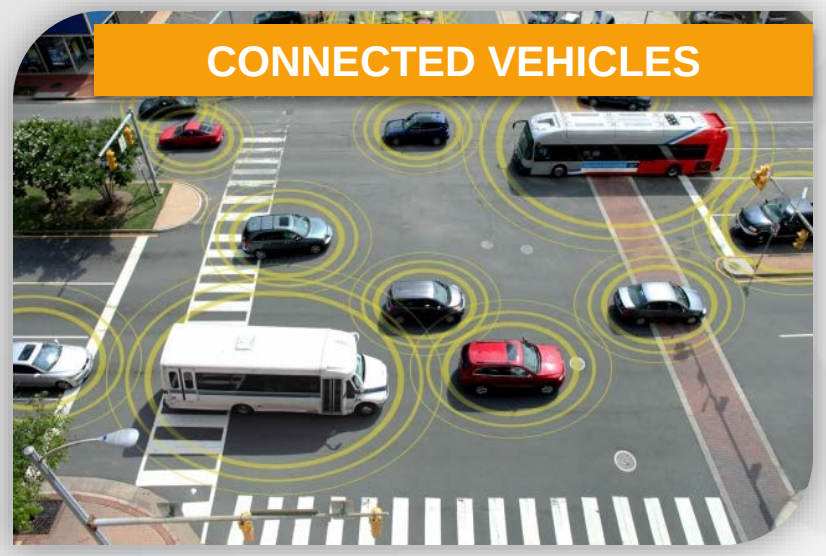
The Florida Automated Vehicles Initiative

Friday, May 6, 2016

Technology Adoption Rate



Automated Vehicles – An Umbrella Term



Automated Vehicles – Technologies Overview

FLORIDA AUTOMATED VEHICLES

CAMERAS
Stereo and infrared camera data helps avoid obstacles, identify road sign messages, and visualize lane markings.

SOFTWARE
On-board computers run advanced software to analyze data collected by sensors to make intelligent maneuvers and real-time route determination.

RADAR
Radar tracks nearby objects, which helps maintain the car's distance from vehicles ahead and detect blind spot obstacles.

LIDAR
Light detection and ranging system generates a point cloud that gives the car a 360-degree view.

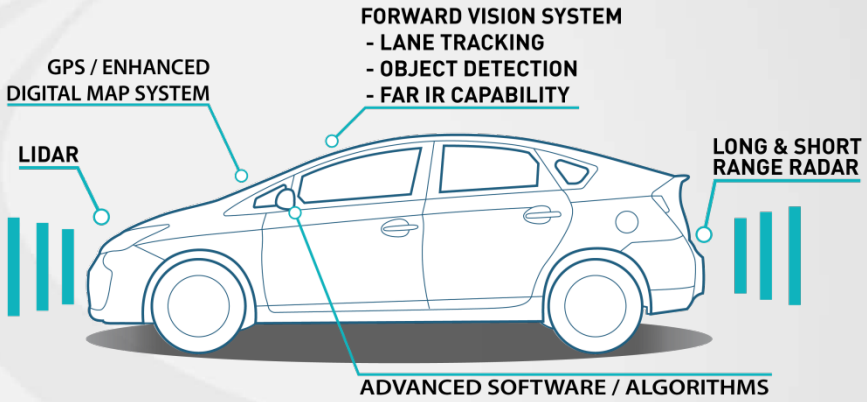
DEDICATED SHORT RANGE COMMUNICATION
Provides communication between vehicles (Vehicle to Vehicle - V2V) and between vehicles and the transportation infrastructure (Vehicle to Infrastructure – V2I). DSRC is expected to be utilized where existing Intelligent Transportation Systems (ITS) are already in place, such as urban areas, high volume limited access facilities, and managed lanes.

Autonomous Vehicles

FLORIDA AUTOMATED VEHICLES

Levels of Automation (as defined by NHTSA)

- **0 – No Automation**, but advanced collision warnings, blind spot monitoring, etc.
- **1 – Function Specific**, such as adaptive cruise control or active lane centering (but not as same time)
- **2 – Combined Function**, such as adaptive cruise control and active lane centering working at same time (must still be actively engaged in operation of vehicle)
- **3 – Limited Self-Driving**, Driver is not expected to monitor vehicle movements for limited time in limited situations (driver operates vehicle during part(s) of trip)
- **4 – Full Self-Driving**, No human operator expected to control safety-critical functions of the vehicle



Safety critical functions of the vehicle (steering/throttle) *are affected* without direct driver input

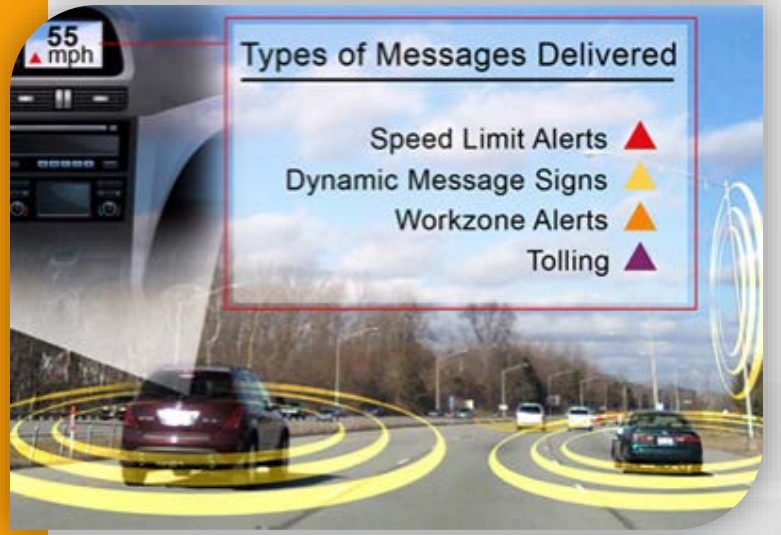
Connected Vehicles

Applications
- Safety Critical Warnings
- Mobility Enhancements
- Environmental Benefits
- 55+ specific applications/uses defined by USDOT

Data Gathering/ Information Exchange
- Vehicle-to-Infrastructure (V2I)
- Vehicle-to-Vehicle (V2V)
- Vehicle-to-Bike/Ped/Other (V2X)

Safety critical functions of the vehicle (steering/throttle) ***not affected*** (operator is in control at all times)

Enhanced Situational Awareness



Connected Vehicles

Technology

- Dedicated Short Range Communications (DSRC)
  - (5.9 GHz designated to transportation by FCC)
- Cellular network
- Satellite communications

Equipment

- All DSRC units are still in development (prototypes)
- Need to identify standards for product specifications
- Controllers are being upgraded to being ‘CV-ready’

On-Board Unit

Road-Side Unit

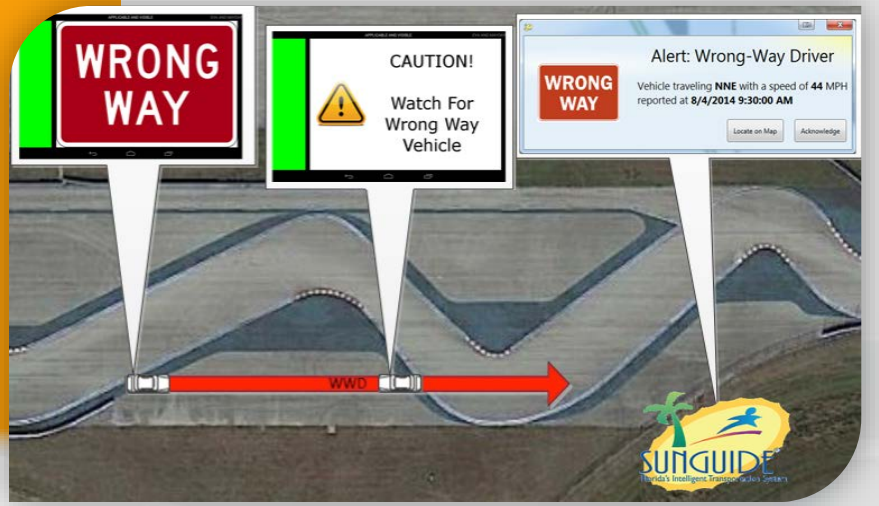
Connected Vehicles

FLORIDA AUTOMATED VEHICLES

Specific Applications FDOT has Developed and/or Integrated from USDOT into SunGuide

- Wrong Way Driver Detection and Alert
- Over-height Detection and Alert
- Emergency Braking
- Emergency Vehicle Alert
- Red Light Violation Warning

Demonstration from 2014 FAV Summit



GM Announced ‘Super Cruise’ at ITS World Congress (2014)

Semi-automated driving technology and Vehicle-2-Vehicle (DSRC) communications

- 2017 Cadillac CTS

Hands free, feet free *(not mind free)* driving

- Highway cruising speeds
- Stop-and-go congestion

“Through technology and innovation, we will make driving safer.”
– Mary Barra, GM CEO

ITS World Congress 9/8/2014

Tesla Provided Over-the-Air Auto-Pilot Update

Models sold after October 2014 optional “Auto Pilot Hardware” (cameras and radar sensors), but software was not included at time of sale.

Approximately 70,000 Model S vehicles currently have Auto-Pilot capability.

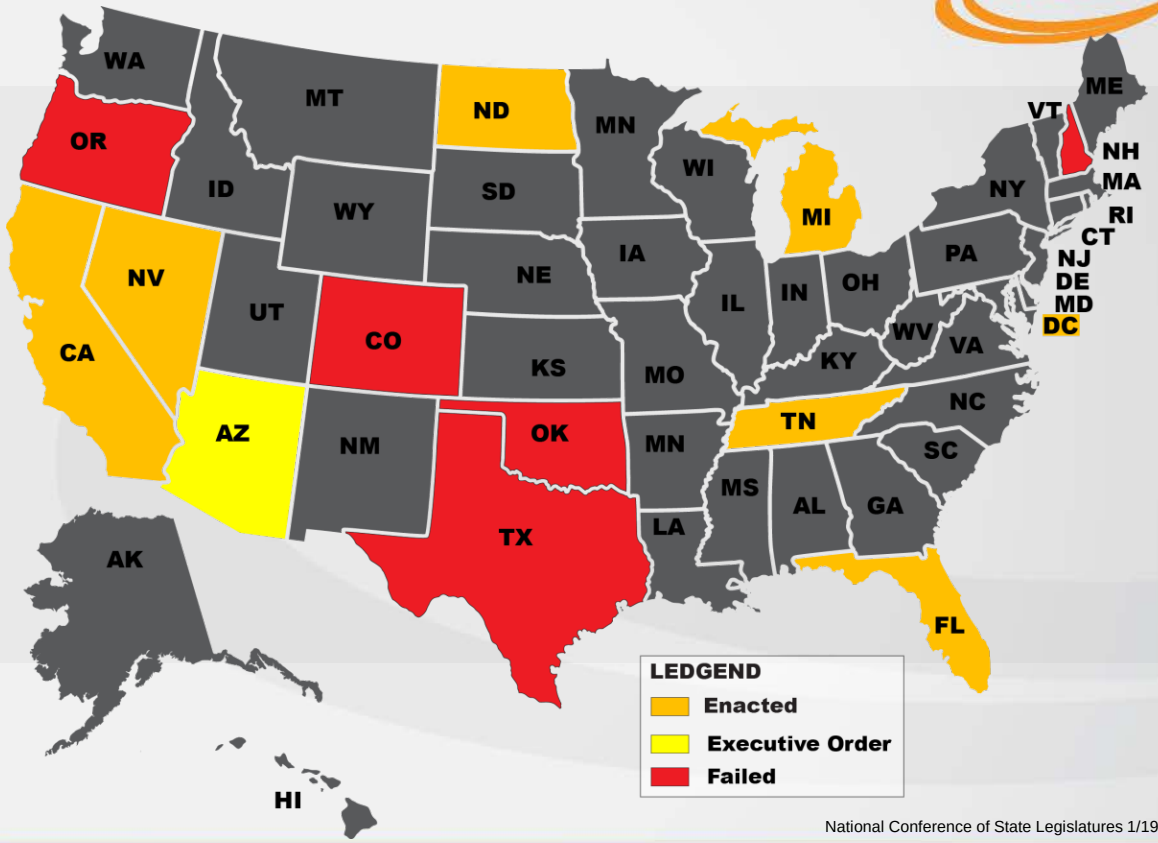
Software 7.1 Update (1/10/2016):

- Auto-Pilot
- Auto-Steer (20-85 mph)
- Use turn signal to change lanes
- Auto-Summon on private property

AV Legislation

Thirteen states introduced legislation related to autonomous vehicles in 2015, up from 12 states in 2014, nine states and D.C. in 2013, and six states in 2012.

States with Enacted AV Legislation



National Conference of State Legislatures 1/19/2016

Florida Statutes – Autonomous Vehicles (2015)

F.S. 316.85 – Autonomous Vehicles; Operation

F.S. 316.86 – Operation of vehicles equipped with autonomous technology on roads for testing purposes; financial responsibility; exemption from liability for manufacturer when third party converts vehicle

F.S. 319.145 – Autonomous Vehicles (Title Certificates)

Florida Statutes – Autonomous Vehicles (2016)

HB 7027, signed April 4th 2016 – updates:

F.S. 316.85 – Autonomous Vehicles; Operation

(1) “A person who possesses a valid driver license may operate an autonomous vehicle in autonomous mode on roads in this state if the vehicle is equipped with autonomous technology, as defined in s. 316.003 (90).”
(2) Unchanged

Florida Statutes – Autonomous Vehicles (2016)

HB 7027, signed April 4th 2016 – updates:

F.S. 316.86 – ~~Operation of vehicles equipped with autonomous technology on roads for testing purposes; financial responsibility~~; exemption from liability for manufacturer when third party converts vehicle

This amendment removed barriers to testing, including: 1) the term “closed course”,
2) requirement of a human operator to be present in the autonomous vehicle (for testing purposes), and
3) insurance requirements.

Florida Statutes – Autonomous Vehicles (2016)

F.S. 319.145 – Autonomous Vehicles (Title Certificates)

(1) An autonomous vehicle registered in this state must continue to meet applicable federal standards and regulations for such motor vehicle.

The vehicle must:

(a) Have a system to safely alert the operator if an autonomous technology failure is detected while the autonomous technology is engaged.

(b) When an alert is given, the system must:

1. Require the operator to take control of the autonomous vehicle; or
2. If the operator does not, or is not able to, take control of the autonomous vehicle, be capable of bringing the vehicle to a complete stop

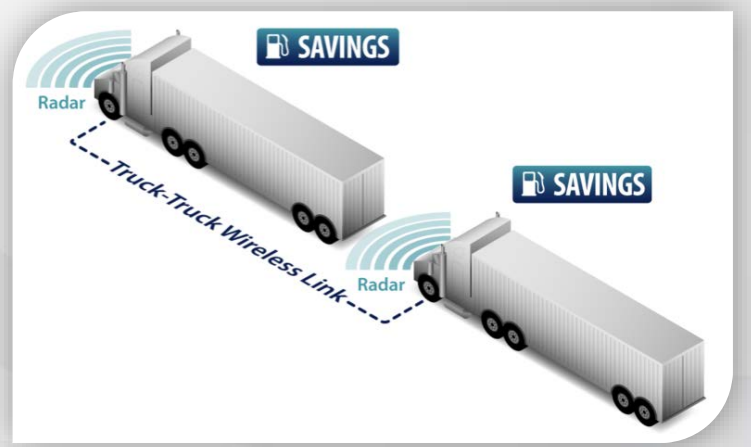
(b) Have a means, inside the vehicle, to visually indicate when the vehicle is operating in autonomous mode.

(c) Be capable of being operated in compliance with the applicable traffic and motor vehicle laws of this state.

Driver-Assistive Truck Platooning Study and Pilot Project

HB 7027 mandates:

"The Department of Transportation, in consultation with the Department of Highway Safety and Motor Vehicles, shall study the use and safe operation of driver-assistive truck platooning technology, as defined in s. 316.003, Florida Statutes, for the purpose of developing a pilot project to test vehicles that are equipped to operate using driver-assistive truck platooning technology."



Stakeholder Working Groups

FLORIDA AUTOMATED VEHICLES

Policies & Legal Issues

Infrastructure/Technology

- Roadway improvements
- Engineering & design standards
- Infrastructure investment

Modal Applications

- Transit
- Freight
- Inspections

University Research Partnerships

FLORIDA AUTOMATED VEHICLES

Universities in Florida have been conducting research on AV/CV/ITS technologies for >10 years

- Policy Implications for AV Technology – MPO LRTPs (UF)
- Simulator for Connected Vehicle Messaging (UCF)
- Autonomous Technologies for Mobility Solutions for the Aging and Disabled Populations (FSU)
- Visioning Future Cities with AV Technologies (FSU)
- Unmanned Aerial Vehicles (FIT) and Unmanned Surface Vessels (FAU) for Bridge Inspections
- AV Requirements for Service Vehicles (ERAU)

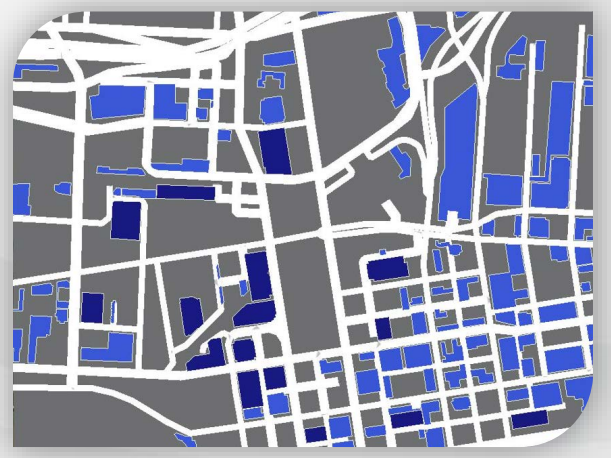
Envisioning Florida's Future:
Transportation and Land Use in an Automated Vehicle World

Design Charrette at 2015 FAV Summit

100 transportation professionals brainstormed what cities may look like in 2040 and 2060 as a result of AV/CV

Major Takeaways:

- Smaller & more efficient ROWs
- A Drop-off revolution
- Parking reform
- Signage & signalization
- Bicycle, pedestrian, and small vehicle oriented
- Redevelopment opportunities



Blue Polygons = Parking

Envisioning Florida's Future:
Transportation and Land Use in an Automated Vehicle World

Figure 2.17 - AVs' Transformation of a City Block: Surface parking lots, traffic lights, and on-street parking, while common today, may disappear in an AV world. In their place we may find drop off lanes, pedestrian and bicycle amenities, in-fill development, and safer, less cluttered intersections.

Identification of Autonomous Service Vehicle Requirements

Understand what sensors, components, and software is needed for the safe and efficient operation of service vehicles.

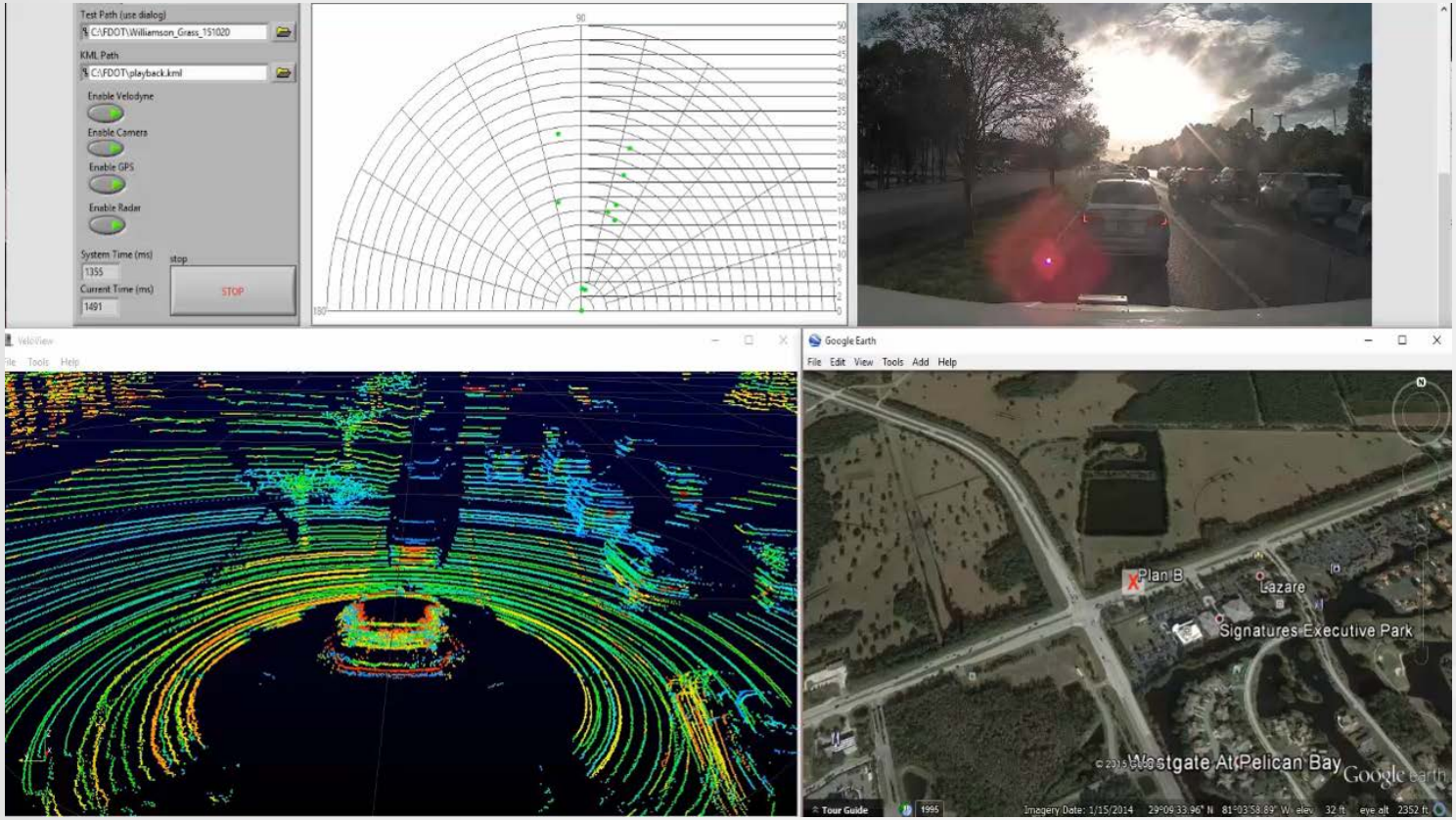
Machine Vision (what the vehicle "sees"):

- What features of the infrastructure is most important for the effective recognition of the roadway and/or off-road conditions?

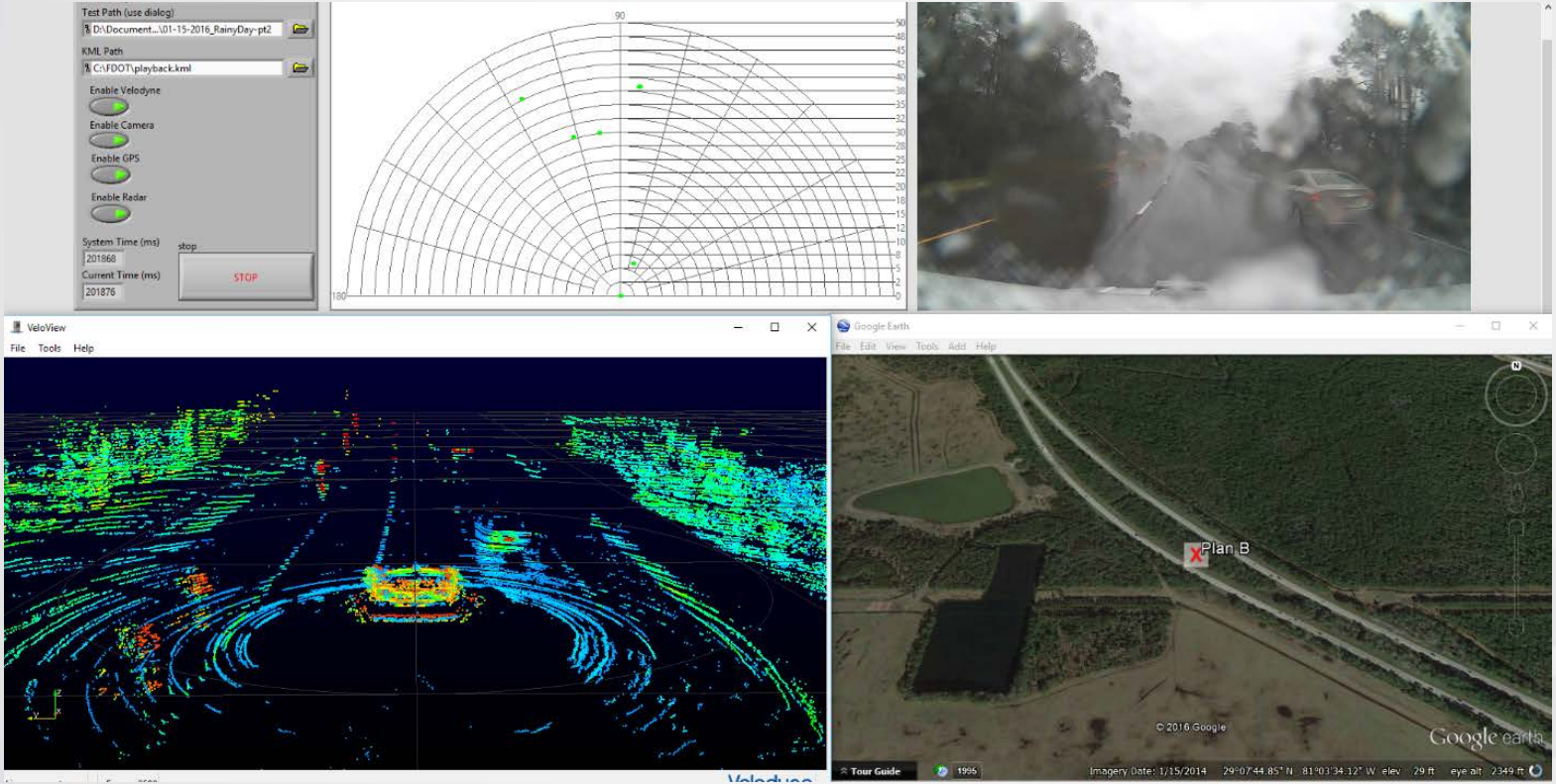
Service Vehicles:

- Roadside & airport mowing operations
- Attenuator trucks (mobile crash cushions)
- Pavement marking vehicles
- Roadway construction vehicles

Identification of Autonomous Service Vehicle Requirements



Identification of Autonomous Service Vehicle Requirements

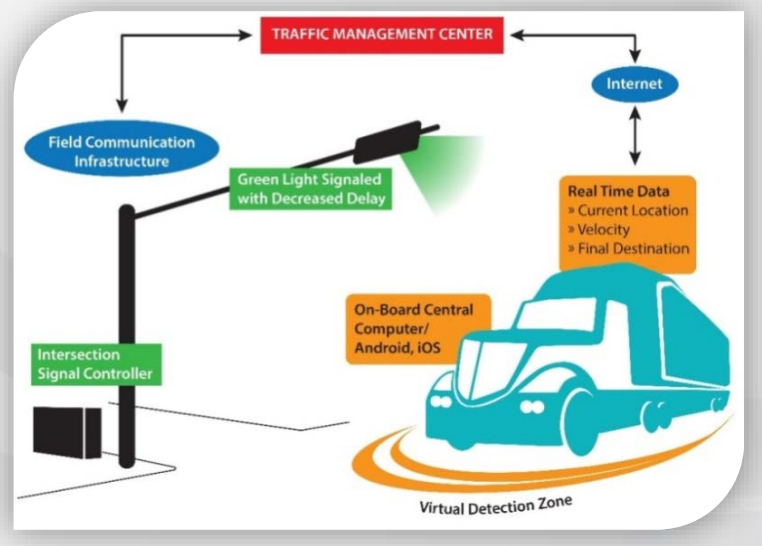


Connected Vehicles for Freight Mobility

Phase I (complete)

- Floral Industry – 86% of all flowers in US go through Miami
- MIA to Distribution Centers (3-6 mile trip)
- Stakeholder Engagement
- Measured pre-existing conditions
  - Delay analysis (travel time)
  - Fuel Savings analysis
  - Cost Benefit analysis
- Research in-cab devices and communications between vehicles and traffic management center

Improving Safety and Mobility



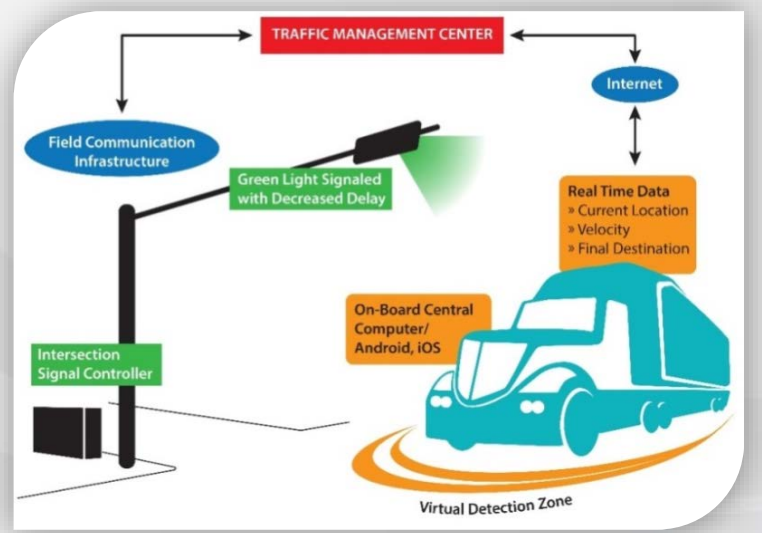
Connected Vehicles for Freight Mobility

FLORIDA AUTOMATED VEHICLES

Phase II (scoping)

- Expand stakeholder engagement
- Install CV onboard units (OBUs) in freight vehicles
- Measure pre-CV communication operations (for baseline/comparison)
- Provide CV messages/priority (SPaT data)
  1) Countdown to red & optimal speed suggestion (does not impact SPaT)
  2) Signal priority/green extension (non peak hours)
  3) If/Then situation, if (2) proves beneficial
- Analyze results and provide recommendations

Improving Safety and Mobility



Assessing Advanced Driver Assistance Systems

District 7 – Tampa Bay Area

- Advanced Driver Assistance Systems (ADAS):
  - Forward Collision Warning (FCW),
  - Lane Departure Warning (LDW),
  - Bike/Ped Detection (BPD)
- Level 0 automation (as defined by NHTSA)
- Aftermarket device by Mobileye
- Installed on passenger vehicles and transit vehicles from the following partners:
  - TBARTA
  - HART
  - PCPT
  - PSTA
  - FDOT District 7

Improving Situational Awareness & Driver Behavior

MOBILEYE

GEOTAB
management by measurement

Assessing Advanced Driver Assistance Systems

100 study vehicles equipped with GeoTab (telematics device), 50 served as control group

- 50 were equipped with Mobileye (ADAS)

Performance Measures (quantitative analysis):

- Driver behavior (reaction to ADAS alert)
  - Lane adherence
  - Following too closely
- If incident occurred, did ADAS reduce severity?
- Does the driver become accustomed to the ADAS alert, and if so, do they ignore it or instinctively react?
- Fuel consumption

Driver feedback (qualitative analysis)

Improving Situational Awareness & Driver Behavior

MOBILEYE

GEOTAB
management by measurement

THEA - Connected Vehicle Pilot Deployment Program

FLORIDA AUTOMATED VEHICLES

TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY

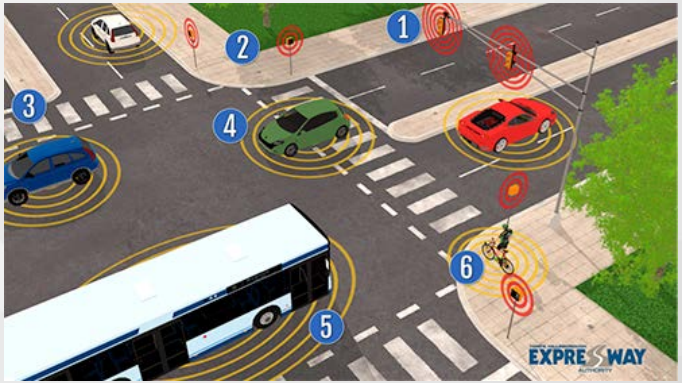
Driving Innovation and Opportunity

USDOT awarded Tampa Hillsborough Expressway Authority (THEA) a $17 million grant

- Focused on reducing the frequency and severity of crashes
- Increase bicycle/pedestrian (V2X) safety
- Enhance traffic flow and shrink the city's carbon footprint

- Data collection of real-world deployment of CV
- Understand limitations of CV systems to identify best practices that will be used to develop national standards

- New York City and State of Wyoming were also awarded



Questions?

Email questions/comments to:
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www.AutomatedFL.com