



# CONNECTED VEHICLE PILOT Deployment Program



## Insights, Challenges, and Lessons Learned from the Concept Development Phase – New York City



***Jonathan Walker (USDOT, NYC CVPD COR)***  
***Mohamad Talas (NYCDOT, NYC CVPD PML)***  
***Bob Rausch (TransCore, NYC CVPD SDL)***

ITS Joint Program Office



# TODAY'S AGENDA



- Purpose of this Webinar
  - To share the insights, challenges, and lessons learned from the New York City Pilot site with the stakeholders of connected vehicle technologies.
  
- Webinar Content
  - Connected Vehicle Pilot Deployment Program Overview
  - Overview of New York City's CV Comprehensive Deployment Plan
  - Insights, Challenges, Lessons Learned for technical and institutional area
  - Stakeholder Q&A
  - How to Stay Connected
  
- Webinar Protocol
  - Please mute your phone during the entire webinar
  - You are welcome to ask questions via chatbox at the Q&A Section
  - The webinar recording and the presentation material will be posted on the CV Pilots website





# CONNECTED VEHICLE PILOT DEPLOYMENT PROGRAM

PROGRAM GOALS



## PILOT SITES



ICF/Wyoming DOT



NYCDOT



Tampa (THEA)

STAY CONNECTED

- Participate in Concept Development Phase Webinars for the three Pilot Sites (see website for exact dates and times)

Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016
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Concept of Operations Webinars

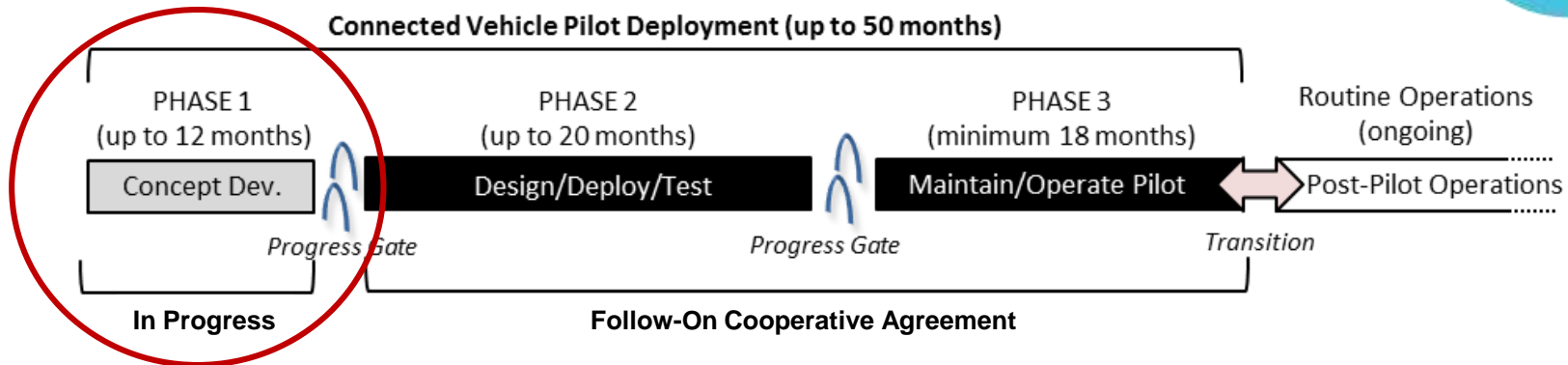
Performance Measurement Webinars

Comprehensive Deployment Plan Webinars

- Visit Program Website for Updates: <http://www.its.dot.gov/pilots>
- Contact: Kate Hartman, Program Manager, [Kate.hartman@dot.gov](mailto:Kate.hartman@dot.gov)



# MOVING FROM CONCEPT DEVELOPMENT PHASE TO DESIGN/DEPLOY/TEST PHASE



*Sites are wrapping up Phase 1; projected Phase 2 Start in September 2016*

- Phase 1: Concept Development (*Current Phase*)
  - Creates the foundational plan to enable further design and deployment
  - **Progress Gate: Is the concept ready for deployment?**
- Phase 2: Design/Deploy/Test
  - 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)





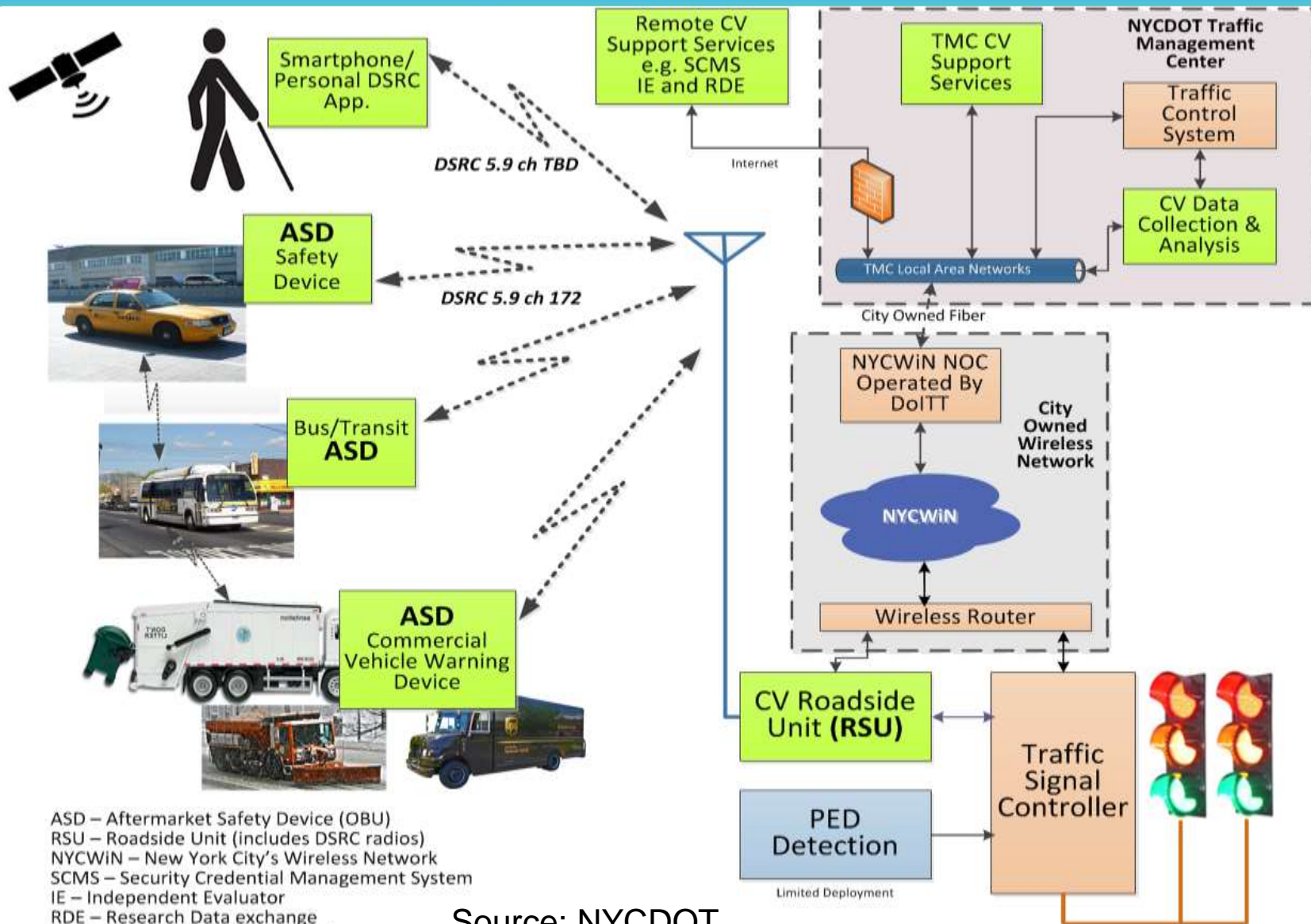
# **New York City CV Pilot Deployment Concept**

Speaker

Mohamad Talas, PE, PTOE, PhD



# Overall Project Concept



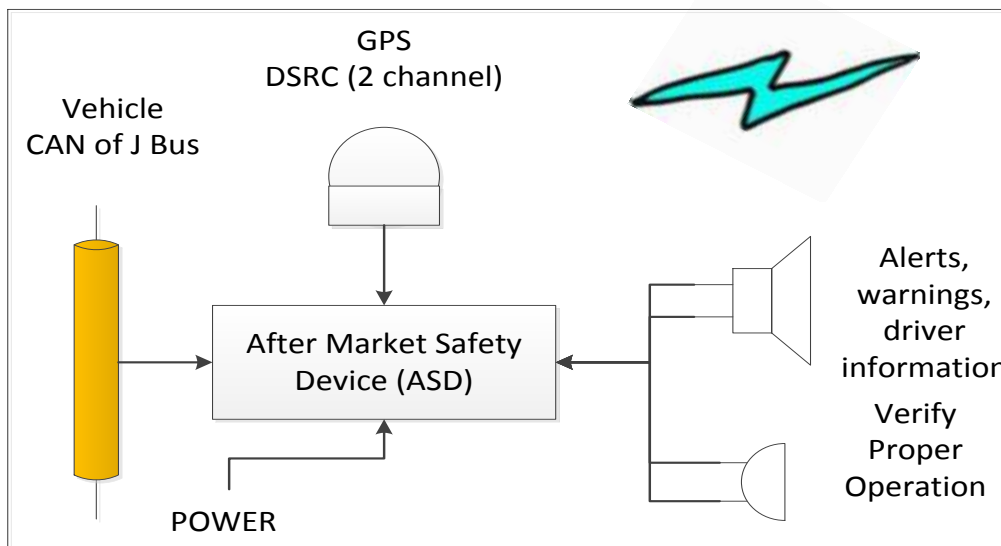
ASD – Aftermarket Safety Device (OBU)  
 RSU – Roadside Unit (includes DSRC radios)  
 NYCWIN – New York City’s Wireless Network  
 SCMS – Security Credential Management System  
 IE – Independent Evaluator  
 RDE – Research Data exchange  
 TMC – Traffic Management Center

Source: NYCDOT

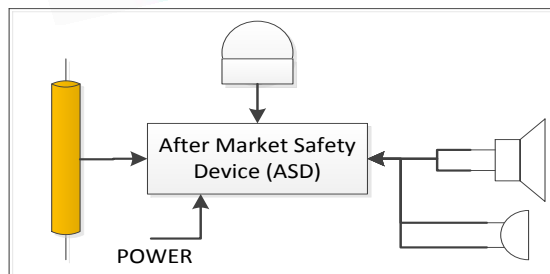
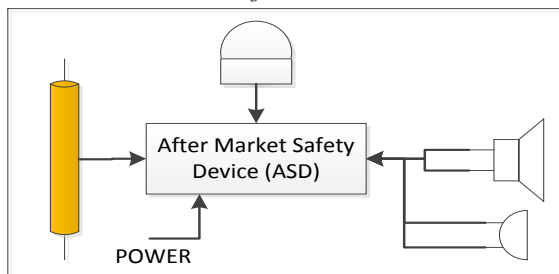
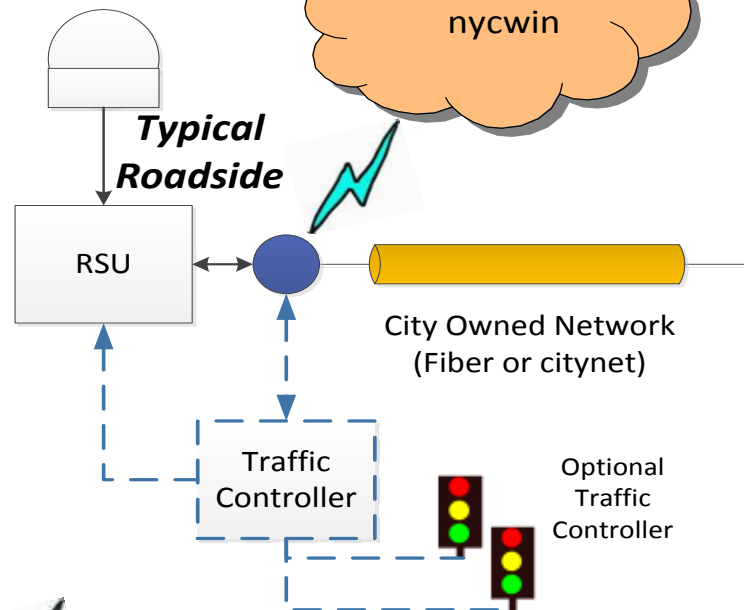
# Field Infrastructure Concept



## Typical Vehicle



GPS DSRC (2 channel)



--- Option Required

Source: NYCDOT

# Locations (Manhattan, Brooklyn)



V2V applications work **wherever** equipped vehicles encounter one another.

V2I applications work where **infrastructure is installed** (highlighted streets)

*The CV project leverages the City's ITS investments*



Source: NYCDOT





# Stakeholders



- NYCDOT Bureau of Traffic Operations
- NYCDOT Fleets
- Department of Sanitation Fleet Operations
- Metropolitan Transportation Authority / NYC Transit
- UPS
- Taxi & Limousine Commission
- New York State Motor Truck Association
- Pedestrians for Accessible and Safe Streets (PASS)
- Department of Information Technology and Telecommunications (DoITT) (NYCWIn)
- NYCDOT IT Department (Security issues)



# Needs Considered



## ■ Safety

- Need to “manage” speed (25 MPH city-wide except Fwy)
- Need to reduce crashes
  - vehicle-to-vehicle crashes
  - pedestrian injuries
  - crashes & injuries at intersections
  - crashes involving buses
  - crashes of vehicles with infrastructure
- Need to inform drivers of serious travel restrictions

## ■ Management

- Protect privacy
- Collect performance metrics (safety benefits, traffic conditions)
- Manage apps in the urban environment (traffic and geometries)
- Manage and monitor overall operational integrity of the system
- Data needs for the independent evaluator
- Support OTA software and parameter updates



# Objectives



- New York City is aggressively pursuing “Vision Zero”  
**“Traffic Death and Injury on City streets  
is not acceptable”**

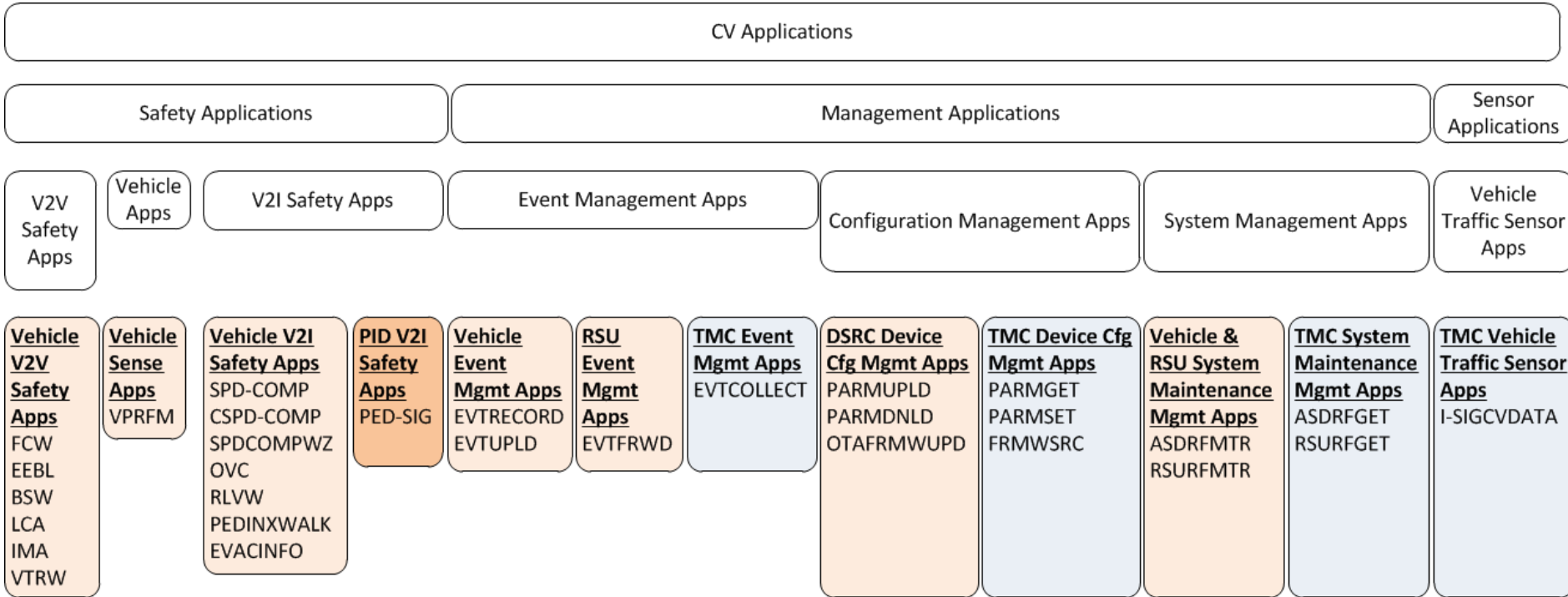
**Vision Zero Goal : to eliminate traffic deaths by 2024**

- CV technology is another potential tool for the Vision Zero initiative.
- The project will evaluate the safety benefits and challenges of implementing CV technology with a significant number of vehicles in the dense urban environment.





# CV Applications - Lexicon



Key: Supplier

Device Vendor

App Dev Solicitation

System Integrator

NOTE: Application abbreviated as "Apps" in the lower level rectangles for presentation purposes only.

Source: NYCDOT



# CV Applications - 1



## V2V Safety Applications

- |   |      |
|---|------|
| ▪ Vehicle Turning Right in Front of Bus Warning | VTRW |
| ▪ Forward Collision Warning                     | FCW  |
| ▪ Emergency Electronic Brake Light              | EEBL |
| ▪ Blind Spot Warning                            | BSW  |
| ▪ Lane Change Warning/Assist                    | LCA  |
| ▪ Intersection Movement Assist                  | IMA  |

*V2V applications based on existing demonstrations and prior developments and documentation*





## V2I Safety Applications

- Red Light Violation Warning RLVW
- Speed **Compliance** SPD-COMP
- Curve Speed **Compliance** CSPD-COM
- Speed **Compliance**/Work Zone SPDCOMPWZ
- Oversize Vehicle **Compliance** OVC
  - Prohibited Vehicle (Parkways)
  - Overheight
- Emergency Communications and Evacuation Information (*Using the traveler information features*) EVACINFO

*V2I applications based on existing demonstrations and/or modifications to prior developments and documentation*

# CV Applications - 3



## Other Applications

- Mobile [[Visually Impaired](#)] Ped Signal System PED-SIG
- Pedestrian in Signalized Intersection Warning PEDINXWALK
- CV Data for Intelligent Traffic Signal System I-SIGCVDAT

## Operations, Maintenance, and Performance Analysis

- RF Monitoring RFMON
- OTA Firmware Update FRMWUPD
- Parameter Up/Down Loading PARMLD
- Traffic data collection TDC
- *Event History Recording* *EVTRECORD*
- *Event History Up Load* *EVTCOLLECT*

*To Meet USDOT  
Requirements for  
Benefit Analysis*



# Equipment



- Deployment of CV Technology in a Dense Urban Environment
  - Up to 8,000 **fleet vehicles** with After Market Safety Devices (ASDs):
    - ~5,850 Taxis (Yellow Cabs)
    - ~1,250 MTA Buses
    - ~ 500 Sanitation & DOT vehicles
    - ~ 400 UPS vehicles
  - Pedestrian **PIDs** ~100 units
  - Roadside Units (**RSU**) at
    - ~371 Locations
    - ~ 8 on FDR
    - ~ 28 on Flatbush Ave
    - ~202 Manhattan Ave
    - ~ 97 Manhattan Cross
    - ~ 36 Support locations (airports, river crossings, terminal facilities)





# Performance Measures Evaluation



NYCDOT Needs	CV App.	No.	Performance Measure Metrics	Question for Evaluation
Reduce Crashes	FCW EEBL BSW LCW IMA	4a	Fatality crash counts	Do the number of reportable crashes decrease?
		4b	Injury crash counts	
		4c	Property damage only crash counts	
		4d	Time to Collision (vehicle to vehicle)	

Other questions for evaluation (see Performance Measures webinar for others):

- Do the number and severity of red light violations at each studied intersection decrease?
- Do the number of bus / right turn vehicle crashes decrease?
- Does speed limit adherence and speed variability within the vehicle fleet on a given study roadway segment for a given time period (cycle length basis) decrease?
- Is this accompanied by an overall increase, decrease or no change in average segment speed?
- Do the number of curve speed violations on each applicable studied roadway segment decrease?
- Do the number of work zone speed violations on each applicable studied roadway segment decrease?
- Do the number of pedestrian related crashes decrease?





# **New York City CV Pilot Deployment Approach**

Speaker

Bob Rausch, PE



# Connected Vehicle Pilot Deployment



## PILOT SITES



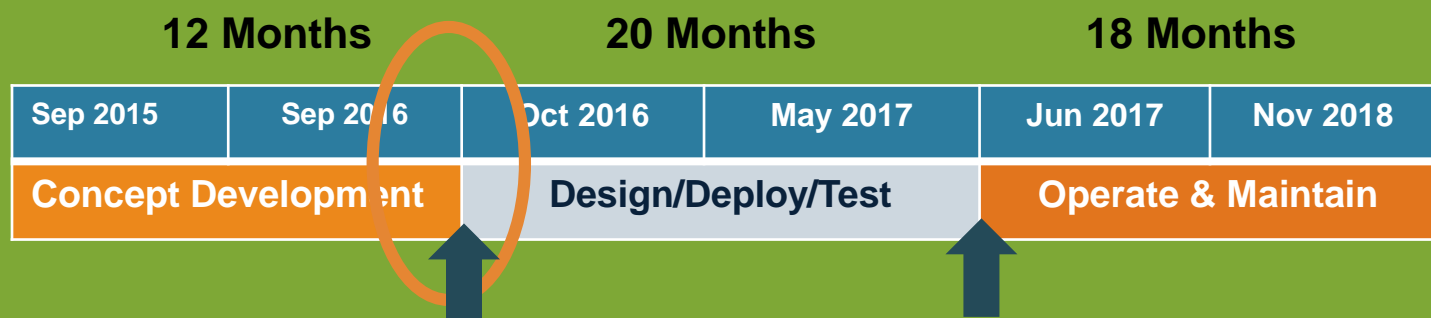
ICF/Wyoming DOT



NYCDOT



Tampa (THEA)



Three Phase, 50 month, Program – with “gates” between each phase



# Our Team



- Continuation of the Phase 1 project team
  - NYCDOT – Prime Contractor
  - TransCore – Prime Subcontractor – Engineering and Software
    - Cambridge Systematics – Evaluation, Outreach, Training
    - Security Innovation – Security
    - KLD Engineering – Traffic Data Evaluation
    - UTRC (SUNY, NYU) – Performance Evaluation and IRB
    - Specialty Consultants – where specific expertise is needed
  
- Procurement – NYCDOT
  - RSU vendor
  - ASD vendor (2)
  
- Services
  - Taxi and fleet installation contractors
  - RSU installation – NYCDOT maintenance crews
  - Other mapping vendors



# Phase 2

## Acquisition and Installation Planning



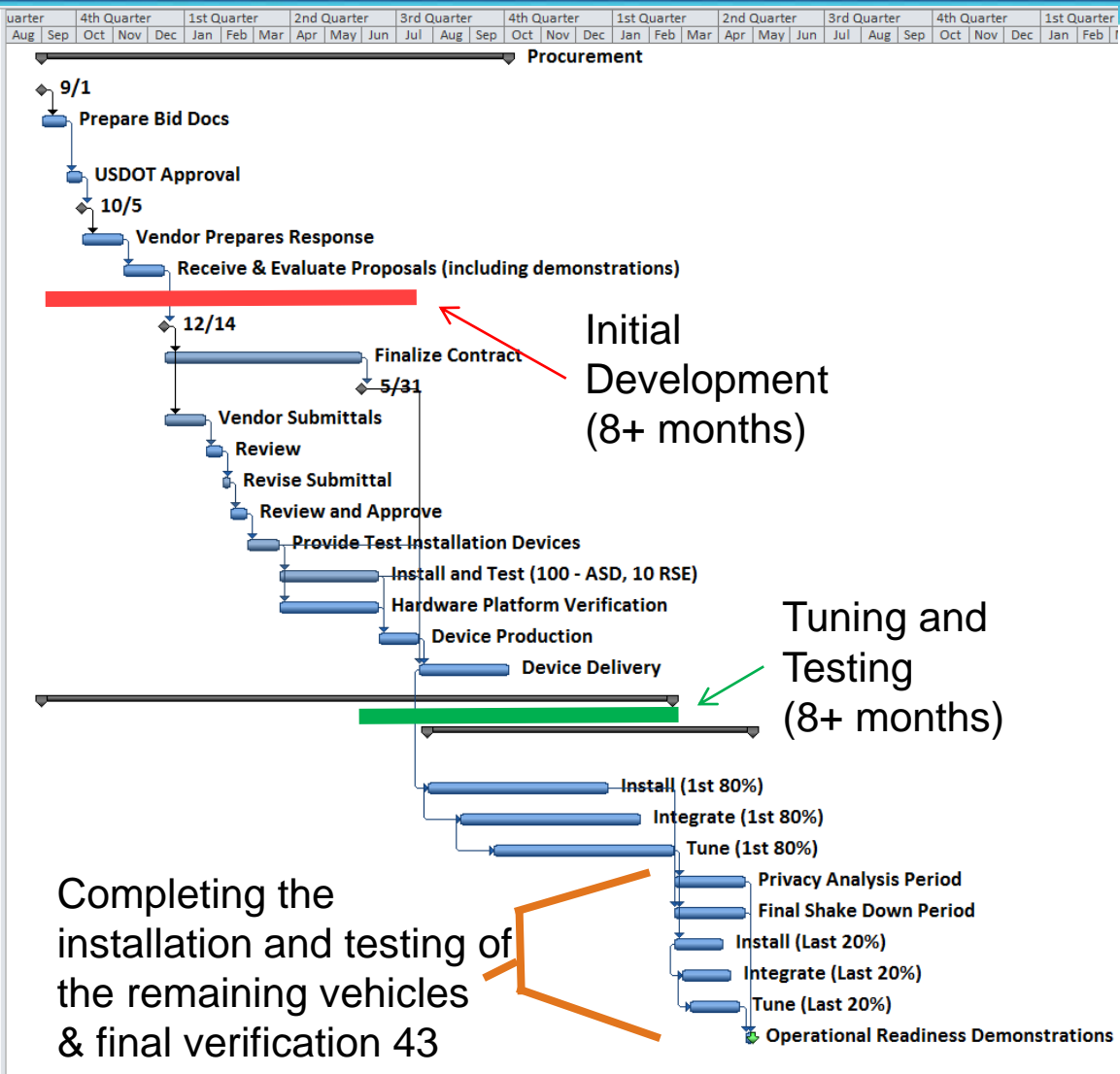
- Approach
  - Early RFQ
  - **Two phases** to installation
    - **Prototype** (100 ASDs, 10 RSUs) to deal with (32+ weeks)
      - vehicle integration by type
      - prove hardware platform
    - **Production** (installation critical path: 22 weeks)
    - After hardware platform accepted, management applications have time for continued development/refinement
  
- Risks/Challenges
  - **Location accuracy in the urban canyons** – Working with Vendors
  - RSU density in the urban environment – leverage CAMP testing
  - OTA software updates and application configuration
  - Vendors are required to agree to proceed at risk without a fully executed contract
  - We don't know what we don't know, yet





# Deployment Schedule

Task Name	Duration	Start	Finish
<b>Device &amp; Procured Apps Procurement</b>	<b>285 days</b>	<b>Thu 9/1/16</b>	<b>Wed 10/4/17</b>
Bid Prepared (75% Spec)	0 days	Thu 9/1/16	Thu 9/1/16
Contracting Documentation Prepared and Bid Released	15 days	Thu 9/1/16	Wed 9/21/16
USDOT Approval of Bid Docs	10 days	Thu 9/22/16	Wed 10/5/16
Bid Posted	0 days	Wed 10/5/16	Wed 10/5/16
Vendor Prepares Response	25 days	Thu 10/6/16	Wed 11/9/16
Receive & Evaluate Proposals (including demonstrations)	25 days	Thu 11/10/16	Wed 12/14/16
Vendors Selected	0 days	Wed 12/14/16	Wed 12/14/16
Finalize Contract	120 days	Thu 12/15/16	Wed 5/31/17
Contract Registration	0 days	Wed 5/31/17	Wed 5/31/17
Vendor Submittals	25 days	Thu 12/15/16	Wed 1/18/17
Review	10 days	Thu 1/19/17	Wed 2/1/17
Revise Submittal	5 days	Thu 2/2/17	Wed 2/8/17
Review and Approve	10 days	Thu 2/9/17	Wed 2/22/17
Provide Test Installation Devices	20 days	Thu 2/23/17	Wed 3/22/17
Install and Test (100 - ASD, 10 RSE)	60 days	Thu 3/23/17	Wed 6/14/17
Hardware Platform Verification	60 days	Thu 3/23/17	Wed 6/14/17
Device Production	25 days	Thu 6/15/17	Wed 7/19/17
Device Delivery	55 days	Thu 7/20/17	Wed 10/4/17
<b>Task 2E: Application Development</b>	<b>384.5 days</b>	<b>Thu 9/1/16</b>	<b>Wed 2/21/18</b>
<b>Task 2H: Installation and Operational Readiness Testing</b>	<b>198 days</b>	<b>Thu 7/27/17</b>	<b>Mon 4/30/18</b>
Install (1st 80%)	110 days	Thu 7/27/17	Wed 12/27/17
Integrate (1st 80%)	110 days	Thu 8/24/17	Wed 1/24/18
Tune (1st 80%)	110 days	Thu 9/21/17	Wed 2/21/18
Privacy Analysis Period	43 days	Thu 2/22/18	Mon 4/23/18
Final Shake Down Period	43 days	Thu 2/22/18	Mon 4/23/18
Install (Last 20%)	30 days	Thu 2/22/18	Wed 4/4/18
Integrate (Last 20%)	30 days	Thu 3/1/18	Wed 4/11/18
Tune (Last 20%)	30 days	Thu 3/8/18	Wed 4/18/18
Operational Readiness Demonstrations	5 days	Tue 4/24/18	Mon 4/30/18



# Deployment Schedule Risks



- FCC petition for emergency stay of DSRC operation/deployment over security concerns
  - FCC Channel Allocation
    - Could necessitate re-design and re-engineering of channel usage, interactions, etc.
    - Could also impact hardware design
  - SCMS Operation & Performance
    - BAA required use of SCMS; must be stable and ready with start of contract  
USDOT expects this to be ready late 2016 or early 2017 which fits our schedule
  - Vendor Support for Security (SCMS 1609.2) and HSM
    - Vendors are waiting but we are pushing them to accelerate their design
    - RFEI vendor meetings were encouraging – vendors indicated solutions under development
  - Certification Tools, etc.
    - Costs as well as documentation – we are working with USDOT – expect to use
  - Vendor Procurement Delays
  - Vendor Product Quality/Reliability
- Mitigation – 2 vendors selected – can terminate and shift deliverables to one
- RSU V 4.1 Specification not ready in time! We are participating in its evolution.
  - Other standards not ready in time (most are now stable – 1202, 1103 1609.x, J2735 and 2945/x (only 2945/1 has been approved)! CV Team is participating (SAE, NEMA, ISO)
  - MAP tool not ready or not fully debugged → USDOT addressing





# **New York City CV Pilot Deployment Project Technical Insights**

Speaker

Bob Rausch, PE





# Insights, Challenges, Lessons



- Perspective: **What would we like to have known before we started?**
- **Initial Assumptions**
  - Safety applications would be COTS (based on CAMP and w/c demos)
  - Would need to tailor the applications for the NYC urban environment
  - Data collection would need be adjusted for our backbone communications
  - Would need to address maintenance at a larger scale
- **Subject Areas (Technical, Institutional)**
  - Materials
  - Tools
  - Concept of Operations
  - Time
  - Budget Challenges
  - Institutional
  - People
  - Vendor Demonstrations



# Materials - 1



- ASD Specification
  - USDOT no longer investing in this area
    - Using ATC & NYCWiN procurement experience
  - Expectation that safety applications would be COTS
    - Proprietary Solutions – different adjustments
    - Need to leverage the existing investment
  - **Question:** What is needed to “buy” a device and applications?
    - Turnkey procurement of RSUs and ASDs
    - Vendor flexibility
  - Working at a design level not anticipated during project formulation – remember the assumptions
  - **Question:** How do we improve location accuracy in the face of random GPS location loses?
    - Goal: Ensure reasonable “continuous” operation in the urban canyon environment (also includes the impacts of bridges, underpasses, “limited sky”)
    - Working with Vendors and alternate technology





# Materials - 2

- RSU Specification
  - Discovering additions needed to FHWA spec. 4.1
    - Security hardware -
    - Output power level control
    - Application management
    - Explicit reliability and watchdog requirements
  - Providing contributions to the next generation
- Standards
  - Revised based on previous lessons
  - Current generation will be tested by the CVPD projects
  - No application oriented performance standards or test procedures (experts say do not use)
    - Project will be developing same



# Tools - 1



- MAP message generation
  - Updating to J2735-201603
  - Looking at other approaches
- TIM message generation
  - Standard needs updating
  - [Work is underway \(participating\)](#)
- Potential BIM message for V2I applications
  - [Work is underway \(participating\)](#)
- SCMS
  - End Entity Requirements
  - Will need the API and executable code
  - Focus of USDOT organized workshops and our team includes the SCMS development team member
- Test and simulation environments
  - [Likely project team will develop](#)
  - [Loading of networks and equipment](#)

## Tool Library Connected Vehicles



ISD Message Creator

Source: USDOT

### Intersections

This tool allows a user to define the lanes and approaches of an intersection using a graphical interface. Once designed, the user can convert the message to ASN.1 or Hex and deposit it to the SDW warehouse.

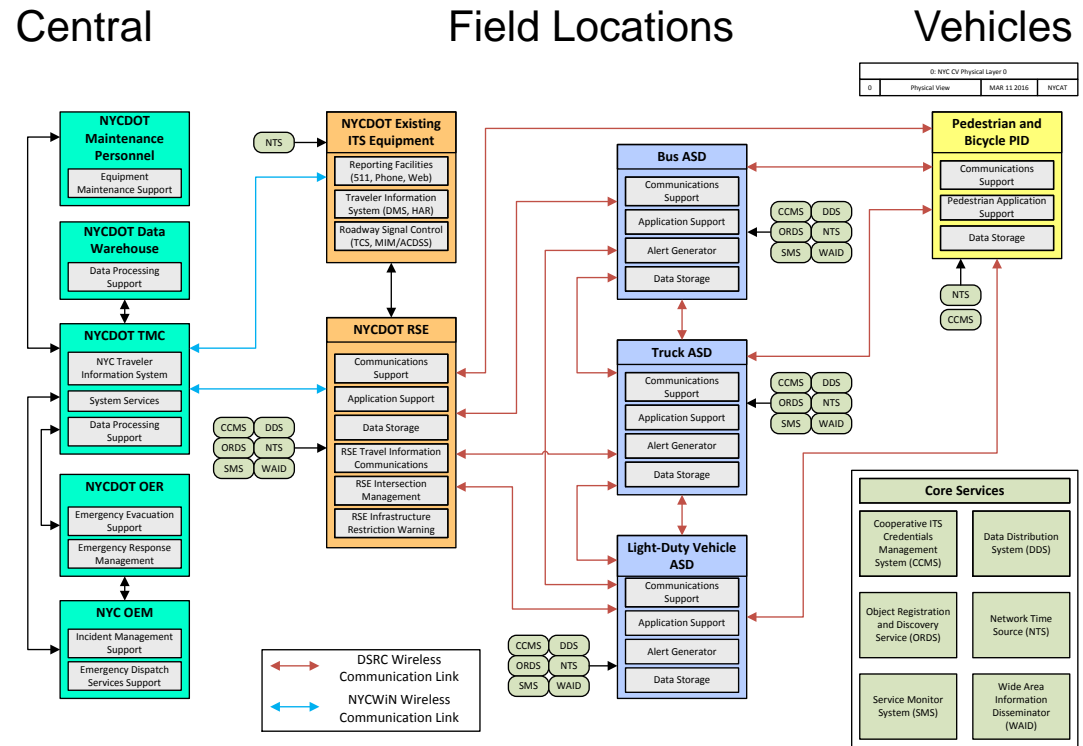


# Tools - 2



## SET-IT

- Leverages the CVRIA
- CVRIA doesn't reflect the needs representative of users or stakeholders
- Format did not meet the need (has been updated)
- Improved over the past year
- System complexity = time investment
- Hope it leads to a "standardized" back office operation in the future
- Looks like this is being tackled by the USDOT through workshops



## Overall Physical Architecture



# Concept of Operations Lessons



- Basic design issue
  - Basic system premise: protect privacy
  - Performance measurement compromises privacy because it requires knowing vehicle identity
  - Protect privacy vs data collection needs of IE
  - FFP contract became open ended data collection
  - Scalable data collection – remember assumptions

*We spent months working with USDOT and their team to balance privacy, capacity, data requirements*

- Pedestrian safety issue
  - Visually challenged pedestrians
  - User need: notify about ALL vehicles
  - Resolution: notify vehicles only
- Security
  - Integrating with existing security systems/policies can be a time consuming challenge
  - Effects existing infrastructure – IT networks and equipment
- Regulatory speeds drive the needs and not the vehicle kinematics
- FCC RSU licensing for “mobile” attenuator vehicles – not permitted (USDOT is working this issue)





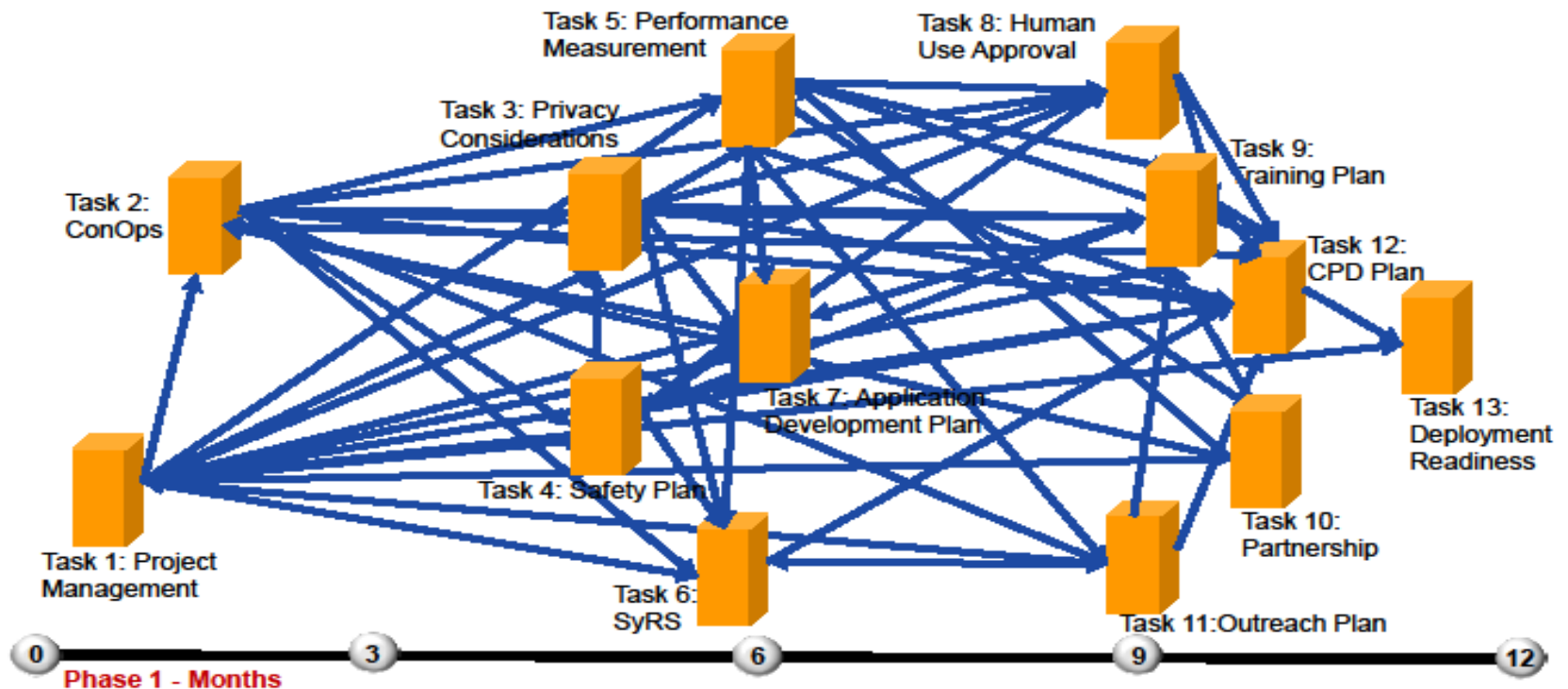
- **Schedule is top priority!**
- Task relationships are complex (See slide 4 and next slide)
  
- FCC Licensing of DSRC devices
  - Start early
  - For 400 devices estimated a person year for input
  - Due to licensing request system being interactive vs batch
  - USDOT is working with the FCC to address the need
- Standards are the tools for building the next generation CV system however they need to be deployed and tested. **It takes time to gain this experience.**
- Need **good project management** skills to keep on top of all the details
- Procurement process – be sure to have enough time for your procurement cycle
- **Vehicle installation time** is a primary driver of our schedule
- Can only **estimate** installation times now – need to **measure** during prototype installation and **assess** what the differences mean!
- More time for CVPD site interaction would have been beneficial to all



## DELIVERABLES ARE HIGHLY INTERDEPENDENT



- Integrating USDOT-identified task interdependencies creates this diagram....



- Stovepipe approach by task is NOT recommended

Source: USDOT





- **Schedule is top priority!**
- Task relationships are complex (See slide 4 and next slide)
  
- FCC Licensing of DSRC devices
  - Start early
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- Standards are the tools for building the next generation CV system however they need to be deployed and tested. **It takes time to gain this experience.**
- Need **good project management skills** to keep on top of all the details
- Procurement process – be sure to have enough time for your procurement cycle
- **Vehicle installation time** is a primary driver of our schedule
- Can only **estimate** installation times now – need to **measure** by vehicle type during prototype installation and **assess** what the differences mean to the schedule!
- Would have benefited from earlier and more complete access to lessons and analyses from Safety Pilot
- More time for CVPD site interaction would have been beneficial to all



# **New York City CV Pilot Deployment Project Institutional Insights**

Speaker

Mohamad Talas, PE, PTOE, PhD





# Budget Challenges

- Plan for the long-term
  - Understand the continued operations and maintenance costs
    - Vehicle fleet turnover – requires reinstallation of equipment
    - Spare devices and installation kits
  - Prepare for ongoing outreach expenses
- Know the contract instruments - strengths, and weaknesses
  - Federal contracting
  - City contracting and procurement
    - Understand Subcontracting procedures

*Creates complex relationships*
- Plan for the unexpected
  - Over \$1M for non-CV data collection to address performance evaluation and confounding factors



# Institutional



- Megaproject syndrome
  - Broad stakeholder participation means many perspectives
  - Other higher priority issues for their time are inevitable
  - **Need to keep stakeholders engaged throughout the project**
- Operational readiness
  - Procurement processes, people, timelines prepared beforehand
  - Resources in place for **stakeholder management**
- DSRC spectrum is sought after
  - Represent the safety user
  - Others have different intentions for its use
  - Needs protection
  - **City is acquiring licenses for all intersections to protect our position**



# People – Stakeholder Involvement



Source: NYCDOT





# Vendor Demonstrations



- One application, three different experiences
  - 1) Your Grandmother would be comfortable
  - 2) It does its job as you gasped that it felt close
  - 3) Its aggressive and all passengers looking for their virtual brake pedal
  - Different parameter tuning, different experience
  - **Confirmed the need for parameter profiles based on facility types, location, etc.**
- GPS tracking
  - In urban canyons, the middle of the road is a good place to be
- Interviewed all vendors
  - Ensured support for NYC Contracting
  - Understand their future commitments



Source: TransCore



Source: NYCDOT



# Thank You Questions?

- Please keep your phone muted
- Please use chatbox to ask questions
- Questions will be answered in the order in which they were received





# STAY CONNECTED



## Contact for CV Pilots Program:

Kate Hartman, Program Manager

[Kate.Hartman@dot.gov](mailto:Kate.Hartman@dot.gov)

## 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>

Twitter: [@ITSJPODirector](https://twitter.com/ITSJPODirector)

Facebook:

<https://www.facebook.com/USDOTResearch>

## CV Pilot Sites' Comprehensive Deployment Plan Webinars

- [August 19, 2016 1:00 – 2:00 pm EDT](#)  
*Tampa (THEA) Comprehensive Deployment Plan Webinar*
- [August 22, 2016 1:00 – 2:00 pm EDT](#)  
*ICF/WYDOT Comprehensive Deployment Plan Webinar*
- [August 22, 2016 3:00 – 4:00 pm EDT](#)  
*NYCDOT Comprehensive Deployment Plan Webinar*

## CV Pilot Sites Document Repository

[http://www.its.dot.gov/pilots/cv\\_pubs.htm](http://www.its.dot.gov/pilots/cv_pubs.htm)

Please visit the CV pilots website for the recording and the briefing material of the previous webinars:

[http://www.its.dot.gov/pilots/technical\\_assistance\\_events.htm](http://www.its.dot.gov/pilots/technical_assistance_events.htm)

