OVERVIEW

- Connected Vehicles Pilot Deployment Program Overview
  - Program Goals
  - Organizing Principles
  - Deployment Requirements
  - Deployment Schedule

- 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

- 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
CV Pilot Organizing Principles

- CV Pilots are *pilot deployments*, that is, real-world environment deployments
  - The successful, deployed technologies are expected to remain as permanent operational elements

- Deployment concepts are *needs-driven*
  - Each site has different needs, focus and applications
    - That is, each pilot deployment will address critical problem(s)
    - The needs of each site will drive the deployment process

- Pilot deployments are expected to be both *large-scale with multiple applications*
  - *Large-scale* implies pilot deployments will have measurable impact, not a specific minimum geographic or vehicle fleet size
  - Sites will deploy *multiple applications* drawing on the products of USDOT and other connected vehicle research
CV PILOT DEPLOYMENT REQUIREMENTS

- Multiple connected vehicle applications will be deployed together

- Pilot deployments should leverage USDOT-sponsored research

- Pilot deployments include the capture of data from multiple sources
  - Integrated or carry-in devices for connected vehicles capable of generating an SAE J2735 Basic Safety Message (BSM)
  - Look to pilot deployment data while protecting privacy and intellectual property

- Dedicated Short Range Communications (DSRC) 5.9 GHz will be utilized as the communications technology

- Well-defined, focused, quantitative performance measures
  - Support an independent evaluation effort

- Security and credentialing management system
CV PILOT DEPLOYMENT SCHEDULE

Connected Vehicle Pilot Deployment (up to 50 months)

- **Phase 1: Concept Development (COMPLETE)**
  - Creates the foundational plan to enable further design and deployment
  - **Progress Gate: Is the concept ready for deployment?**

- **Phase 2: Design/Deploy/Test (CURRENT PHASE- began September 1, 2016)**
  - Detailed design and deployment followed by testing to ensure deployment functions as intended (both technically and institutionally)
  - Progress Gate: Does the system function as planned?

- **Phase 3: Maintain/Operate**
  - Focus is on assessing the performance of the deployed system
  - Post Pilot Operations (CV tech integrated into operational practice)
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.
Wyoming DOT
https://wydotcvp.wyoroad.info/
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
### WYDOT Pilot Deployment Proposed CV Application-Fleet Distribution

<table>
<thead>
<tr>
<th>CV Application</th>
<th>WYDOT Fleet</th>
<th>Integrated Commercial Trucks</th>
<th>Retrofit Vehicles</th>
<th>Basic Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Forward Collision Warning</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2. Spot Weather Impact Warning</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3. Work Zone Warnings</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4. Situational Awareness</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5. Distress Notification</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

Other related traffic management and traveler information services:

- Setting and removing variable speed limits along the I-80 corridor
- Supporting 511 and other traveler information
- Supporting road weather advisories and freight-specific travel guidance through CVOP
WYDOT Pilot Deployment Vision

122 VSL Signs

Low Visibility / VSL

Available Truck Parking

402 Miles of I-80

75 RSU

High Wind Warning Lifted

Zero Trucks Blown Over

Open to Light, High Profile Vehicles

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

55 Parking Locations

Note: The number is a rough estimate for the concept development phase.
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)
  - Deploy Roadside equipment (RSE) along FDR Drive
NYCDOT Pilot Deployment Site

Manhattan Grid
- Closely spaced intersections (600’ x 250’)
- Day vs. Night conditions
- Residential/commercial mix
- High accident rate (red dot) (2012-2014)
  - 20 fatalities
  - 5,007 injuries
- 204 intersections

Central Brooklyn – Flatbush Ave
- Over-Height restrictions
  - Tillary St.; Brooklyn Bridge
- High accident rate (red dots) (2012-14)
  - 1,128 injuries
  - 8 fatalities
- Average AM speed 15 mph
- 35 intersections

Manhattan – FDR Drive
- Limited access highway
- Excludes trucks/buses
- Short radius of curvature
- Over-Height restrictions
- $1,958,497 in Over-Height incident delay costs (2014)
  - 24% of City-wide total
<table>
<thead>
<tr>
<th>CV Application</th>
<th>Taxi &amp; Limousine</th>
<th>NYC DOT/Sanitation</th>
<th>MTA/NYCTA Buses</th>
<th>Commercial Vehicles</th>
<th>Pedestrian</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Speed Compliance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2. Red Light Violation Warning</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3. Ped. in Signalized Crosswalk Warn.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4. RT Vehicle in Front of Bus Warning</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>5. Mobile Accessible Ped Signal Sys.</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6. Curve Speed Compliance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>7. Oversize Vehicle Compliance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>8. Work Zone Speed Compliance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>9. I-SIG</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>10-14. V2V Applications (5)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>15. Evacuation Information</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
NYCDOT Pilot Deployment Vision

1,250 MTA Buses

100 Vulnerable Road User Device

500 Sanitation & DOT vehicles

5,850 Taxis

400 UPS Vehicles

353 RSU

11 PED Detection System

Note: The numbers are rough estimates for the concept development phase.
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 SITE
AN OVERVIEW OF DOWNTOWN TAMPA

Tampa Hillsborough Expressway Authority – Connected Vehicle Map

LEGEND: Connected Vehicle Application

V2I Safety
- End of Ramp Deceleration Warning (ERDW)
- Wrong Way Entry (WWE)
- Pedestrian in Signalized Crosswalk (PED-X)
- Mobile Accessible Pedestrian Signal (PED-SIG)

V2V Safety
- Emergency Electronic Brake Light (EEBL)
- Forward Collision Warning (FCW)
- Intersection Movement Assist (IMA)
- Vehicle Turn Right in Front of Transit Vehicle (VTRFTV)

V2I Mobility
- Intelligent Traffic Signal System (I-SIG)
- Transit Signal Priority (TSP)

V2I Agency Data
- Probe Data Enabled Traffic Monitoring (PDETM)
<table>
<thead>
<tr>
<th>Use Case No.</th>
<th>Description</th>
<th>Applications Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Morning Backup</td>
<td>End of Ramp Deceleration Warning, Intelligent Signal Control, Emergency Electronic Brake Light, Forward Collision Warning</td>
</tr>
<tr>
<td>2</td>
<td>Wrong Way Entry</td>
<td>Wrong Way Entry, Intelligent Signal Control, Intersection Movement Assist</td>
</tr>
<tr>
<td>3</td>
<td>Pedestrian Safety</td>
<td>Pedestrian in a signalized crosswalk warning, Mobile Accessible Pedestrian Signal, Intelligent Signal Control</td>
</tr>
<tr>
<td>4</td>
<td>Transit Signal Priority</td>
<td>Intelligent Signal Control, Transit Signal Priority, Intersection Movement Assist</td>
</tr>
<tr>
<td>5</td>
<td>Trolley Conflicts</td>
<td>Intelligent Signal Control, Mobile Accessible Pedestrian Signal, Pedestrians in Signalized Crosswalk, Vehicle Turning in Front of a Transit Vehicle</td>
</tr>
<tr>
<td>6</td>
<td>Traffic Progression</td>
<td>Intelligent Signal Control, Probe Data Enabled Traffic Monitoring, Intersection Movement Assist</td>
</tr>
</tbody>
</table>
Tampa (THEA) Pilot Deployment Vision

- 500 equipped pedestrians
- 1,600 vehicles equipped with OBU
- 10 equipped buses
- 10 equipped trolleys
- 40 intersections (I-SIG, TSP, PED-SIG)

Note: The numbers are rough estimates for the concept development phase.

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 Pilot Deployment Proposed CV Applications

<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>
</tbody>
</table>
| V2I/I2V Safety | **I2V Situational Awareness***  
Work Zone Warnings (WZW)*  
Spot Weather Impact Warning (SWIW)* |
| V2I and V2V Safety | Distress Notification (DN) |

<table>
<thead>
<tr>
<th>Category</th>
<th>NYCDOT – CV Application</th>
</tr>
</thead>
</table>
| V2I/I2V Safety | Speed Compliance  
Curve Speed Compliance  
Speed Compliance/Work Zone  
Red Light Violation Warning  
**Oversize Vehicle Compliance** |
| 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  
Emergency Communications and Evacuation Information  
Pedestrian in Signalized Crosswalk  
Mobile Accessible Pedestrian Signal System (PED-SIG)  
Intelligent Traffic Signal System (I-SIG)  
Transit Signal Priority (TSP)  
**Data Probe-enabled Data Monitoring (PeDM)** |

<table>
<thead>
<tr>
<th>Category</th>
<th>Tampa (THEA) – CV Application</th>
</tr>
</thead>
</table>
| V2I Safety | End of Ramp Deceleration Warning (ERDW)  
Pedestrian in Signalized Crosswalk Warning (PED-X)  
Wrong Way Entry (WWE) |
| 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-enabled Data Monitoring (PeDM) |

* The applications have mobility/efficiency as a secondary benefit.
## Overview of Pilot Deployment Proposed CV Devices

### WYDOT – Devices

<table>
<thead>
<tr>
<th>Devices</th>
<th>Estimated Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadside Unit (RSU)</td>
<td>75</td>
</tr>
<tr>
<td>WYDOT Fleet Subsystem On-Board Unit (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><strong>Total Equipped Vehicles</strong></td>
<td><strong>400</strong></td>
</tr>
</tbody>
</table>

### Tampa (THEA) – Devices

<table>
<thead>
<tr>
<th>Devices</th>
<th>Estimated Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadside Unit (RSU) at Intersection</td>
<td>40</td>
</tr>
<tr>
<td>Vehicle Equipped with On-Board Unit (OBU)</td>
<td>1,600</td>
</tr>
<tr>
<td>Pedestrian Equipped with App in Smartphone</td>
<td>500</td>
</tr>
<tr>
<td>HART Transit Bus Equipped with OBU</td>
<td>10</td>
</tr>
<tr>
<td>TECO Line Street Car Equipped with OBU</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total Equipped Vehicles</strong></td>
<td><strong>1,620</strong></td>
</tr>
</tbody>
</table>

### NYCDOt – Devices

<table>
<thead>
<tr>
<th>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>1,250</td>
</tr>
<tr>
<td>UPS Truck Equipped with ASD*</td>
<td>400</td>
</tr>
<tr>
<td>NYCDOt Fleet Equipped with ASD*</td>
<td>250</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><strong>Total Equipped Vehicles</strong></td>
<td><strong>8,000</strong></td>
</tr>
</tbody>
</table>

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

* In addition, 600 spare ASDs will be purchased.
## Schedule of Phase 2 Activities

| Task                                    | 09/16 | 10/16 | 11/16 | 12/16 | 01/17 | 02/17 | 03/17 | 04/17 | 05/17 | 06/17 | 07/17 | 08/17 | 09/17 | 10/17 | 11/17 | 12/17 | 01/18 | 02/18 | 03/18 | 04/18 |
|-----------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 2-A – Program Mgt.                      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-B – System Arch/Design                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-C – Data Mgt. Planning                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-D – Acquisition/Install Plan          |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-E – App Development                   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-F – Participant/Staff Training        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-G – Test/Demo Planning                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-H – Installation and Testing          |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-I – Maint. And Ops Planning           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-J – Stakeholder Outreach              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-K – Perf. Measurement/IE Support      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 2-L – Standards Development            |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
# Schedule of Phase 3 Activities

| Task                          | 04/18 | 05/18 | 06/18 | 07/18 | 08/18 | 09/18 | 10/18 | 11/18 | 12/18 | 01/19 | 02/19 | 03/19 | 04/19 | 05/19 | 06/19 | 07/19 | 08/19 | 09/19 | 10/19 |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 3-A – Program Mgt.            |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 3-B – System Ops/Maint        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 3-C – Stakeholder Outreach    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 3-D – Perf/Meas./IE Support   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 3-E – Transition Planning     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 3-F – Standards Development  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
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

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**Twitter:** @ITSJPODirector  
**Facebook:** https://www.facebook.com/USDOTResearch

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  G.Vadakpat@dot.gov  
  THETA: http://www.tampacvpilot.com/