CONNECTED VEHICLE PILOT
Deployment Program

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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

Spur Early CV Tech Deployment

Wirelessly Connected Vehicles

Mobile Devices

Infrastructure

Measure Deployment Benefits

Safety

Mobility

Environment

Resolve Deployment Issues

Technical

Institutional

Financial
The Three Pilot Sites

- **WYDOT**
  - 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.

- **New York City DOT**
  - 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.

- **Tampa (THEA)**
  - 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.
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)
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

<table>
<thead>
<tr>
<th>Category</th>
<th>WYDOT - CV Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>V2V Safety</td>
<td>Forward Collision Warning (FCW)</td>
</tr>
<tr>
<td>V2I/I2V Safety</td>
<td>Situational Awareness</td>
</tr>
<tr>
<td></td>
<td>Work Zone Warnings (WZW)</td>
</tr>
<tr>
<td></td>
<td>Spot Weather Impact Warning (SWIW)</td>
</tr>
<tr>
<td>V2I and V2V Safety</td>
<td>Distress Notification (DN)</td>
</tr>
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#### WYDOT - Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Estimated Number</th>
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</thead>
<tbody>
<tr>
<td>Roadside Unit (RSU)</td>
<td>75</td>
</tr>
<tr>
<td>WYDOT Fleet Subsystem OBU</td>
<td>100</td>
</tr>
<tr>
<td>Integrated Commercial Truck Subsystem OBU</td>
<td>150</td>
</tr>
<tr>
<td>Retrofit Vehicle Subsystem OBU</td>
<td>25</td>
</tr>
<tr>
<td>Basic Vehicle Subsystem OBU</td>
<td>125</td>
</tr>
<tr>
<td>Total Equipped Vehicles</td>
<td>400</td>
</tr>
</tbody>
</table>

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### Diagram

#### I2V/V2I Situational Awareness

- **Vehicle 1**
- **Vehicle 2**
- **Vehicle 3**

**Source:** WYDOT
WYDOT Pilot Deployment Vision

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

- 402 Miles of I-80
- 122 VSL Signs
- 75 RSU
- 55 Parking Locations
- On-site Meteorology
- Available Truck Parking
- High Wind Warning Lifted
- Truck Parking Notification
- Low Visibility / VSL
 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

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

## Category: NYCDOT - Devices

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

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

*In addition, 600 spare ASDs will be purchased.*
NYCDOT Pilot Deployment Vision

- 400 UPS Vehicles
- 700 MTA Buses
- 1,050 Sanitation & DOT vehicles
- 5,850 Taxis
- 353 RSU
- 11 PED Detection System
- 100 Vulnerable Road User Device
- 400 UPS Vehicles
- 11 PED Detection System
- 100 Vulnerable Road User Device
- Modified Aftermarket Safety Device (ASD)
- Data Collection
- NYC Wireless Network
- Advanced Traffic Controller
- Security Credential Management System
- Other CV Support

NYC DOT
Commercial Vehicle Warning Device
Roadside Equipment (RE)
Traffic Control System
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.
## Tampa (THEA) Pilot Deployment

### Proposed CV Applications & Devices

<table>
<thead>
<tr>
<th>Category</th>
<th>Tampa (THEA) - CV Application</th>
<th>Tampa (THEA) - Devices</th>
<th>Estimated Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V2I Safety</strong></td>
<td>End of Ramp Deceleration Warning (ERDW)</td>
<td>Roadside Unit (RSU) at Intersection</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Wrong Way Entry (WWE)</td>
<td>Vehicle Equipped with OBU</td>
<td>1,580</td>
</tr>
<tr>
<td></td>
<td>Pedestrian in Signalized Crosswalk Warning (PED-X)</td>
<td>Pedestrian Equipped with App in Smartphone</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>Pedestrian Collision Warning (PCW)</td>
<td>HART Transit Bus Equipped with OBU</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Pedestrian Transit Movement Warning (PTMW)</td>
<td>TECO Line Street Car Equipped with OBU</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total Equipped Vehicles</strong></td>
<td></td>
<td></td>
<td><strong>1,600</strong></td>
</tr>
</tbody>
</table>

| **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)                     |                                                 |                 |

Source: THEA
Tampa (THEA) Pilot Deployment Vision

- 1,580 vehicles equipped with OBU
  - 10 equipped buses
  - 10 equipped trolleys

- 500 equipped pedestrians
- 40 intersections
  (I-SIG, TSP, PED-SIG)

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.”
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 J 2945/1.
    - 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.


**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/](https://www.cvp.nyc/)
- Tampa (THEA): [https://www.tampacvpilot.com/](https://www.tampacvpilot.com/)
- Wyoming DOT: [https://wydotcvp.wyoroad.info/](https://wydotcvp.wyoroad.info/)

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