CONNECTED VEHICLE PILOT
Deployment Program

New York City Pilot Acquisition and Installation Experiences

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ITS Joint Program Office

TODAY'S AGENDA

- Purpose of this Webinar
  - Provide an overview of the approach for identifying the type and number of devices, equipment, and software-based capabilities that needed to be acquired
  - Share experiences of engaging with vendors and getting the devices in hand and installed while adhering to a stringent installation schedule
  - Identify technical and other barriers and how they are being overcome

- Webinar Content
  - Connected Vehicle Pilot Deployment Program Overview
  - New York City Pilot Acquisition and Installation Experiences
  - Stakeholder Q&A

- 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

WYDOT

NYCDOT

Tampa (THEA)

STAY CONNECTED

- Participate in upcoming Webinars/Conference Presentations from the three Pilot Sites (see website for exact dates and times)

July 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019
◆ ◆ ◆		●		◆ ◆ ◆		●
Device Acquisition and Installation		ITE Annual Meeting		Operational Readiness		TRB

◆ Public Webinars ● Conference Presentations

- Visit Program Website for Updates: http://www.its.dot.gov/pilots
- Contact: Kate Hartman, Program Manager, Kate.Hartman@dot.gov

U.S. Department of Transportation

New York City CV Pilot Deployment Overview

Mohamad Talas PE, PhD.

NYC DOT Program Manager

NYC Pilot Overview

VISION ZERO

"Traffic Death and Injury on City streets is not acceptable"

The goal is to use the Connected Vehicle Pilot Program as a platform to help achieve Vision Zero goals.

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.**

Locations: Manhattan, Brooklyn

Vehicle to Vehicle (V2V) applications work **wherever** equipped vehicles encounter one another.

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

The CV project leverages the City's transportation investments

Source: NYCDOT

CV Deployment Equipment

- Up to 8,000 **fleet** vehicles with Aftermarket Safety Devices (ASDs):
  - Taxis (Yellow Cabs)
  - MTA Buses
  - Sanitation & DOT vehicles
  - DCAS vehicles
- Pedestrian PIDs ~100 units
- Roadside Units (RSU) at ~353 Locations
  - ~202 Manhattan Ave
  - ~ 79 Manhattan Cross
  - ~ 28 on Flatbush Ave
  - ~ 8 on FDR
  - ~ 36 Support locations (airports, river crossings, terminal facilities)

Operating Statistics:
Vehicles are in motion or active ***~14 hours per day!***
Average taxi drives 197 miles per day
Fleet total Vehicle Miles Traveled:
>1.3 Million Miles per day
~40 Million Miles per month


Source: USDOT

CV Safety Applications

Vehicle-to-Vehicle

- Vehicle Turning Right in Front of Bus Warning
- Forward Collision Warning
- Emergency Electronic Brake Light
- Blind Spot Warning
- Lane Change Warning/Assist
- Intersection Movement Assist

Pedestrian Applications

- Pedestrian in Crosswalk
- PED-SIG

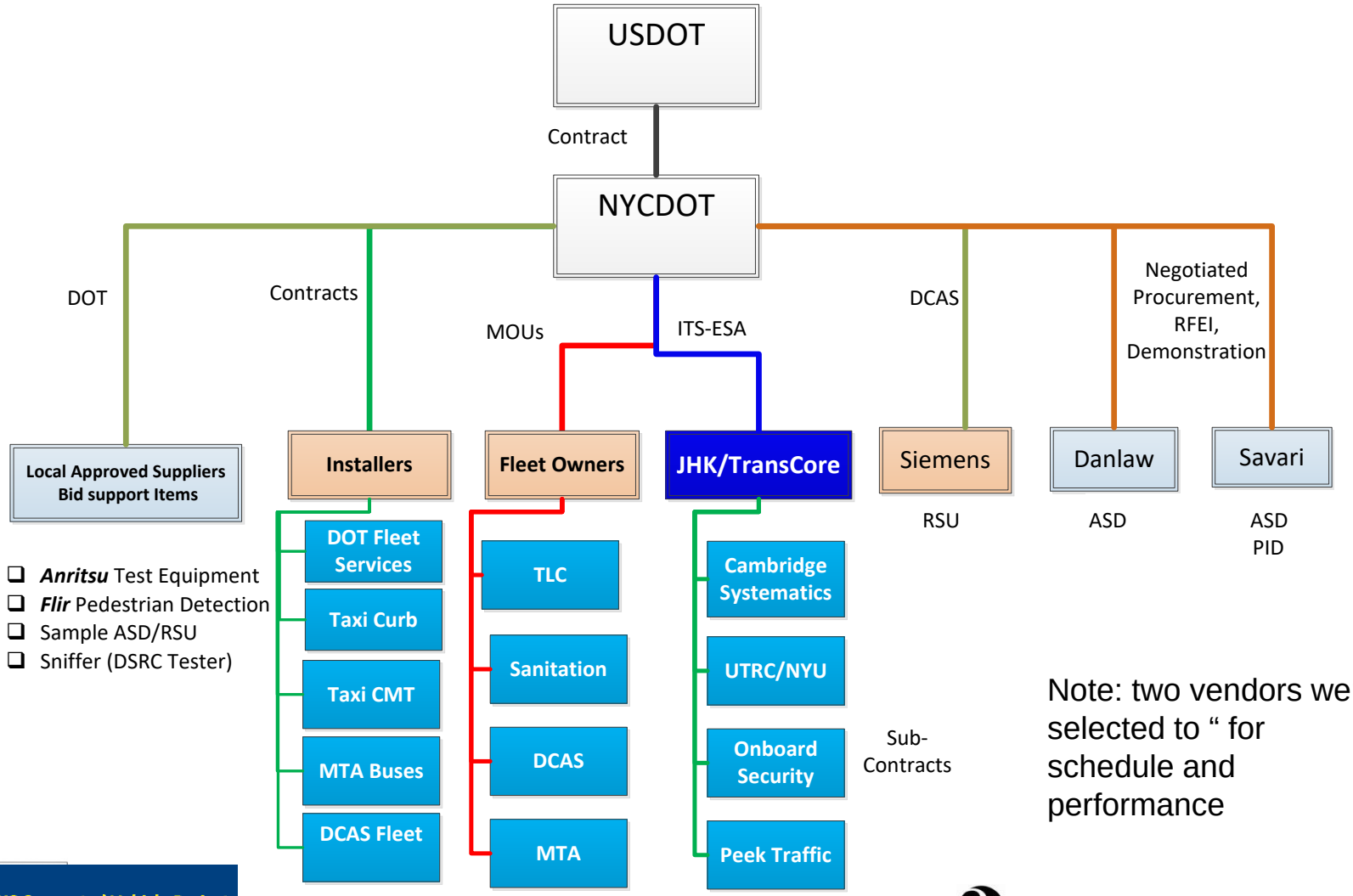
Vehicle-to-Infrastructure

- Red Light Violation Warning
- Speed Compliance
- Curve Speed Compliance
- Speed Compliance/Work Zone
- Oversize Vehicle Compliance
  - Prohibited Facilities (Parkways)
  - Over Height warning
- Emergency Communications and Evacuation Information

Acquisition Approach

- **GOALS:**
  - Protect project viability where emerging technology is involved
    - Multiple sources
  - Purchase to leverage vendor experience
  - Sustainable approach for large scale deployment
- **CAVEAT:**
  - Delivery and installation time for vehicles
- **APPROACH:**
  - Leverage existing standards, specifications, processes
    - IEEE 1609.x SAE J2735 SAE J2945/1
    - USDOT RSU 4.1 Safety Pilot ASD
  - Augment with project requirements
  - Bid well defined products: RSU, Pedestrian Detection
  - Risky products compete and demonstrate: ASD, Personal Information Device

Contracting Structure



- ***Anritsu*** Test Equipment
- ***Flir*** Pedestrian Detection
- Sample ASD/RSU
- Sniffer (DSRC Tester)

Note: two vendors were selected to “ for schedule and performance

Acquisition Overview

Category	Summary	Approach	Method
Aftermarket Safety Device (ASD/OBU)	Completed a vendor demonstration May 17-24, currently under review by NYC DOT. 6 vendors participated in the demo.	**Selection of 2 vendors.** Intent announced, and prototypes acquired from 2 vendors Negotiated Contracts based on Demo	Request for Expression of Interest and Proposal
Roadside Units (RSU)	Bid complete, Pre-bid held on June 12, proposals submitted June 21, Expect PO to be issued by NYCDOT this week	Selection of 1 vendor. Acquiring 10 units to undergo a prototype phase	Competitive Sealed Bid
Mobile Device (PID)	Acquisition Method being finalized	Selection of 1 vendor. Acquiring 10 units to undergo a prototype phase	Method being finalized
TMC Equipment	CV Data Storage Server, Mass Storage Device, and Network Equipment received and being installed	Standard installation at the TMC utilizing IT standard methods	Master Agreement
RF Test Devices	Expected to be received July 27, 2018 RF Test Equipment for tracking interference and testing units (ASD/RSU)	Support Capital Assets - purchased through local suppliers	Competitive Sealed Bid (CSB)
ASN.1 Compiler	Received May 31, 2017	A license has been acquired, to simplify TMC software development	Micro Purchase - QPL
Codeon Software	Enables updated software to be download using small blocks broadcast to multiple vehicles by multiple RSUs – expedites software updates.	License/unit – Paid by NYCDOT Used by ASD and RSU to support OTA Updates	Method being finalized
ISS/Greenhills Hardware Security Module (HSM)	Received April, 2018 Used to sign the MAP message and TIM message and future RTCM if needed.	Traffic Management Center V2X Message Authority	Procured via negotiated agreement with contractor

Pilot Site Overview

NYC DOT has procured, or is in the process of procuring the following field equipment required to support the Connected Vehicle Program

Type	Vendor	Pre Prototype Samples (Multi vendor)	Prototype - Quantity	Production - Quantity
ASD/OBU	Vendor 1	45+9 RSUs	100	4200
ASD/OBU	Vendor 2	68	100	4200
RSU	Siemens		10	390
Pedestrian Detection System	FLIR			10 intersection, 120 units
Hardware Security Module (HSM)	ISS/Greenhills		Redundant Pair due to critical nature of function	2

New York City CV Pilot Acquisition Experiences

Applications
& Supporting Software

Bob Rausch

Acquisition Approach

- GOALS:
  - Protect project viability where emerging technology is involved
    - Multiple sources
  - Purchase to leverage vendor experience
- CAVEAT:
  - Delivery and installation time for vehicles
  - Approach to allow installation concurrent with development and tuning
- APPROACH:
  - Leverage existing standards, specifications, processes
    - IEEE 1609.x
    - SAE J2735
    - SAE J2945/1
    - USDOT RSU 4.1
    - Safety Pilot ASD
    - NTCIP
  - Augment with project requirements
  - Bid well defined products: RSU, Pedestrian Detection
  - Risky products compete and demonstrate: ASD, Personal Information Device

Coordinate with the other pilots on security and standards usage!

Software Required

Field Devices

- After Market Safety Devices – ASD
- Roadside Units - RSU
- Traffic Controller - ATC

- Safety Applications
- Data Collection Applications
- Security Management Applications
- Operation Management

- OTA software updates
- OTA application “tuning”
- OTA data collection
- Device health monitoring

Central Office Support (TMC)

- MAP message management & distribution
- TIM message management & distribution
- RTCM Management – IF REQUIRED
- Software updates
  - RSU & ASD
- Application “tuning” and parameter adjustments
  - RSU – Data collection parameters
  - ASD – Applications and data collection parameters
- Data collection
  - From RSU (RSU collects from ASD)
- Security Credential Management
  - Non 1609.2 (i.e. RSU, ATC, X.509)
- Device health management/monitoring
  - Communications, ASD, RSU, Security
- Pedestrian Data collection

ASD: Buy or Build?

- The “safety” applications - “well known”
  - FHWA demonstrations
  - CAMP Demonstrations
  - Vendor demonstrations (phase 1)

- Some of the applications were easy to “define” conceptually at a high level
  - Based on other “known” applications
  - Extrapolation for NYC
  - NYC required changes to concepts
  - Defined in functional terms
  - Held Further Vendor Demonstrations

- Pedestrian Applications
  - Functionality & Requirements well defined

Core Safety Applications

- Forward Collision Warning
- Emergency Electronic Brake Light
- Blind Spot Warning
- Lane Change Warning/Assist
- Intersection Movement Assist
- Red Light Violation Warning

Modified Safety Applications

- Vehicle Turning Right in Front of Bus Warning
- Speed ***Compliance***
- Curve Speed **Compliance**
- Speed **Compliance**/Work Zone
- Oversize Vehicle **Compliance**
- Prohibited Facilities (Parkways)
- Over Height warning

ASD Procurement

- Decision to **buy** not build –
  - ***Project team did not attempt to develop software for the ASD***

- Based Procurement document on ASD/VAD specification from Safety Pilot
  - Note: no USDOT support for this document
  - Developed prior to SAE J2945/1
  - Developed prior to J2735-2016
  - Modified environmental and added reliability requirements
- Extensive additions of system requirements for NYC in the areas of:
  - Security
  - Event recording
  - Over-The-Air updates
  - RF monitoring and other management applications

- Treated the project as a joint development between NYCDOT and the vendors

ASD Applications

- **Work With the Vendors**
  - Safety Applications
    - Second Round of Demonstrations
    - Procurement - prototypes and ***on-site engineering support***
    - Specifications - support cooperative development
    - Added requirements for location triangulation
    - Requested option - Ultra Wide Band location tech.
  - Data Collection Applications
    - Developed Detailed Functional specifications/requirements
    - Required interactive development with backoffice
  - Support for OTA firmware and parameter updates RSU to ASD
  - Support for OTA data collection ASD to RSU

Group design meetings "how to best get it done – and be interoperable"

- Joint Design Effort – Onboard Security, TransCore, Siemens, DanLaw, Savari
- Adopted an efficient DSRC broadcast approach for Large Fleets
- Vendors tested approach – Will undergo initial deployment shortly

Traffic Controller Software

- Currently have 3 versions of hardware/software – installation since ~2004
  - Phase 1 was QNX based – before ATC standard
  - Phase 2 & 3 are ATC based – Linux
  - Single vendor – Peek Traffic
- Followed the new NTCIP 1202v3 where possible!
  - Changed to ATC “push” – change driven at 10 Hz
  - Included time tick – allows RSU to adjust J2735 SPaT data
  - Required DTLS 1.2 and X.509 certificates
  - Modified “initialization” procedures – extensive use of USB
- Version now supports multiple RSUs (4) (SPaT) and secure & reliable connection!
- Supports pushing SPaT information to TMC for PED Applications

- Extensive regression testing now planned to verify CV without errors in operation!
- NYC includes: Adaptive Control, NEMA Act./Nonact. phase based control, TSP, interval based Semi Act. and pretimed control.

Central Office Support (TMC)

- MAP message management & distribution
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- Device health management/monitoring
  - Communications, ASD, RSU, Security
- Pedestrian Data collection → Savari – NYU and TransCore based on stakeholder Requirements
- Benefits Analysis software → Cambridge Systematics, NYU, and Transcore

- Being developed by TransCore – Atlanta
- Established an End-to- end test facility – Atlanta

New York City CV Pilot Installation Experiences

Nader Barhoum

Fleet Vehicle Types Sampler

Aftermarket Safety Device

- **Two terms**
  - Aftermarket Safety Device (ASD)
  - On-Board Unit (OBU)
- **Includes: receiver and antenna**
  - GPS
  - Dedicated Short-Range Communications (DSRC)
- **These devices:**
  - Determine time & vehicle location from GPS signal
  - Broadcast the Basic Safety Message (BSM)
    - Here I am (location & speed)
    - Where I've been (last few seconds-path history)
    - Where I'm heading
  - Listen for other nearby Vehicle's BSMs
  - Listen to Roadside Units (RSU) – traffic signal status & geometrics
    - CV applications process messages from remote vehicles to identify potential threats
    - CV applications process traffic signal status to identify possible intersection intrusion
    - Alert the driver of the threat using a combination of audible tones and speech

Vendor 1: Danlaw V2X Aftermarket Safety Device

Vendor 2: Savari MobiWave V2X Aftermarket Safety Device

Aftermarket Safety Device (Antennas)

- Two types of antennas are being deployed. The Antenna installed depends on feasibility and any limitations on vehicle types/Makes/Models and any other aftermarket equipment currently installed such as (Other Radios, GPS, Emergency light bars, etc)
- **Savari**
  - Hircshmann single casing 2 DSRC, 1 GNSS antenna (Requires roof drilling/access)
  - Mobile Mark single casing 2 DSRC, 1 GNSS antenna (Requires roof drilling/access)
- **Danlaw**
  - Danlaw through Glass Stub Antenna 2 DSRC, 1 GNSS antenna

Hirschmann Antenna

MobileMark Antenna

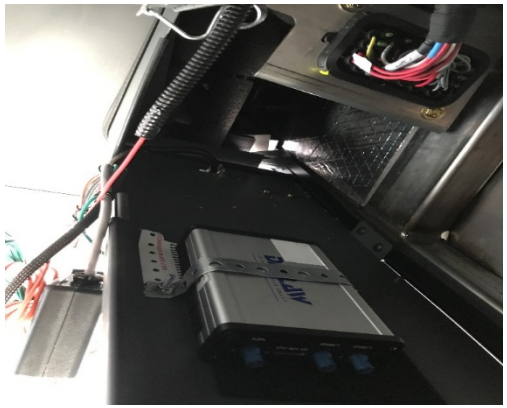
Danlaw through the glass Stub Antenna

NYC DOT Installations

- NYC DOT Installation
  - See Ford F-550 Light Duty Vehicle Installation
  - Various Makes/Models/Year NYC DOT vehicles are being equipped with prototype ASDs in order to fine tune and optimize installation methods and approaches
  - NYC DOT Vehicles 770
    - Toyota
      - Prius
      - RAV4
    - Ford
      - Fusion
      - F-150 – F-550
    - Chevrolet
      - Silverado
      - HD3500
      - Economy

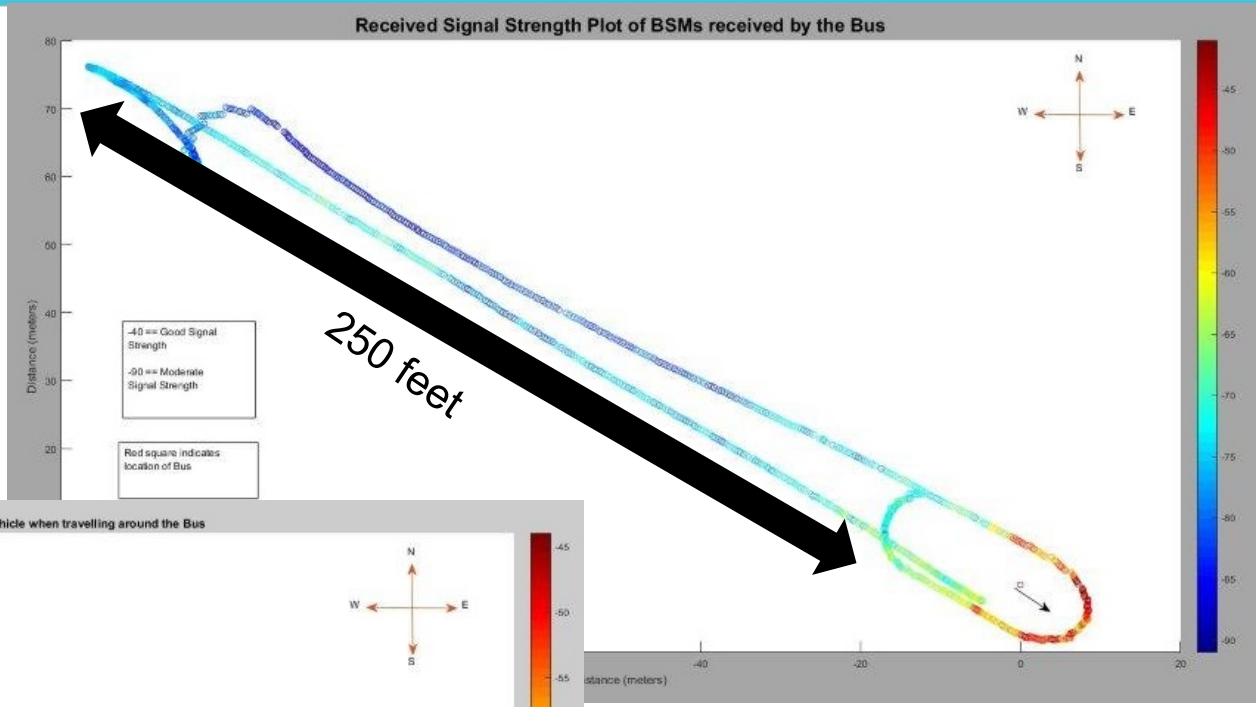
MTA Installation

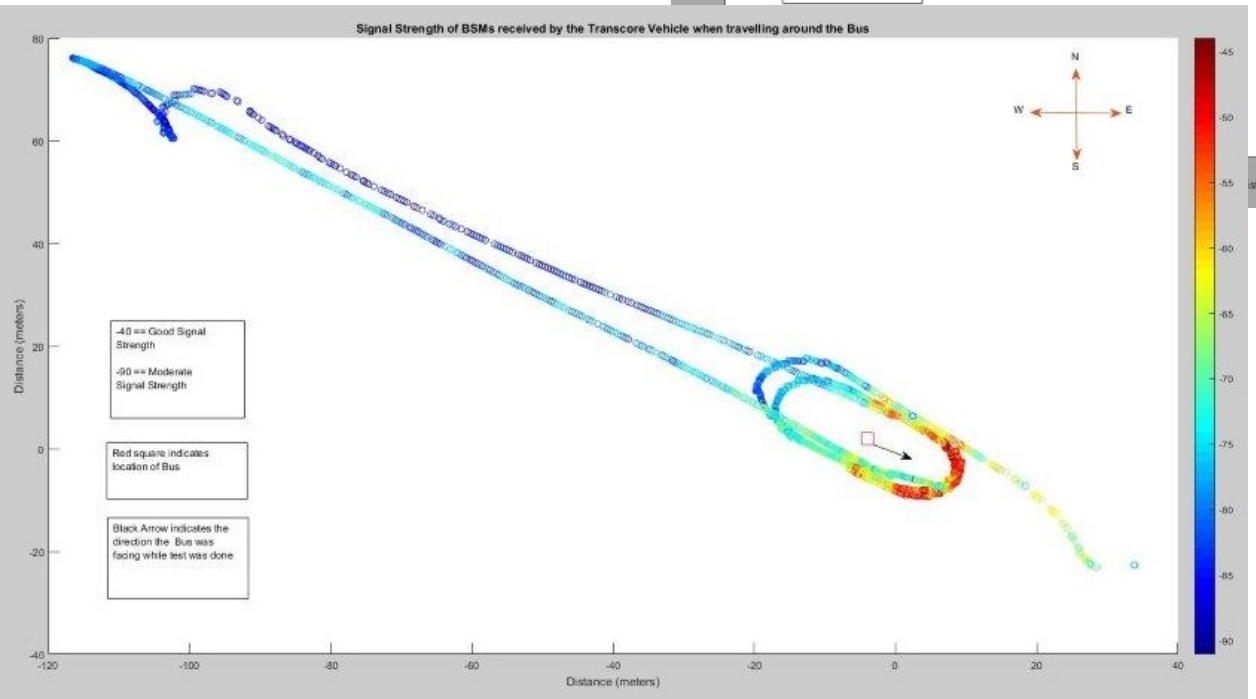
- Progress made on installing 2 NYC Transit Buses
  - Nova Bus LFS60102 60FT Articulator (2011)
  - New Flyer T 60FT Articulator (2017)
- The buses were installed to test RF DSRC communication with light vehicles, and to develop an installation template
- MTA has committed 700 vehicles for the CV Project
- Lessons Learned
  - Deutsch wide connector as opposed to J1939 connector will be used.
  - Separate bus installation kit has been developed for bus installations.
  - 60-day antenna durability test was conducted.
  - Brackets were developed for specifically bus installation.



RF Signal Strength

Signal Strength of BSM received by the bus from our light vehicle

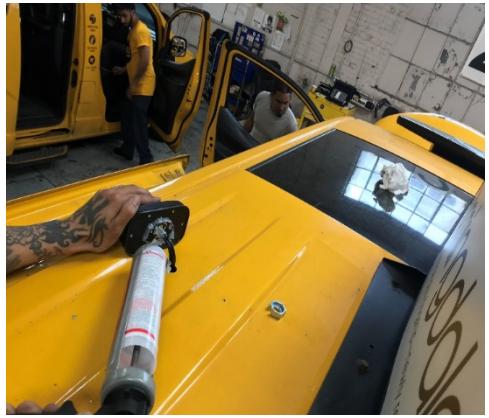




Signal Strength of BSM received by the light vehicle from the bus

Taxi Installation

- Taxi Installations are estimated at 5000 vehicles between the participating fleet owners
- Curb and CMT, are 2 authorized technology installers for TLC that have been engaged in installing ASD equipment in their vehicles
- Taxi fleet is expected to include:
  - Toyota
    - Prius
    - Sienna
    - RAV4
  - Nissan NV 200
- 10 taxis installed to date
- Challenges:
  - Overhead digital display

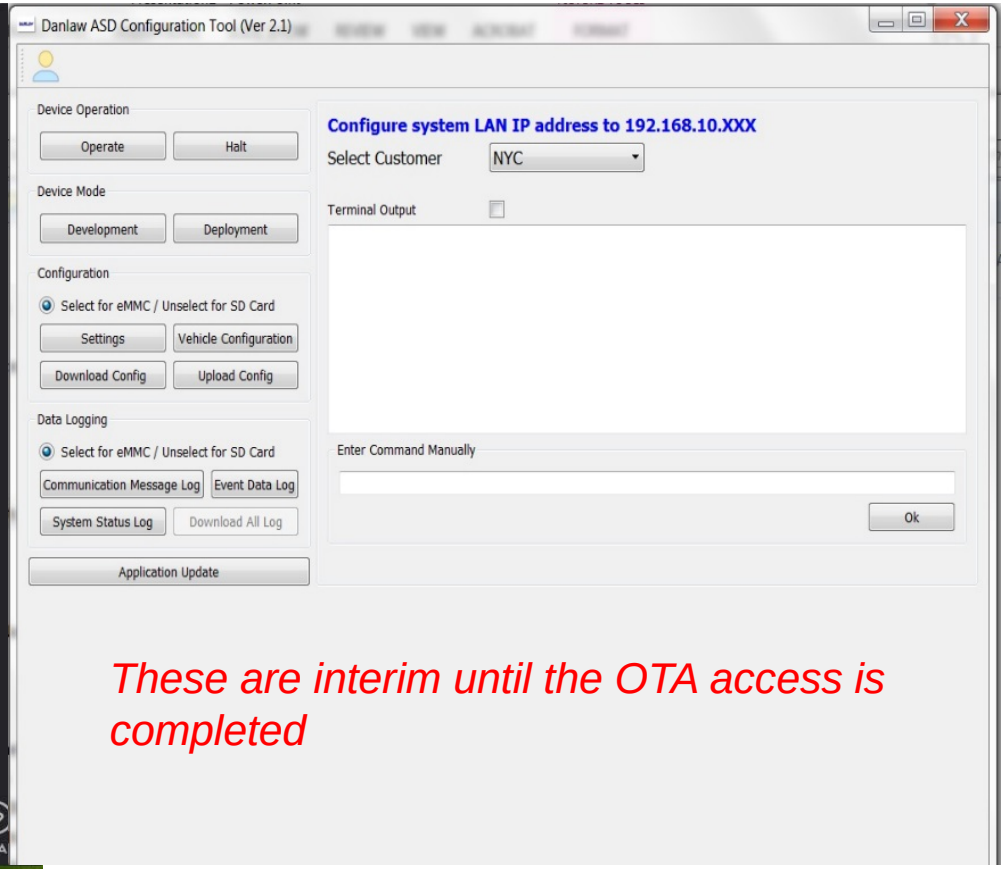


DSNY Installation

- DSNY have offered 170 participating vehicles
- NYC CV Team is currently surveying the vehicles for feasibility of installation and RF communication
- DSNY Vehicles include:
  - Light Duty supervisor vehicles
    - Toyota
    - Ford
    - GM
  - Heavy Duty Trucks
    - Granite Trucks
    - Mack Trucks
  - Global Sweeper

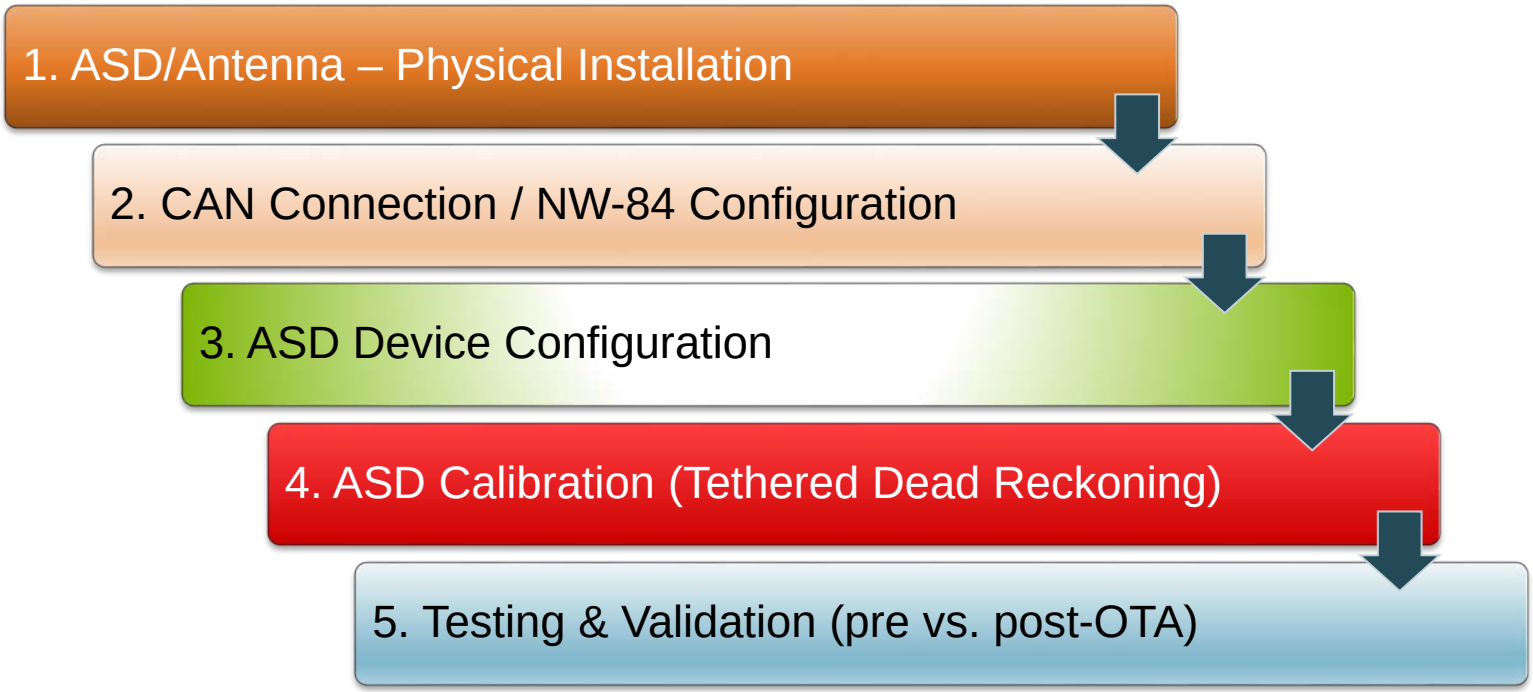
Installation User Interface (GUI)

- Both Vendors Danlaw and Savari have developed a web based user friendly Graphical User Interface
- These GUIs are used by the installers for: Downloading BSM logs, Upgrading SW/FW, ASD configuration and inputting vehicle parameters and Antenna offset measurements



These are interim until the OTA access is completed

Installation Process



Installation Challenges

- CAN/OBD2 availability of required messages
  - Speedometer Speed
  - Yaw Rate
  - Wheel angle
  - Turn Signal
  - Braking
  - Vin – to determine if the ASD has been moved to another vehicle!

Major Challenge – no support from automakers – vehicle data buses are changing – security is a real issue – not all data available from all vehicles.

- Downtime City Fleet Vehicles
  - NYC Fleet vehicles are revenue generating vehicles and/or have strict deployment schedule.
- Installations have to be fine tuned and refined in the current prototype phase for a smooth installation hand over

ASD Additional Vehicle Equipment

- Installation Kit Includes:
  - Speakers
  - Microphone (alert verification only)
  - Power fusing
  - Antennas
  - CAN interface (OBD2 connection or SAE J1939)
  - Cabling (antenna signals, CAN interface, turn signals, ignition KOEO)
- Installation kits or bulk components

Issues Summary - ASD

- ASD
  - Procurement approach
    - NYC process is tedious; many reviews with complex document and vendor requirements! First attempt low bid (cancelled for approach) – final was negotiated based on demonstration
  - Vehicle interface
    - Installation procedures, including CAN bus data is a real challenge
  - Vehicle installation
    - Working with the various City shops and the professional shops has been a challenge.
    - Establishing test and verification (RSU) at each installer in process
    - ASD required limited quiescent current draw! Stakeholders want “Zero”
  - Calibration
    - Vendor “requirements” are not always practical – working to find efficient techniques
  - Installation Verification
    - Ensure @ completion – we won’t need to see the vehicle again!

Issues Summary - Other

- RSU
  - Units (prototypes available now)
  - Extensive testing of new features required
- PID
  - No DSRC availability – dealing with Cellular Carrier
  - Modified ATC design, modified TMC design
- TMC
  - Security requirements to attach to the SCMS
- ASD Location Accuracy
  - Two vendors now about to test their approach – affects RSU!
- Security
  - Need to re-enroll all devices once testing is complete
  - Test certificates not compatible with production certificates

Thank You

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STAKEHOLDER Q&A

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

STAY CONNECTED

Join us for the *Ready to Design, Build, and Test Operational Systems* 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/
- Tampa (THEA): https://www.tampacvpilot.com/
- Wyoming DOT: https://wydotcvp.wyoroad.info/

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