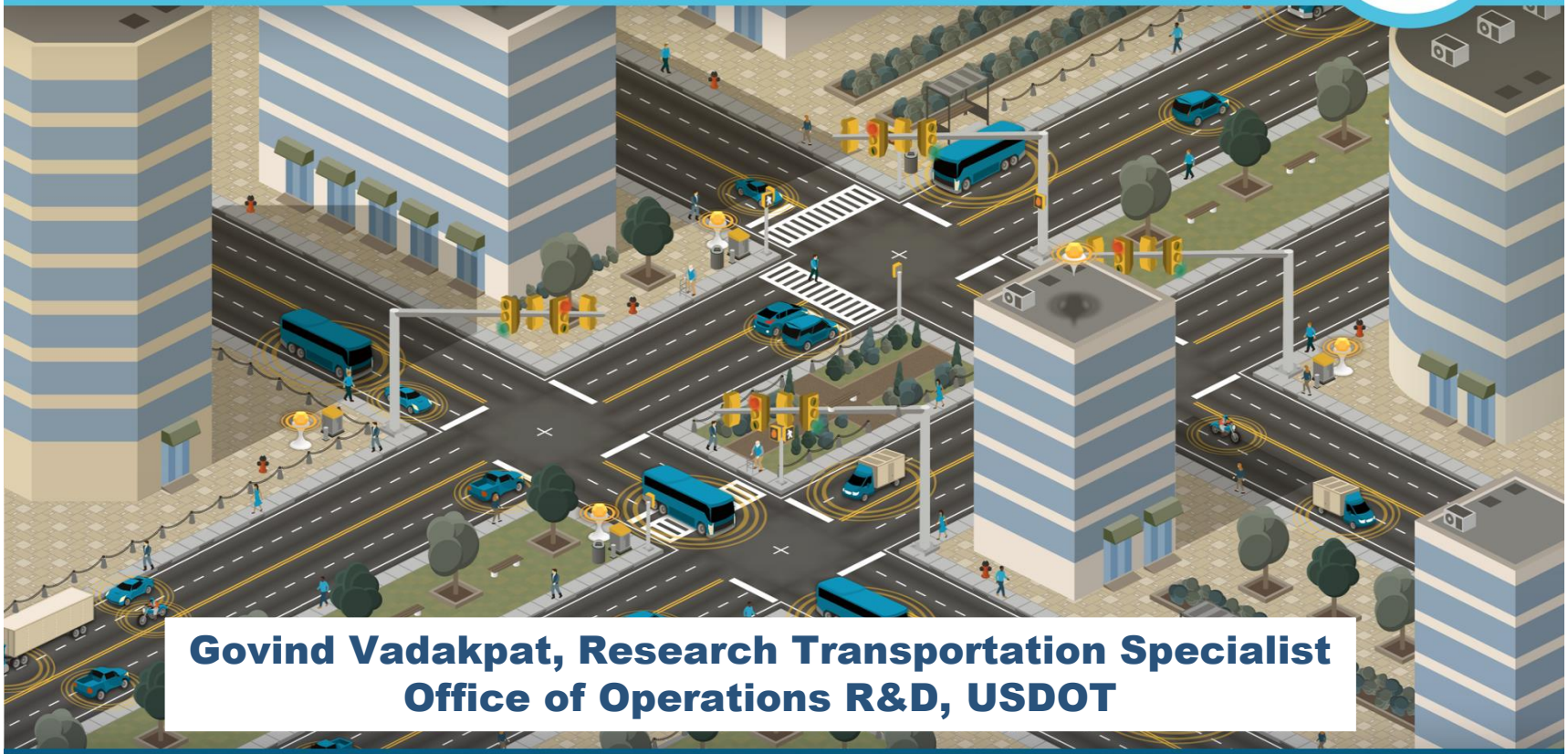
CONNECTED VEHICLE PILOT
Deployment Program



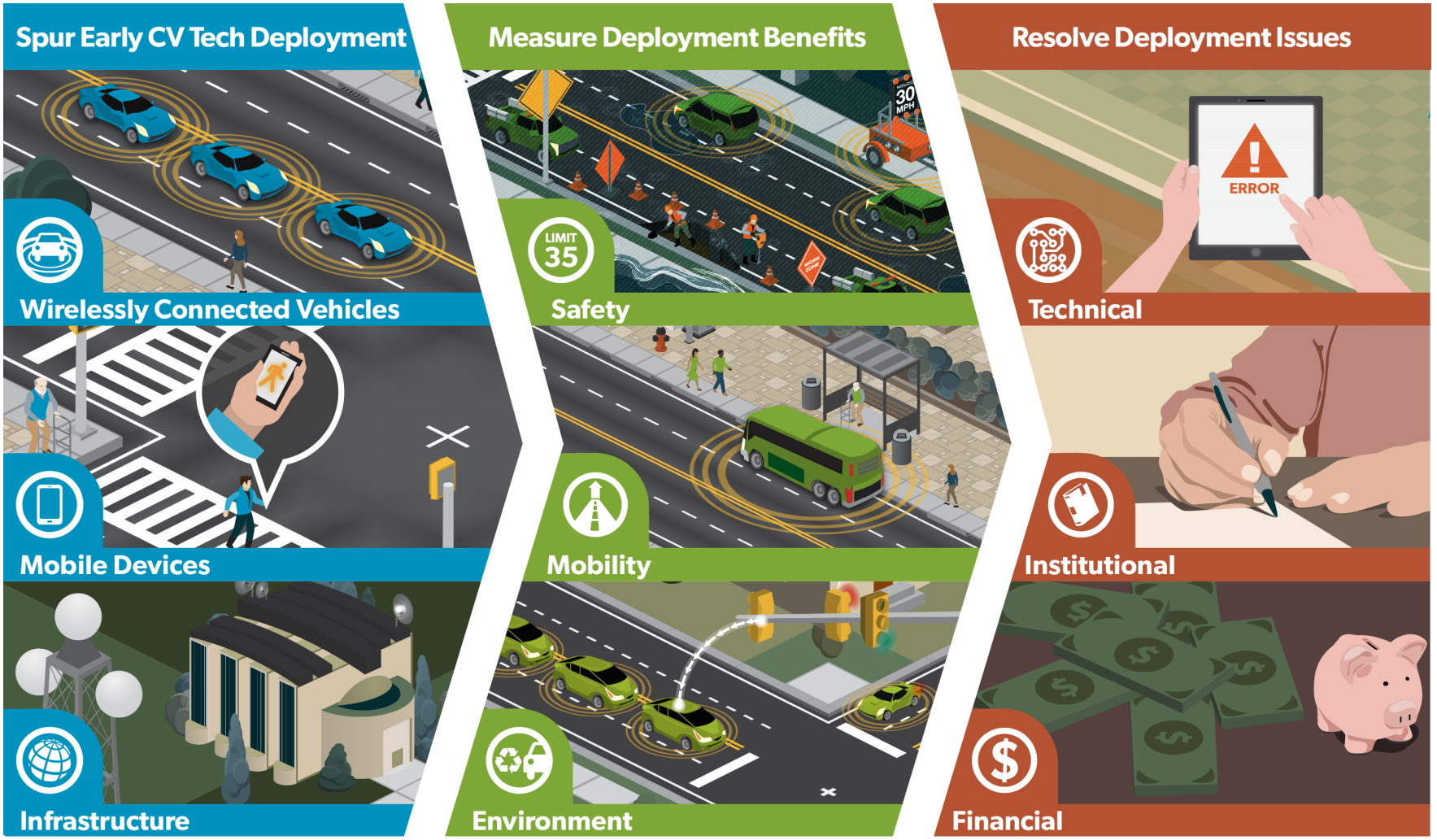
Govind Vadakpat, Research Transportation Specialist
Office of Operations R&D, USDOT

ITS Joint Program Office

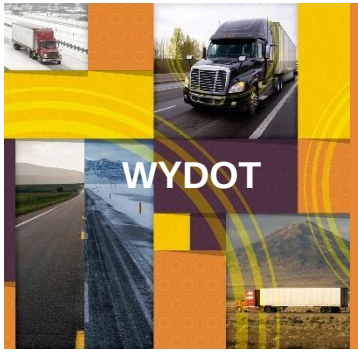
OVERVIEW

- Connected Vehicles Pilot Deployment Program Overview
- Overview of CV Pilot Program Award Sites
  - Wyoming DOT (WYDOT) CV Pilot Deployment
  - New York City (NYC) DOT CV Pilot Deployment
  - Tampa (THEA) CV Pilot Deployment
- Interoperability Testing Summary
- How to Stay Connected

CV Pilot Deployment Program Goals



The Three Pilot Sites

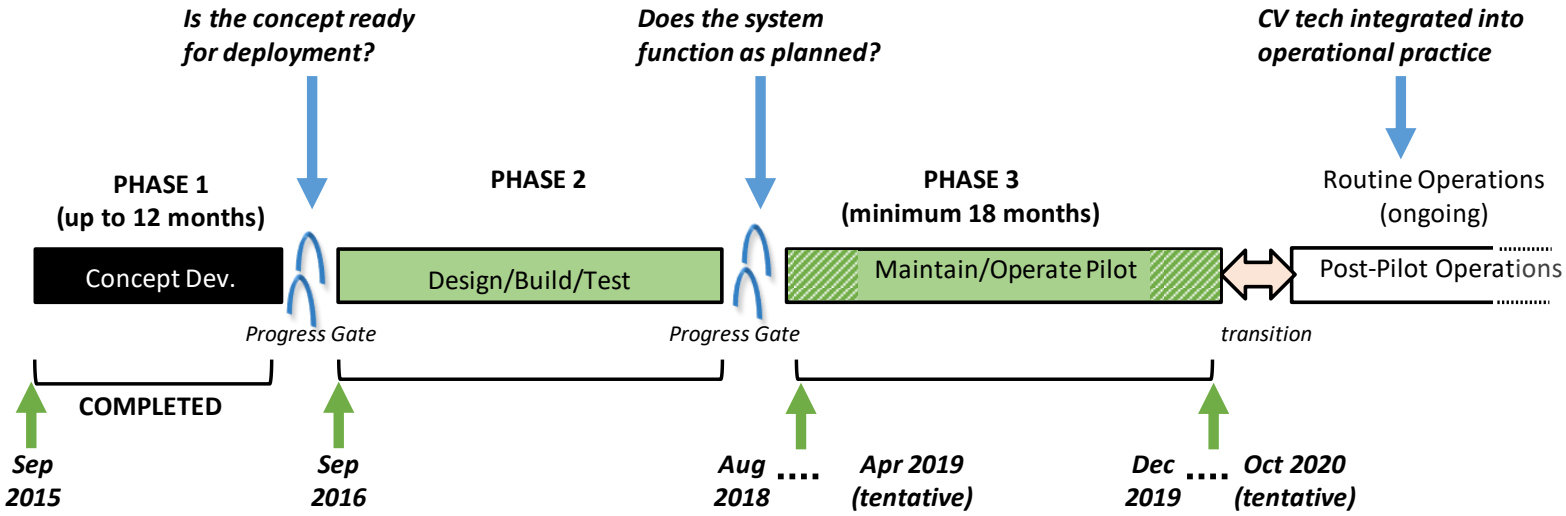


- Reduce the number and severity of adverse weather-related incidents in the I-80 Corridor in order to improve safety and reduce incident-related delays.
- Focused on the needs of commercial vehicle operators in the State of Wyoming.

- Improve safety and mobility of travelers in New York City through connected vehicle technologies.
- Vehicle to vehicle (V2V) technology installed in up to 8,000 vehicles in Midtown Manhattan, and vehicle to infrastructure (V2I) technology installed along high-accident rate arterials in Manhattan and Central Brooklyn.

- Alleviate congestion and improve safety during morning commuting hours.
- Deploy a variety of connected vehicle technologies on and in the vicinity of reversible express lanes and three major arterials in downtown Tampa to solve the transportation challenges.

CV Pilot Deployment Schedule



Last updated: June 12, 2018

- **Phase 1: Concept Development (COMPLETE)**
  - Creates the foundational plan to enable further design and deployment
- **Phase 2: Design/Deploy/Test**
  - Detailed design and deployment followed by testing to ensure deployment functions as intended (both technically and institutionally)
- **Phase 3: Maintain/Operate**
  - Focus is on assessing the performance of the deployed system
- Post Pilot Operations (CV tech integrated into operational practice)

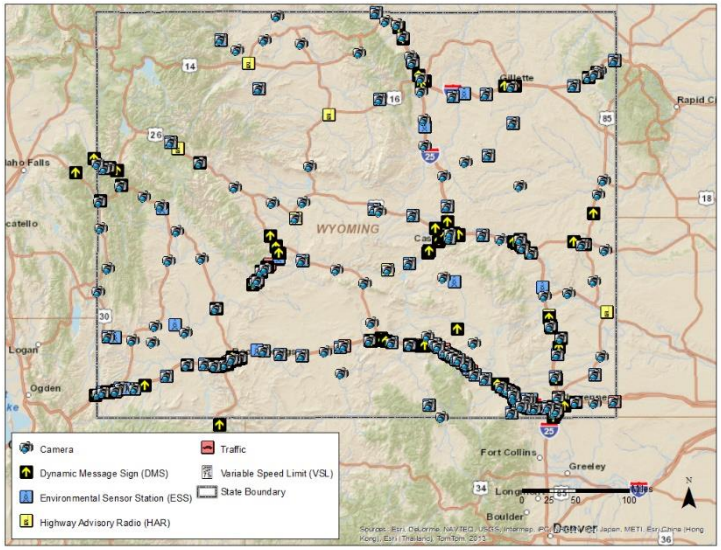
WYDOT Pilot Deployment Overview

Objective:

- Reduce the number and severity of adverse weather-related incidents (including secondary incidents) in the I-80 Corridor in order to improve safety and reduce incident-related delays.
  - Focused on the needs of the commercial vehicle operator in the State of Wyoming

Approach:

- Equip fleet vehicles (combination of snow plows, maintenance fleet vehicles, emergency vehicles, and private trucks) that frequently travel the I-80 corridor to transmit basic safety messages (BSMs), collect vehicle and road condition data and provide it remotely to the WYDOT TMCs
- Deploy DSRC roadside equipment (RSE) to supplement existing assets and initiatives
- Road weather data shared with freight carriers who will transmit to their trucks using exiting in-vehicle systems

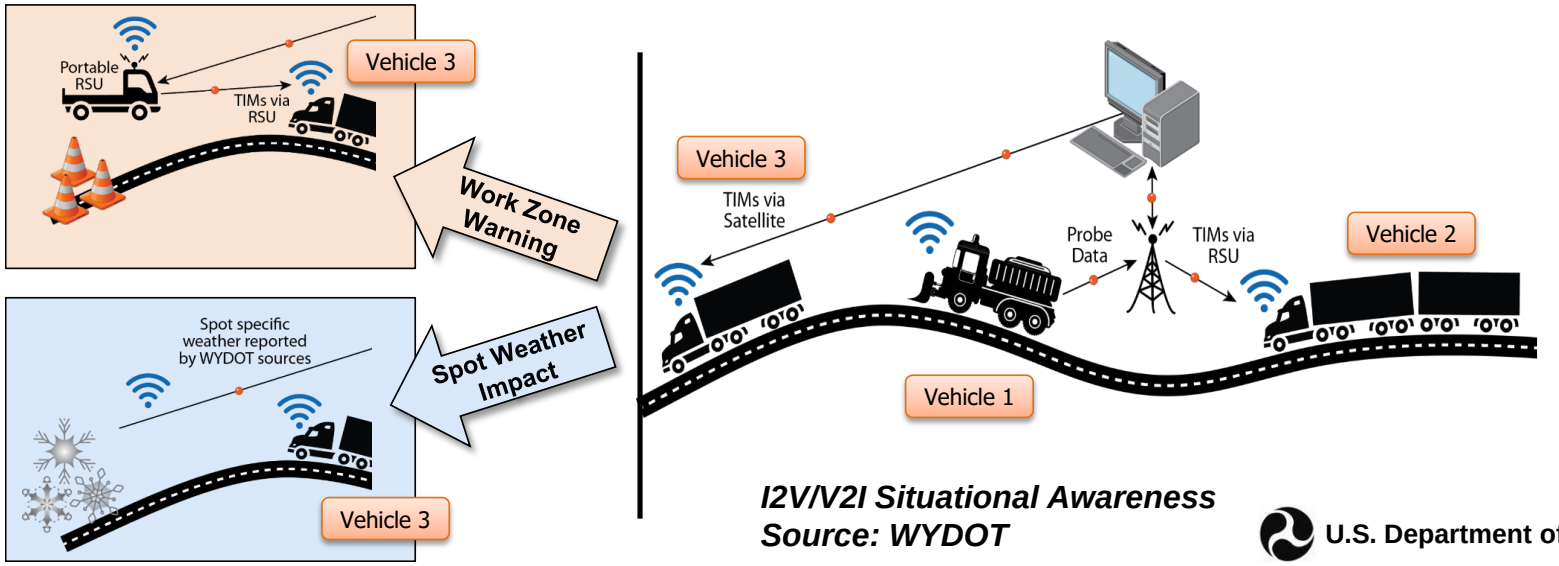


Source: Wyoming DOT

WYDOT Pilot Deployment Proposed CV Applications & Devices

Category	WYDOT – CV Application
V2V Safety	Forward Collision Warning (FCW)
V2I/I2V Safety	Situational Awareness
	Work Zone Warnings (WZW)
	Spot Weather Impact Warning (SWIW)
V2I and V2V Safety	Distress Notification (DN)

WYDOT – Devices	Estimated Number
Roadside Unit (RSU)	75
WYDOT Fleet Subsystem OBU	100
Integrated Commercial Truck Subsystem OBU	150
Retrofit Vehicle Subsystem OBU	25
Basic Vehicle Subsystem OBU	125
Total Equipped Vehicles	*400*



I2V/V2I Situational Awareness
Source: WYDOT

WYDOT Pilot Deployment Vision

400 Equipped Trucks:
- 100 WYDOT Fleet
- 150 Integrated Commercial Trucks
- 25 Retrofit Vehicles
- 125 Basic Vehicles

122 VSL Signs

75 RSU

402 Miles of I-80

55 Parking Locations

NYCDOT Pilot Deployment Overview

Objective:

- Improve safety and mobility of travelers in New York City through connected vehicle technologies
  - Aligned with the NYC's Vision Zero initiative, which seeks to reduce crashes and pedestrian fatalities, and increase safety of travelers in all modes of transportation

Approach:

- Equip up to 8,000 vehicles (taxis, buses, commercial fleet delivery trucks, and City-owned vehicles) that frequently travel in Midtown Manhattan and Central Brooklyn to transmit and receive connected vehicle data
- Install V2I technology at high-accident rate arterials:
  - Upgrade 310 traffic signals along 1st, 2nd, 5th, and 6th Avenues in Manhattan and Flatbush Avenue in Central Brooklyn (emergency evacuation route). In addition to the north/south avenues, five east/west two-way cross streets (14th, 23rd, 34th, 42nd, and 57th Streets) will be secondary corridors.
  - Deploy Roadside equipment (RSE) along FDR Drive

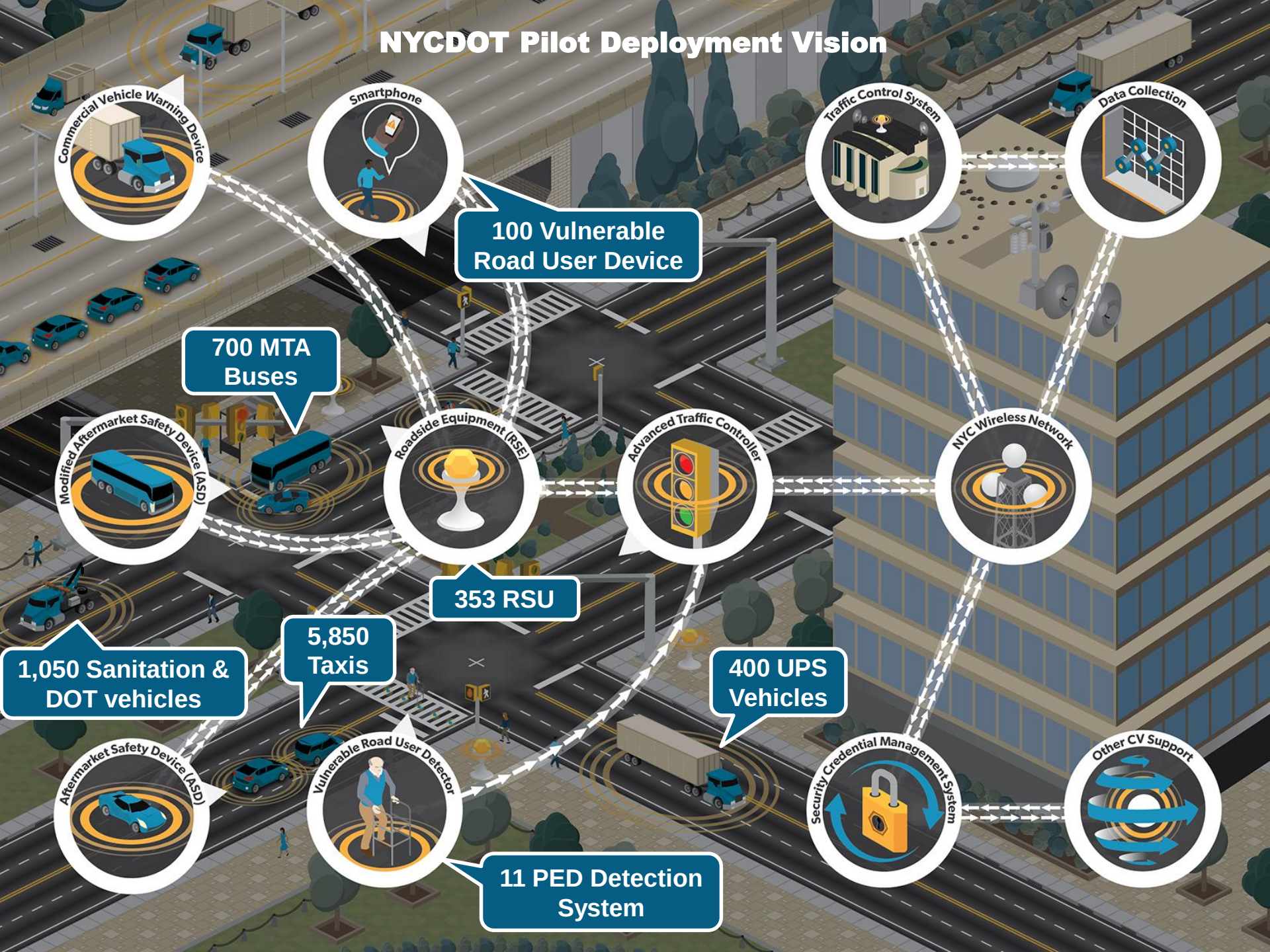
NYCDOT Pilot Deployment Proposed CV Application-Fleet Distribution

Category	NYCDOT – CV Application
V2I/I2V Safety	Speed Compliance
	Curve Speed Compliance
	Speed Compliance/Work Zone
	Red Light Violation Warning
	Oversize Vehicle Compliance
	Emergency Communications and Evacuation Information
V2V Safety	Forward Crash Warning (FCW)
	Emergency Electronics Brake Lights (EEBL)
	Blind Spot Warning (BSW)
	Lane Change Warning/Assist (LCA)
	Intersection Movement Assist (IMA)
	Vehicle Turning Right in Front of Bus Warning
V2I/I2V Pedestrian	Pedestrian in Signalized Crosswalk
	Mobile Accessible Pedestrian Signal System (PED-SIG)
Mobility	Intelligent Traffic Signal System (I-SIGCVDATA)

NYCDOT – Devices	Estimated Number
Roadside Unit (RSU) at Manhattan and Brooklyn Intersections and FDR Drive	353
Taxi Equipped with Aftermarket Safety Device (ASD)*	5,850
MTA Fleet Equipped with ASD*	700
UPS Truck Equipped with ASD*	400
NYCDOT Fleet Equipped with ASD*	800
DSNY Fleet Equipped with ASD*	250
Vulnerable Road User (Pedestrians/Bicyclists) Device	100
PED Detection System	10 + 1 spare
Total Equipped Vehicles	*8,000*

MTA: Metropolitan Transportation Authority; DSNY: City of New York Department of Sanitation

** In addition, 600 spare ASDs will be purchased.*


NYCDOT Pilot Deployment Vision
Commercial Vehicle Warning Device
Smartphone
100 Vulnerable Road User Device
Traffic Control System
Data Collection
700 MTA Buses
Modified Aftermarket Safety Device (ASD)
Roadside Equipment (RSE)
Advanced Traffic Controller
NYC Wireless Network
353 RSU
1,050 Sanitation & DOT vehicles
5,850 Taxis
400 UPS Vehicles
Aftermarket Safety Device (ASD)
Vulnerable Road User Detector
Security Credential Management System
Other CV Support
11 PED Detection System

TAMPA (THEA) PILOT DEPLOYMENT OVERVIEW

Objective:

- The primary objective of this deployment is to alleviate congestion and improve safety during morning commuting hours.
  - Deploy a variety of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) safety, mobility, and agency data applications to create reinforcing benefits for motorists, pedestrians, and transit operation.

Approach:

- Deploy a variety of connected vehicle technologies on and in the vicinity of reversible express lanes and three major arterials in downtown Tampa to solve the following transportation challenges:
- Morning peak hour queues, wrong-way entries, pedestrian safety, bus rapid transit (BRT) signal priority optimization, trip time and safety, streetcar trolley conflicts, and enhanced signal coordination and traffic progression.

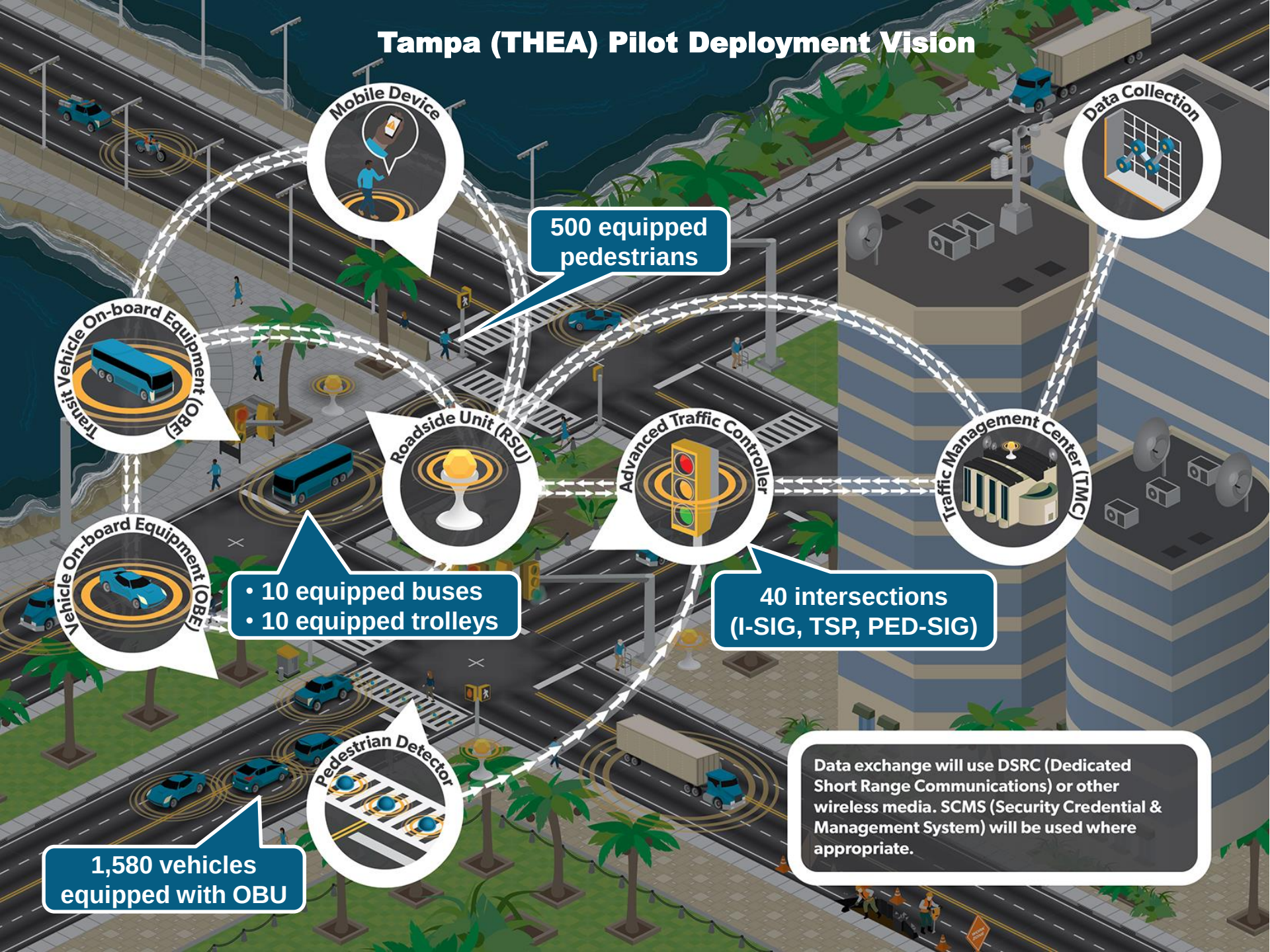
Source: THEA

Tampa (THEA) Pilot Deployment
Proposed CV Applications & Devices

Category	Tampa (THEA) – CV Application
V2I Safety	End of Ramp Deceleration Warning (ERDW)
	Wrong Way Entry (WWE)
	Pedestrian in Signalized Crosswalk Warning (PED-X)
	Pedestrian Collision Warning (PCW)
	Pedestrian Transit Movement Warning (PTMW)
V2V Safety	Emergency Electronic Brake Lights (EEBL)
	Forward Collision Warning (FCW)
	Intersection Movement Assist (IMA)
	Vehicle Turning Right in Front of a Transit Vehicle (VTRFTV)
Mobility	Mobile Accessible Pedestrian Signal System (PED-SIG)
	Intelligent Traffic Signal System (I-SIG)
	Transit Signal Priority (TSP)
Agency Data	Probe Date Enabled Traffic Monitoring (PDETM)

Tampa (THEA) – Devices	Estimated Number
Roadside Unit (RSU) at Intersection	44
Vehicle Equipped with OBU	1,580
Pedestrian Equipped with App in Smartphone	500
HART Transit Bus Equipped with OBU	10
TECO Line Street Car Equipped with OBU	10
Total Equipped Vehicles	***1,600***

Source: THEA


Tampa (THEA) Pilot Deployment Vision
Mobile Device
500 equipped pedestrians
Data Collection
Transit Vehicle On-board Equipment (OBE)
Roadside Unit (RSU)
Advanced Traffic Controller
Traffic Management Center (TMC)
Vehicle On-board Equipment (OBE)
• 10 equipped buses
• 10 equipped trolleys
40 intersections (I-SIG, TSP, PED-SIG)
Pedestrian Detector
1,580 vehicles equipped with OBU
Data exchange will use DSRC (Dedicated Short Range Communications) or other wireless media. SCMS (Security Credential & Management System) will be used where appropriate.

Overview of Interoperability Test

- Dates/Location:
  - June 25 – 28, 2018 at FHWA Turner-Fairbank Highway Research Center (TFHRC)

- Objectives:
  - Test interoperability among connected vehicle (CV) devices from the three sites as well as to identify potential interoperability issues that may require resolution prior to the sites advancing to an operational phase of the CV Pilot Deployment Program later in 2018.

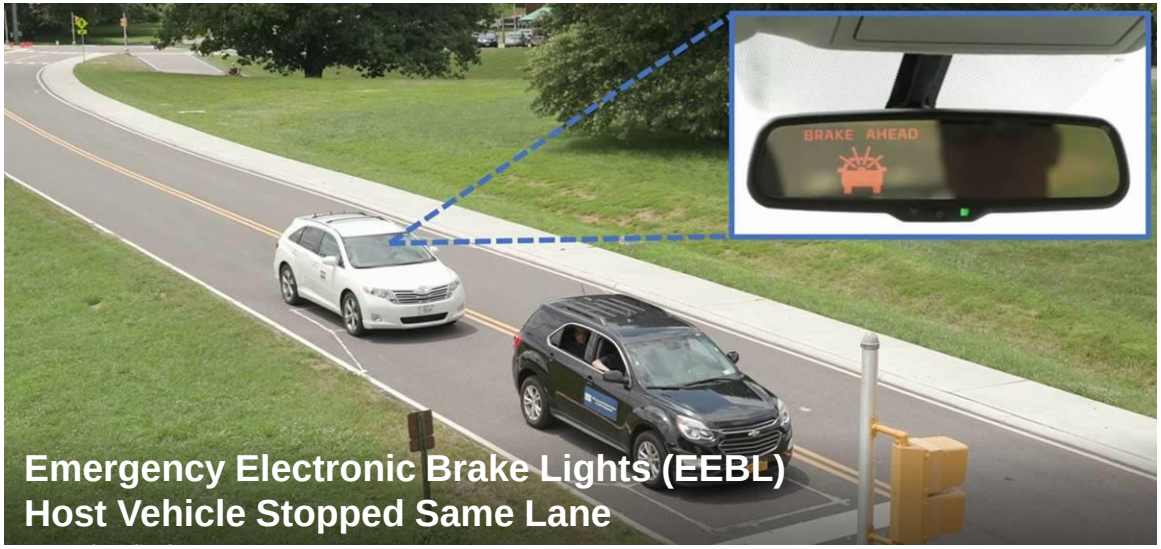
- Interoperability Definition (defined by the team):
  - "*A vehicle with an onboard unit (OBU) from one of the three CV Pilot sites is able to interact with OBUs and roadside units (RSUs) from each of the other sites in accordance with the key connected vehicle interfaces and standards*."

NYCDOT Tampa (THEA) WYDOT USDOT

Overview of Test Plan

- CV Pilots Phase 2 Interoperability Test demonstrated interactions among different site's OBUs and among selected OBUs and RSUs.
  - OBU Interactions :
    - Receive Basic Safety Messages (BSMs) transmitted by the other site's OBUs via DSRC; authenticate them as needed; parse them; and process them in accordance with SAE J2945/1.
    - CV applications: Forward Collision Warning (FCW), Electronic Emergency Brake Light (EEBL), and Intersection Movement Assist (IMA) - only NYC/Tampa
  - OBU and RSU interactions:
    - Signal Phase and Timing (SPaT) and MAP (only NYC and Tampa)

Photos for Example Tests



Emergency Electronic Brake Lights (EEBL)
Host Vehicle Stopped Same Lane

Forward Collision Warning (FCW)
Stationary Remote Vehicle Same Lane

Intersection Movement Assist (IMA) Host Vehicle Stopped

SUMMARY

- Key Results
  - More than 100 test runs within three days.
  - Successful message transfer via multiple communications.
  - Interoperability demonstrated inclusive of SCMS enrollment.
  - Nearly 5 GB of test data generated for analysis.

- Testimonials with Respect to Value
  - Test Team did an outstanding job planning and organizing the tests.
  - Everyone had a good experience with the testing.
  - A test of this nature had never been conducted before.

NYCDOT Tampa (THEA) WYDOT USDOT

STAY CONNECTED

Join us for the *Getting Ready for Deployment* Series

- Discover more about the CV Pilot Sites
- Learn the Essential Steps to CV Deployment
- Engage in Technical Discussion

Visit the Pilot Site Websites for more Information:

- NYCDOT Pilot: https://www.cvp.nyc/
- Tampa (THEA): https://www.tampacvpilot.com/
- Wyoming DOT: https://wydotcvp.wyoroad.info/

Contact for CV Pilots Program:

Kate Hartman, Program Manager

Kate.hartman@dot.gov

Contact for Pilot Sites:

- Kate Hartman, WYDOT Site AOR Kate.Hartman@dot.gov
- Jonathan Walker, NYCDOT Site AOR Jonathan.b.Walker@dot.gov
- Govind Vadakpat, THEA Site AOR G.Vadakpat@dot.gov