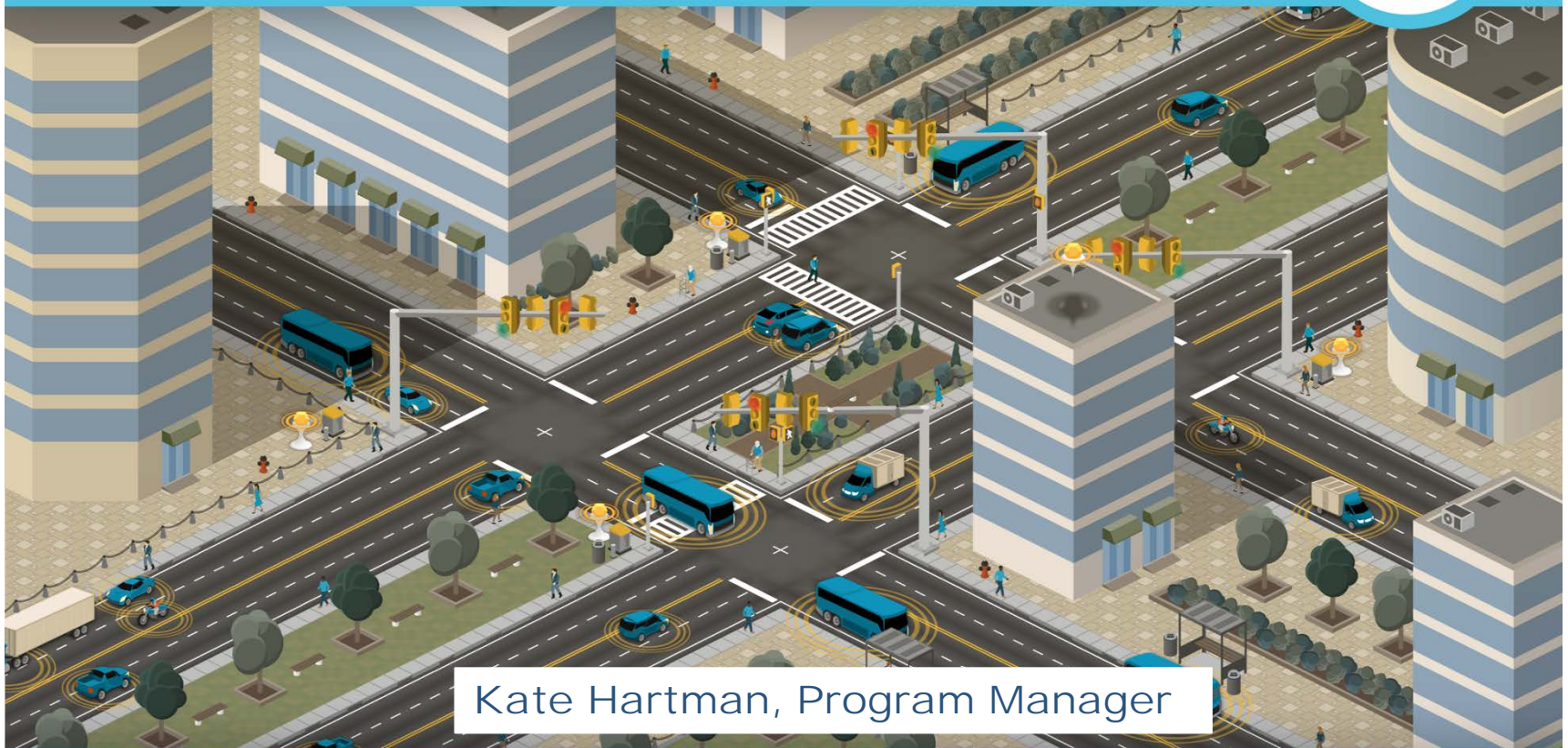




CONNECTED VEHICLE PILOT Deployment Program



Kate Hartman, Program Manager

ITS Joint Program Office





- Connected Vehicles Pilot Deployment Program Overview
 - Program Goals
 - Deployment Schedule
 - Overview of CV Pilot Program Award Sites

- Lessons Learned in the CV Pilots Concept Development Phase
 - Collaboration
 - Technical Related
 - Deployment Complexity

- How to Stay Connected

CV PILOT DEPLOYMENT PROGRAM GOALS



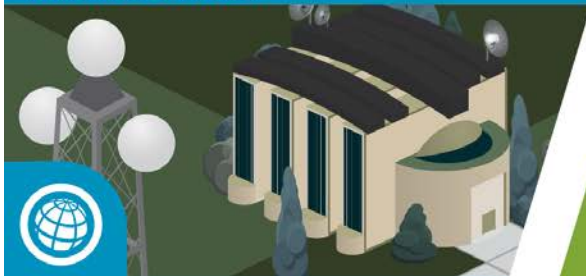
Spur Early CV Tech Deployment



Wirelessly Connected Vehicles



Mobile Devices



Infrastructure

Measure Deployment Benefits



Safety



Mobility



Environment

Resolve Deployment Issues



Technical



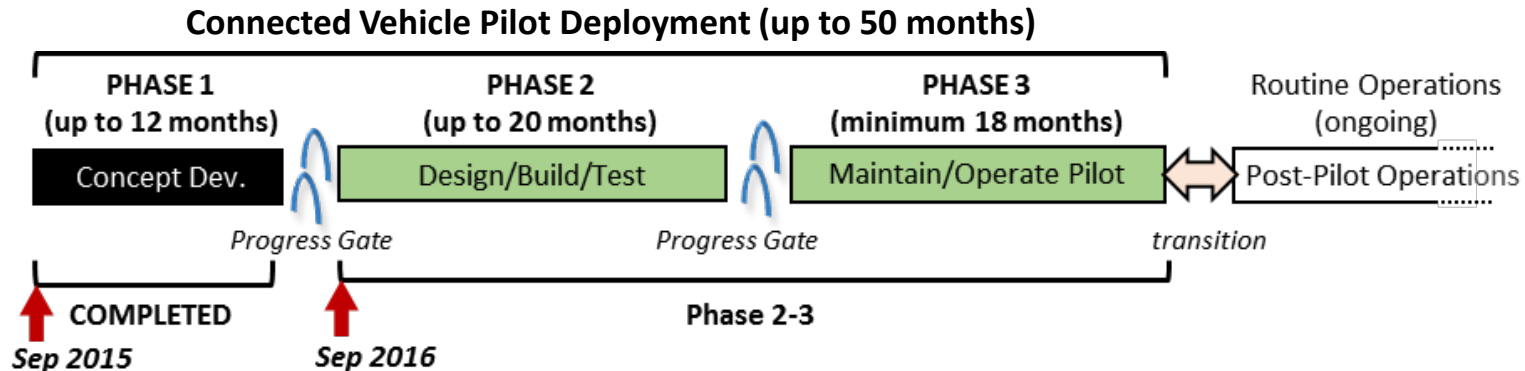
Institutional



Financial



CV PILOT DEPLOYMENT SCHEDULE



- **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)**



WYDOT PILOT DEPLOYMENT OVERVIEW

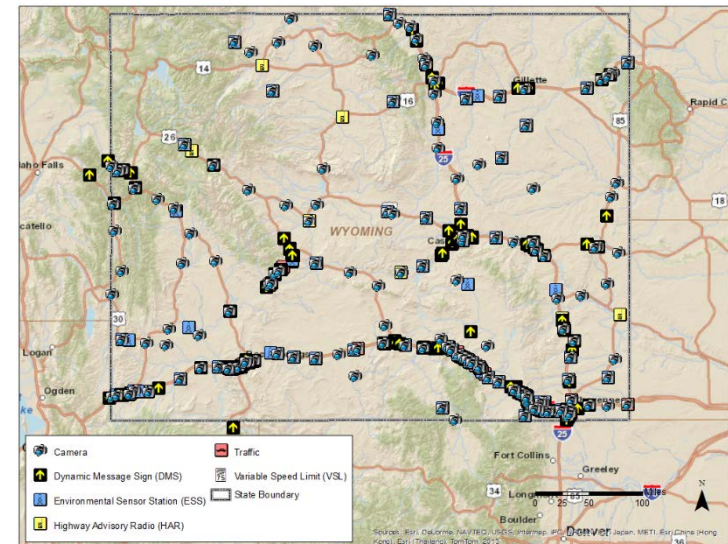


Objective:

- 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 (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 existing in-vehicle systems.



Source: Wyoming DOT



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.
- Deploy approximately 310 RSUs at signalized intersections in Manhattan and Central Brooklyn (emergency evacuation route); 8 RSUs along the higher-speed Franklin D. Roosevelt (FDR) Drive to address challenges such as short-radius curves, a weight limit and a minimum bridge clearance; 36 RSUs at other strategic locations throughout the City to support system management functions.
- Equip approximately 100 pedestrians with personal devices and deploy approximately 11 pedestrian detection systems to reduce vehicle-pedestrian conflicts.



Source: NYC DOT



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 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 1,500 cars, 10 buses, 10 trolleys, 500 pedestrians with smartphone applications, and approximately 40 roadside units along city streets.



Source: THEA



OVERVIEW OF PILOT DEPLOYMENT PROPOSED CV APPLICATIONS



| Category | WYDOT – CV Application |
|--------------------|--|
| V2V Safety | Forward Collision Warning (FCW) |
| V2I/I2V Safety | I2V Situational Awareness* |
| | Work Zone Warnings (WZW)* |
| | Spot Weather Impact Warning (SWIW)* |
| V2I and V2V Safety | Distress Notification (DN) |
| Category | Tampa (THEA) – CV Application |
| V2I Safety | Curve Speed Warning (CSW) |
| | Pedestrian in Signalized Crosswalk Warning (PED-X) |
| | Red Light Violation Warning (RLVW) |
| 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) |

| 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) |

** The applications have mobility/ efficiency as a secondary benefit.*



OVERVIEW OF PILOT DEPLOYMENT PROPOSED CV DEVICES



| WYDOT – Devices | Estimated Number |
|---|------------------|
| Roadside Unit (RSU) | 75 |
| WYDOT Fleet Subsystem On-Board Unit (OBU) | 100 |
| Integrated Commercial Truck Subsystem OBU | 150 |
| Retrofit Vehicle Subsystem OBU | 20-30 |
| Basic Vehicle Subsystem OBU | 100-150 |
| <i>Total Equipped Vehicles</i> | <i>400</i> |

| Tampa (THEA) – Devices | Estimated Number |
|--|------------------|
| Roadside Unit (RSU) at Intersection | 40 |
| Vehicle Equipped with On-Board Unit (OBU) | 1,500 |
| Pedestrian Equipped with App in Smartphone | 500 |
| HART Transit Bus Equipped with OBU | 10 |
| TECO Line Street Car Equipped with OBU | 10 |
| <i>Total Equipped Vehicles</i> | <i>1,520</i> |

| 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* | 1,250 |
| UPS Truck Equipped with ASD* | 400 |
| NYCDOT Fleet Equipped with ASD* | 250 |
| DSNY Fleet Equipped with ASD* | 250 |
| Vulnerable Road User (Pedestrians/Bicyclists) Device | 100 |
| PED Detection System | 10 + 1 spare |
| <i>Total Equipped Vehicles</i> | <i>8,000</i> |

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

* In addition, 600 spare ASDs will be purchased.





LESSONS LEARNED IN CV PILOTS CONCEPT DEVELOPMENT PHASE



(FROM THE FEDERAL TEAM PERSPECTIVE)





FEDERAL TEAM PERSPECTIVE: ENCOURAGING COLLABORATION



- Stakeholder interaction and partnership was a critical early focus area
 - Stakeholder interaction early and often leads to better concepts and more buy-in
 - Pilot sites did a good job of picking partners as subs to fill out the experience required for many different activities
- Non-competitive structure assisted site-to-site coordination
 - Cooperation on security, vendor interaction, stakeholder coordination (UPS in WY and NYC)
 - Participation in virtual roundtables allowed sites to learn from each other
- Phase 1 site deliverables created examples for others to follow





FEDERAL TEAM PERSPECTIVE: TECHNICAL OBSERVATIONS



- Leverage guidance from previous deployment and evaluation efforts
 - Good lessons learned from Safety Pilot Model Deployment on installation planning/training
 - Good feedback from ICM and Volpe's Safety Pilot Evaluation teams
- Building in performance measurement to a deployed system requires cross functional coordination within the team
- Using standards (intelligently) can help to advance sites systems engineering
- USDOT open source applications made a great starting point for teams to build their ConOps around, but will require significant tailoring to be “deployment ready”
- Building agreements with equipment suppliers is a long and uncertain activity – sites have started to explore options
- Gaining an early understanding of Institutional Review Board (IRB) process and timeframes can help in planning and managing schedule risk
 - E.g., considering how frequently the IRB meets in planning the project schedule





FEDERAL TEAM PERSPECTIVE: MANAGING DEPLOYMENT COMPLEXITY



- Sites were eager to consume USDOT technical assistance
 - Deployments are complex, requiring a lot of diverse elements to come together in an integrated system (technical, security, privacy, performance measurement, institutional, financial, etc.)

- Concept development takes some time to conduct – prior to procuring/designing/installing equipment
 - Sites are willing to “do the hard work now” rather than later, which would be more challenging and expensive
 - E.g., participating in detailed SyRS walkthroughs, thinking through initial application development cost estimates
 - Early discussions and information sharing regarding the Phase 2 and 3 NOFO allows agencies to investigate options for coming up with the required cost share





LESSONS LEARNED IN CV PILOTS CONCEPT DEVELOPMENT PHASE



NYCDOT



Tampa (THEA)



WYDOT

(FROM THE PILOT SITE PERSPECTIVE)



PILOT SITE PERSPECTIVE: PROGRAM MANAGEMENT



■ Program Management

- Importance of face to face progress meetings followed by breakout sessions.
- Each progressive document must be reconciled with prior documents.
 - Incorporate a reconciliation document for tracking these connected changes.
- Balance needed to keep all teams informed and connected
 - Between empowering team leads to operate autonomously and maintaining centralized program management.
- Plan with post-pilot operation in mind.



■ Stakeholder Engagement

- Stakeholders' participation is key to success and to the “Benefits” of the program
 - Need to not only engage stakeholders early, but to educate early.
 - Formalized agreements with private partners take time.
 - Engage procurement and contracting personnel early.
- Address commercial operator's priorities and concerns.
 - E.g., privacy, liability, flexibility, etc.



PILOT SITE PERSPECTIVE: SYSTEMS ENGINEERING APPROACH



■ Concept of Operations

- Develop an approach to integrate CV pilot with existing transportation systems management and operations.



- Need to look at the use of non-CV technology as part of solution.

■ System Requirements

- Development of Verifiable System Requirements is challenging as the standards are evolving.
 - Research vs. real-life deployment requires different approaches (deployment of a “production CV system” is different from an R&D platform).
 - Be prepared for concept evolution – must meet actual needs.

■ Application and Device

- In a mature CV environment, a local level transportation agency would typically not be supplying/procuring the vehicle resident CV system components (ASD, OBU) and their safety applications.
- A systems engineering approach is recommended for procuring these end devices. Insist on release of fundamental operating requirements for “existing” applications – including test procedures.



PILOT SITE PERSPECTIVE: PERFORMANCE MEASUREMENT RELATED



- Performance Measurement, Data Collection and Independent Evaluation Support



- Performance Measurement development takes time and thought.
- Balancing data needs is important
 - Protecting participant PII while also providing sufficient data to support performance measurement.
 - Privacy is a critical issue for our stakeholders.
 - Data collection schemes need to be tempered by the privacy issues.
 - Plan additional time for understanding the issues, formulating workable solutions, and negotiating agreements with the many stakeholders.
- Early involvement in activities such as System Requirements helps facilitate meaningful performance measurement.
- Early definition of needs and role of Independent Evaluator is helpful.



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



Website: <http://www.its.dot.gov/pilots>

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