Connected Deployment

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WHAT I’LL BE COVERING TODAY...

- Connected Vehicles Pilot Deployment Program Overview
  - NYCDOT
  - Tampa (THEA)
  - WYDOT

- Smart City Challenge Overview
  - SMART CITY CHALLENGE
  - SMART COLUMBUS

- Policy Insights / Key Take-Aways
  - Financial and Institutional Sustainability, Data and Performance Measurement, Positive Peer Pressure

- How to Stay Connected
CV PILOT DEPLOYMENT PROGRAM GOALS

- Spur Early CV Tech Deployment
- Measure Deployment Benefits
- Resolve Deployment Issues

Wirelessly Connected Vehicles
Safety
Technical

Mobile Devices
Mobility
Institutional

Infrastructure
Environment
Financial
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.
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 (400 equipped trucks, a combination of snow plows, maintenance fleet vehicles, emergency vehicles, and private trucks) that frequently travel the I-80 corridor to transmit BSMs, collect vehicle and road condition data and provide it remotely to the WYDOT TMCs.
- Deploy approximately 75 DSRC RSUs along the 402 miles of I-80 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 APPLICATIONS & DEVICES**

<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>
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<tr>
<td>V2I and V2V Safety</td>
<td>Distress Notification (DN)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>WYDOT - Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated Number</td>
</tr>
<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>

Source: WYDOT
WYDOT Pilot Deployment Vision

400 Equipped Vehicles:
- 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

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 Proposed CV Application-Fleet Distribution

<table>
<thead>
<tr>
<th>Category</th>
<th>NYCDOT - CV Application</th>
<th>NYCDOT - Devices</th>
<th>Estimated Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V2I/I2V Safety</strong></td>
<td>Speed Compliance</td>
<td>Roadside Unit (RSU) at Manhattan and Brooklyn Intersections and FDR Drive</td>
<td>353</td>
</tr>
<tr>
<td></td>
<td>Curve Speed Compliance</td>
<td>Taxi Equipped with Aftermarket Safety Device (ASD)*</td>
<td>5,850</td>
</tr>
<tr>
<td></td>
<td>Speed Compliance/Work Zone</td>
<td>MTA Fleet Equipped with ASD*</td>
<td>1,250</td>
</tr>
<tr>
<td></td>
<td>Red Light Violation Warning</td>
<td>UPS Truck Equipped with ASD*</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td><strong>Oversize Vehicle Compliance</strong></td>
<td>NYCDOT Fleet Equipped with ASD*</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Emergency Communications and Evacuation Information</td>
<td>DSNY Fleet Equipped with ASD*</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Forward Crash Warning (FCW)</td>
<td>Vulnerable Road User (Pedestrians/Bicyclists) Device</td>
<td>100</td>
</tr>
<tr>
<td><strong>V2V Safety</strong></td>
<td>Emergency Electronics Brake Lights (EEBL)</td>
<td><strong>PED Detection System</strong></td>
<td><strong>10 + 1 spare</strong></td>
</tr>
<tr>
<td></td>
<td>Blind Spot Warning (BSW)</td>
<td><strong>Total Equipped Vehicles</strong></td>
<td><strong>8,000</strong></td>
</tr>
<tr>
<td></td>
<td>Lane Change Warning/Assist (LCA)</td>
<td><strong>V2V Safety</strong></td>
<td><strong>Vehicle Turning Right in Front of Bus Warning</strong></td>
</tr>
<tr>
<td></td>
<td>Intersection Movement Assist (IMA)</td>
<td><strong>V2I/I2V Pedestrian</strong></td>
<td><strong>Mobile Accessible Pedestrian Signal System (PED-SIG)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>V2I/I2V Pedestrian</strong></td>
<td><strong>Pedestrian in Signalized Crosswalk</strong></td>
<td><strong>Mobile Accessible Pedestrian Signal System (PED-SIG)</strong></td>
</tr>
<tr>
<td></td>
<td>Pedestrian in Signalized Crosswalk</td>
<td><strong>Mobility</strong></td>
<td><strong>Intelligent Traffic Signal System (I-SIGCVDATA)</strong></td>
</tr>
<tr>
<td></td>
<td>Mobile Accessible Pedestrian Signal System (PED-SIG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Mobility</strong></td>
<td></td>
<td></td>
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</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

1,250 MTA Buses
500 Sanitation & DOT vehicles
100 Vulnerable Road User Device
353 RSU
400 UPS Vehicles
5,850 Taxis
500 Sanitation & DOT vehicles
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 V2V and 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.
  - Employ DSRC to enable transmissions among approximately 1,600 cars, 10 buses, 10 trolleys, 500 pedestrians with smartphone applications, and approximately 40 roadside units along city streets.
# Tampa (THEA) Pilot Deployment

## Proposed CV Applications & Devices

### Tampa (THEA) - CV Applications

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

### Tampa (THEA) - Devices

<table>
<thead>
<tr>
<th>Tampa (THEA) - 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 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>
</tbody>
</table>

**Total Equipped Vehicles:** 1,620

*Source: THEA*
Tampa (THEA) Pilot Deployment
Proposed CV Applications & Devices

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

- 1,600 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.
The Smart City Challenge

- Encourage cities to put forward their best and most creative ideas for innovatively addressing the challenges they are facing.

- Demonstrate how advanced data and intelligent transportation systems (ITS) technologies and applications can be used to reduce congestion, keep travelers safe, protect the environment, respond to climate change, connect underserved communities, and support economic vitality.
The Smart City Challenge

78 Applications and 7 Finalists - Austin, Columbus, Denver, Kansas City, Pittsburgh, Portland, and San Francisco

How We Move
44 cities proposed projects to test the use of automated shared use vehicles to help travelers connect to their destinations.

How We Move Things
11 cities envisioned improving urban freight delivery by implementing smarter curb space management (through sensors, dynamic reservations, and other technologies) to speed loading and unloading.

How We Adapt
17 cities proposed using inductive wireless charging to charge electric vehicles, buses, or shuttles.

How We Move Better
53 cities proposed implementing Dedicated Short Range Communication (DSRC) to connect vehicles to infrastructure and each other.

How We Grow Opportunity
9 cities proposed providing free public WiFi on buses, taxis, and public spaces. The seven Smart City Challenge finalists proposed over 60 unique strategies to increase access to jobs, provide training, reach underserved areas, and ensure connectivity for all.

How We Align Decisions and Dollars
45 cities proposed implementing a unified traffic or transportation data analytics platform, which would help them make better decisions with their limited resources.
SMART COLUMBUS

Connected Vehicles, Multimodal Traveler Information, Smart Mobility Hubs, Prenatal Trip Assistance, and Mobility Assistance

Connected Electric Automated Vehicles (CEAVs) and Enhanced Human Services

Truck Platooning and “Intent-to-Platoon” Freight Signal Priority

U.S. Department of Transportation
POLICY INSIGHTS / KEY TAKE-AWAYS

- Plan early for long-term financial sustainability post-pilot
- Organize and align partners around the conceptual vision
- Design systems with critical performance measurement built-in
- Plan to manage and share data
- Utilize positive peer pressure
- Reach out and engage stakeholders
Tampa Hillsborough Expressway Authority (THEA) is the main contractor of the Tampa (THEA) Pilot project

Utilizing toll incentive program to continue attracting participants (more than 1,200 sign-ups to date)

THEA toll revenue will be the main financial resource after end of pilots

Operation and maintenance cost is built into the THEA 30-year business plan.
Organize and Align Partners Around the Conceptual Vision

Insights from the Smart City Challenge and Smart Columbus Program

- **Leadership and Internal Coordination**
  - Identify committed leader(s) and champion(s) with sufficient standing and authority in the organization to get things done
  - Coordinate vision across departments around proposed concepts and approaches (e.g., agile software development, open data requirements, and open source tools)

- **Finalize Concepts before Choosing Partners**
  - Engage stakeholders and the community early in the process to identify real-world challenges, problems, and issues – and follow a systems engineering process to define concepts
  - Avoid letting vendor solutions drive the proposed concept
  - Identify opportunities to partner with other public agencies, universities, non-profits, and the private sector that have “skin in the game”
The NYC Pilot Goal is tied to NYCDOT’s Vision Zero Program

- The NYC pilot will evaluate the safety benefits and challenges of implementing CV technology with a significant number of vehicles in the dense urban environment.

Performance metrics and evaluation methods are built into the system while preserving privacy

- Data collection: everything that “occurred” immediately before and after the alert
- Safety improvement by comparing 47 identified metrics (e.g., crash rate, red light violations) from the previous measures.

“Traffic Death and Injury on City streets is not acceptable”

Source: USDOT
The WYDOT Pilot utilizes the USDOT-developed Operational Data Environment (ODE) for real-time operation and data sharing

- Transmitting logged messages and warnings in real time
- Sending data to the independent evaluator and internal researchers
- Sharing data with public after
  - removing private information
  - performing quality checks
Utilize Positive Peer Pressure

- Positive peer pressure can be a powerful force
- Non-competitive structure assisted site-to-site coordination
  - Learn from each other
    - Example: FCC license application, interface design document, single vs. dual radio.
  - Cooperation on security, vendor interaction, stakeholder coordination
    - Example: UPS in WY and NYC, SCMS enrollment and use of certificates
- Interoperability coordination
  - Contributing to evolution of communication standards
  - Harmonization of BSM, SPaT/MAP, and TIM messages
  - Resolve standards issues related to crosswalks and application identification codes.
REACH OUT AND ENGAGE STAKEHOLDERS

- Stakeholders local to your deployment
  - Hillsborough Community College (HCC) to perform OBU installations in over 1600 privately and publicly-owned vehicles in Tampa

- Sharing insights with other CV stakeholders
  - Hosting webinars to update project status and answer questions
  - Posting documentation through the website
  - Sharing experiences to support other early deployers (e.g., Smart Columbus)

https://www.its.dot.gov/pilots/
STAY CONNECTED

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Program Website:
- https://www.its.dot.gov/pilots/

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