



CONNECTED VEHICLE PILOT Deployment Program



New York City (NYC) Concept of Operations



Jonathan Walker, NYC CV Pilot Site COR
Steve Galgano, NYC CV Pilot Site Project Manager

ITS Joint Program Office



AGENDA



- Purpose of this Webinar
 - To share the Concept Development Activities from the NYC Pilot site with the stakeholders of connected vehicle technologies.

- Webinar Content
 - Connected Vehicle Pilot Deployment Program Overview (*Jonathan Walker*)
 - NYC Concept of Operations (*NYC Team*)
 - Stakeholder Q&A (*Jonathan Walker & NYC Team*)
 - How to Stay Connected (*Jonathan Walker*)

- 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

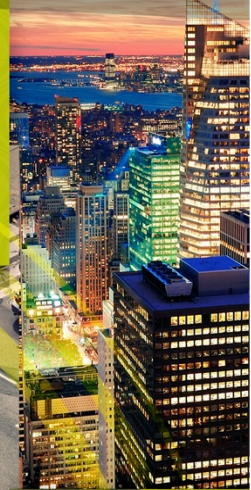
- Visit Program Website for Updates: <http://www.its.dot.gov/pilots>
- Contact: Kate Hartman, Program Manager, Kate.hartman@dot.gov





Photo Courtesy: MTA New York City Transit

New York City Site Orientation and Key Issues



Mohamad Talas
Deputy Project Manager



Project Focus: Safety



- New York City is aggressively pursuing its “Vision Zero” initiative:

**“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.



NYC Pilot Deployment - Users



- Up to 10,000 **fleet** vehicles with **After Market Safety Devices (ASD)**:
 - ~7,500 Taxis - Yellow Cabs
(Authorized for “hail” fares in lower Manhattan and airports.)
 - ~1,500 MTA Buses – which frequent lower Manhattan
 - ~500 Sanitation & DOT vehicles servicing Manhattan
 - ~500 UPS vehicles servicing Manhattan



NYC Pilot Deployment - Users



- Working with Pedestrian Applications



Dense Urban Environment



NYC Advanced Infrastructure




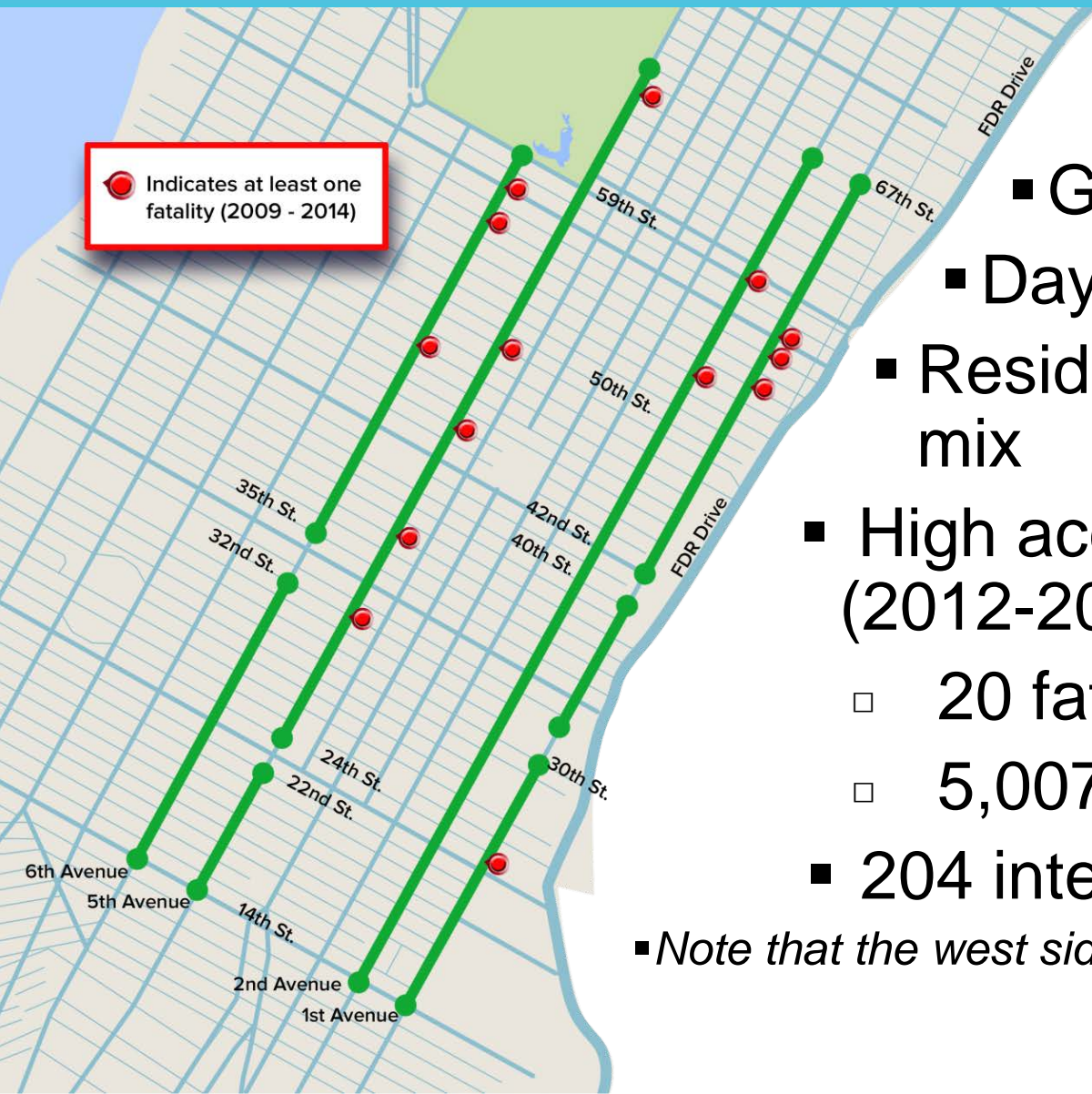
- 12,600 Signalized Intersections – already “Advanced Traffic Controllers”
- Megabit Wireless communications backhaul covers all 5 Boroughs
- Extensive fiber network for backhaul at key locations
- Central system that integrates all traffic signal and ITS devices City-wide
- Aggressive maintenance program with 2 Hr response time 24x7x365 and 311

Pilot Deployment Site

Manhattan - Arterial



 Indicates at least one fatality (2009 - 2014)

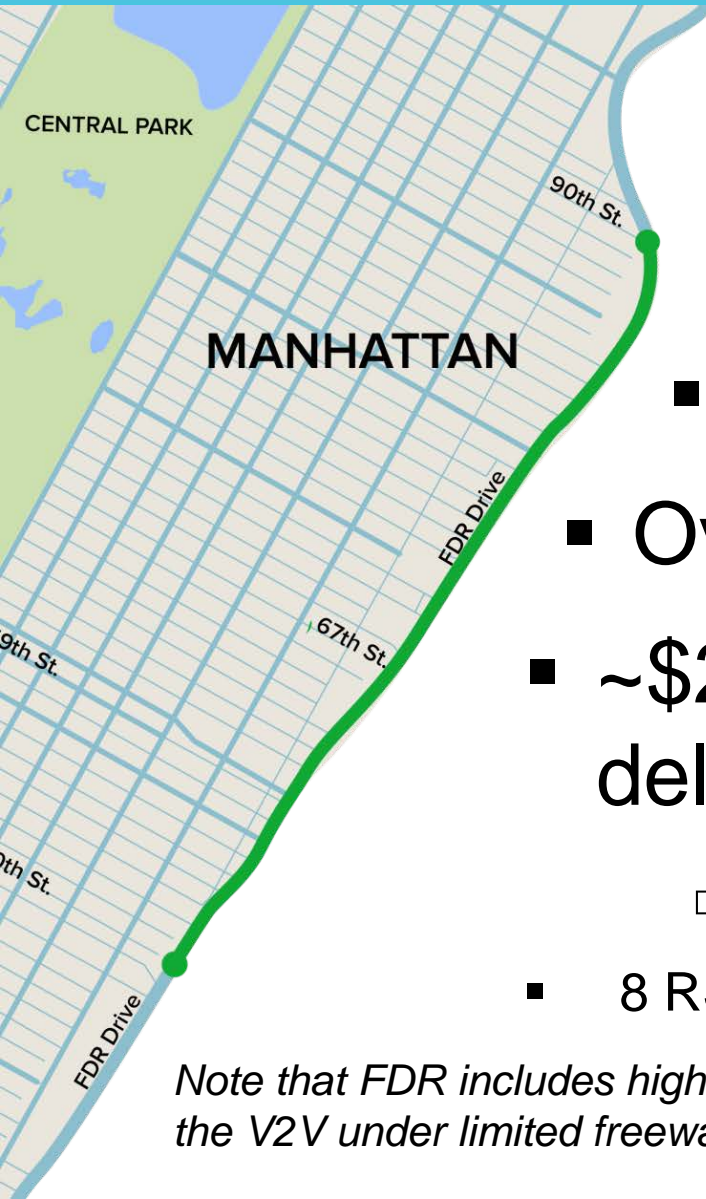


- Grid (600' x 250')
- Day vs. Night conditions
- Residential/commercial mix
- High accident rate arterials (2012-2014)
 - 20 fatalities
 - 5,007 injuries
- 204 intersections
- *Note that the west side can be used for comparison*



Pilot Deployment Site

FDR Drive - Freeway



- Limited access highway
- Excludes trucks/buses
- Short radius curves
- Over-Height restrictions
- ~\$2M in Over-Height incident delay costs (2014)
 - 24 % of City-wide total
- 8 RSE locations

Note that FDR includes higher speeds to evaluate the V2V under limited freeway conditions



Pilot Deployment Site

Brooklyn – Flatbush Ave.



- Over-Height restrictions
 - Tillary St.
 - Manhattan Bridge
- High accident rate arterial 2012-2014 (red dots)
 - 1,128 injuries
 - 8 fatalities
- Average speed 15 mph (AM inbound)
- 38 intersections



NYC Pilot Deployment – Users Summary



- Project area:
 - Manhattan Arterials (below 67th street)
 - Manhattan “freeway” – FDR Drive
 - Brooklyn (Flatbush Ave.)
- Fleets will experience V2I applications where CV infrastructure is installed
- Fleets will experience V2V applications throughout the City
- City fleets (MTA, DOT, & Sanitation) return to “barn” daily
- Taxis – return to “barn” for shift changes

- RSE Locations:
 - 8 on FDR, 38 on Flatbush, 204 Manhattan (Avenues), 40 Manhattan Cross-Town, 38 Other locations = ~ 320 (TBD)



NYC CV Challenges - *Everywhere*



- Density of Roadside DSRC Transponders (RSE)
 - ~76 M for short blocks *DSRC – Nominal 300M*
 - ~200 M for the long blocks (between avenues)
- DSRC only communications
 - Need to develop applications for system operation and management
- Bandwidth limitations of the wireless backhaul (RSE to TMC)
- Stakeholder privacy concerns vs. USDOT desire for broad evaluation data
- Stakeholder requirements to avoid distracting “**cockpit**” displays
- Ongoing maintenance and support (in-vehicle and infrastructure) of the large scale deployment (10,000 Vehicles and ~320 RSEs)
 - *Security Credential Management System*
- SCMS* for all applications & DSRC Over-the-air (OTA) certificate distribution
- OTA DSRC data collection – bandwidth limited
- OTA DSRC software updates
- Location accuracy in the urban canyons (*both relative V2V and absolute V2I*)



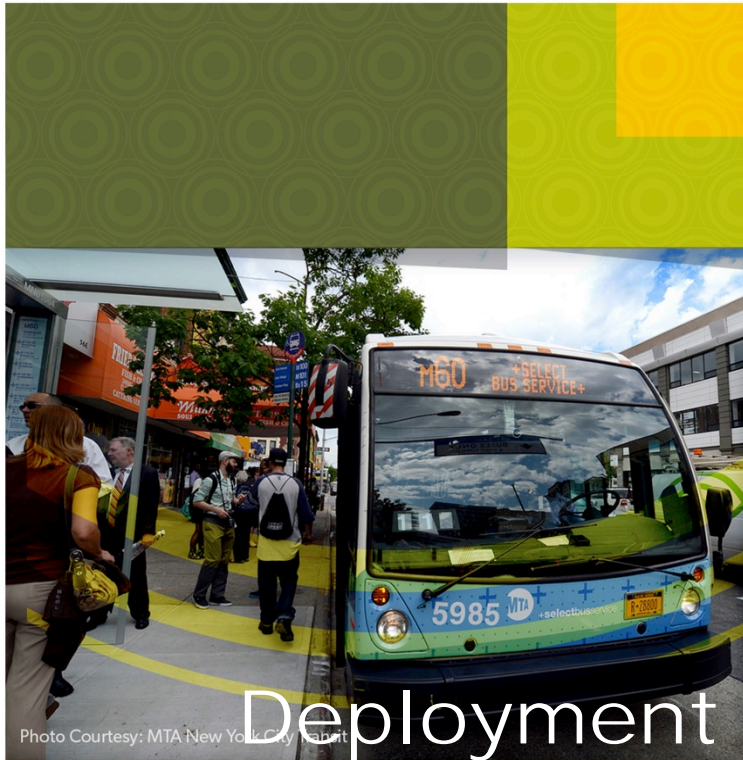


Photo Courtesy: MTA New York City Transit



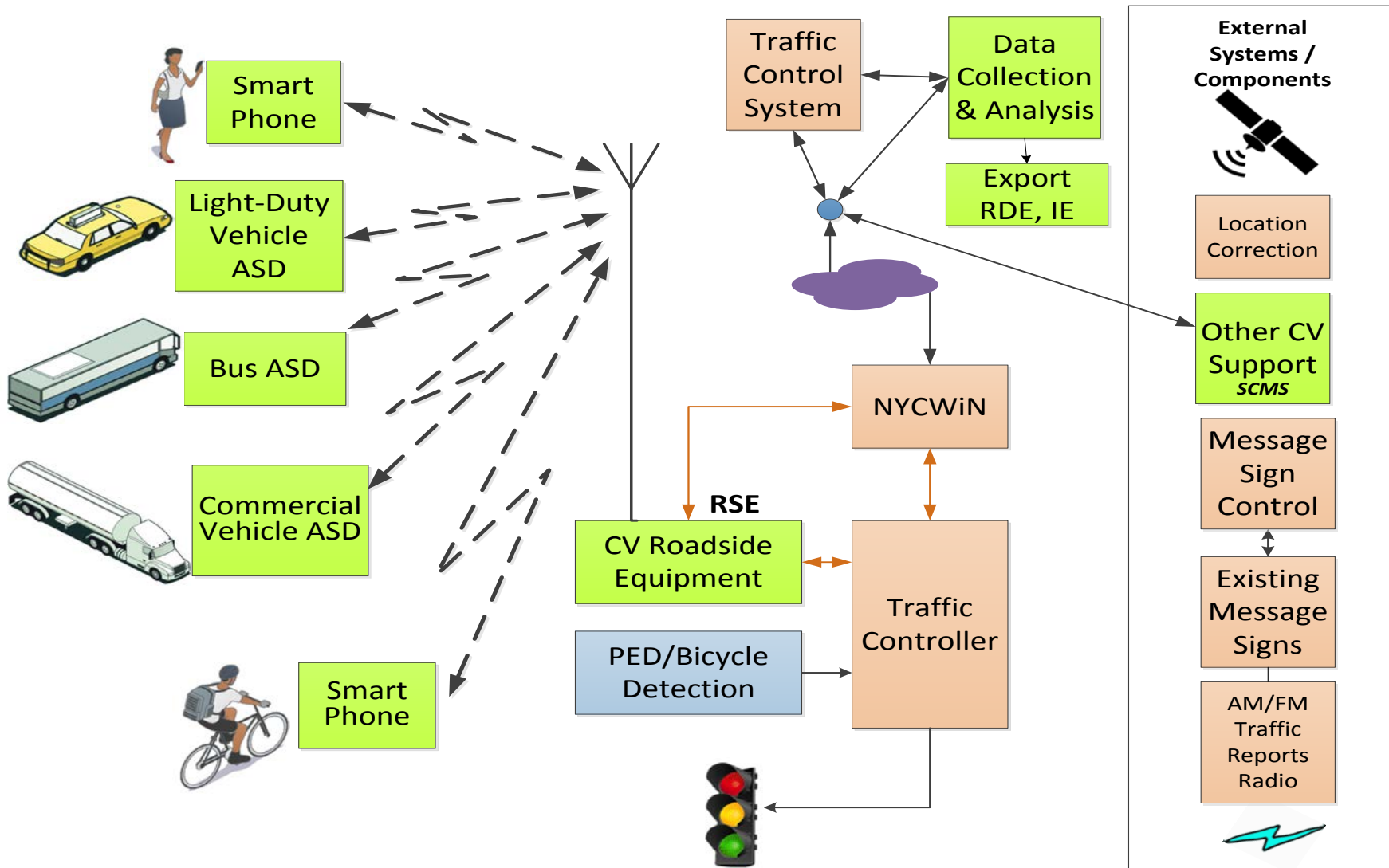
Photo Courtesy of: MTA New York City Transit

New York City Deployment Concept Overview

Bob Rausch,
Concept Development Lead



Overall Project Concept



User *Safety* Needs



- Need to “manage” speed (25 MPH city-wide except Fwy)
- Need to reduce vehicle-to-vehicle crashes
- Need to reduce pedestrian injuries
- Need to reduce crashes & injuries at intersections
- Need to reduce crashes involving buses
- Need to reduce the crashes of vehicles with infrastructure
 - Overheight, and restricted roadways
- Need to inform drivers of serious incidents and major travel restrictions
 - Evacuation, special event restrictions, detour
 - Likely restricted by area and roadway



Other User Needs



Stakeholder

- Minimize introduction of additional **driver distractions**
- Ensure **privacy** for the drivers
- Minimize union concerns for fleet drivers – *performance monitoring*
- Manage CV applications for the changing (daily) traffic environment

DOT ITS

- Determine utility of CV BSM data for input to the City's Adaptive Control System (MIM-ACDSS)

Pedestrians

- Evaluate use of CV technology to reduce PED injuries
- Evaluate use of CV technology with *Smartphone* applications for disabled pedestrians
 - Notifications to Vehicles, Stakeholders: **do NOT notify pedestrians**

Project

- Needs for data to measure system performance
- Needs to manage the overall operational integrity of the system
- Data needs for the Independent Evaluator



The Approach



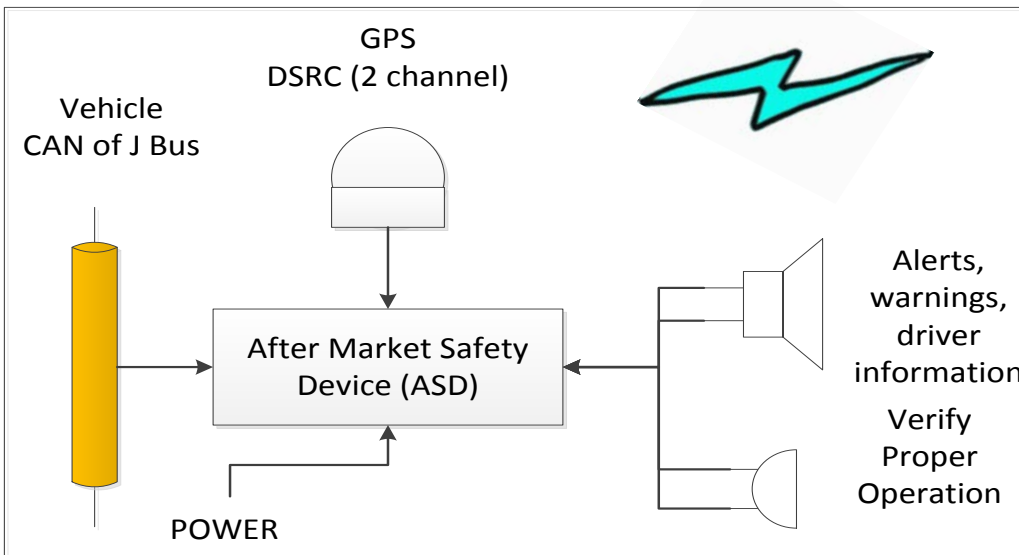
- Focus on “proven” **Safety Applications** – rather than mobility
 - BAA stressed that R&D has shown the benefits
 - Pilot Deployment will evaluate the benefits on a larger scale – dense urban situation
- Leverage “existing” safety applications – rather than “re-invent”
- Modify several existing applications to encourage speed compliance
 - Note that the City recently reduced city-wide speed from 30 MPH to 25 MPH!
- Use the *Systems Engineering Process* to:
 - Develop the operations and maintenance support applications
 - Develop the pedestrian applications
 - Develop the data collection applications
 - Develop benefit evaluation applications



Field Infrastructure Concept

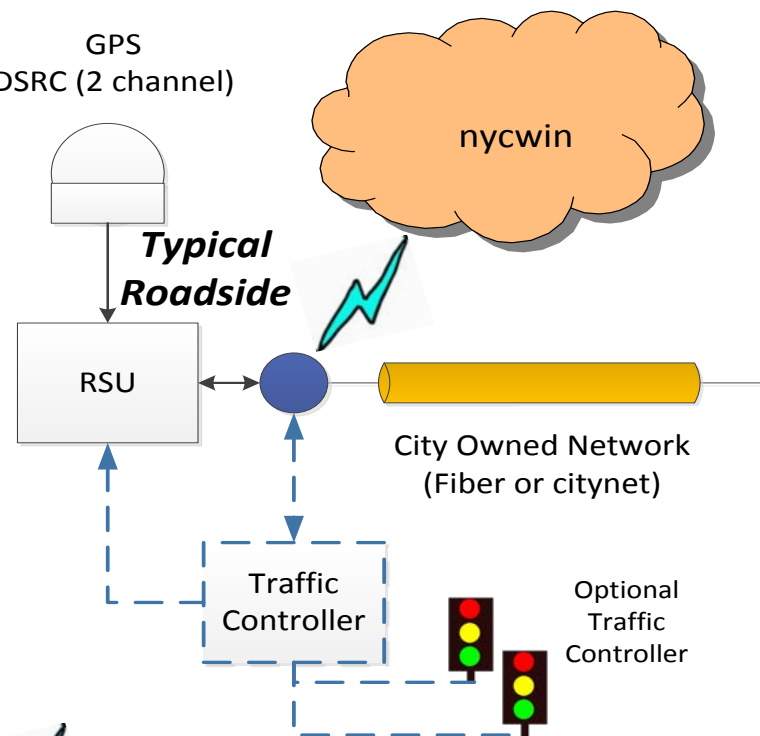


Typical Vehicle



GPS
DSRC (2 channel)

Typical Roadside

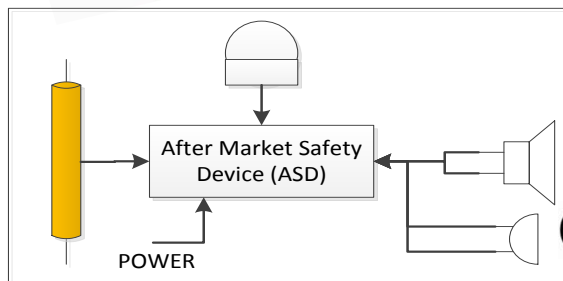
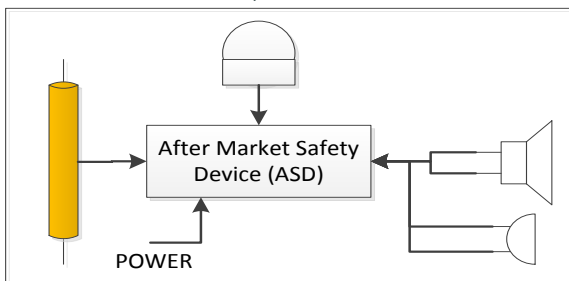


DSRC
V2V

DSRC
V2I

DSRC
V2V

DSRC
V2I





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-COMP
 - Speed **Compliance**/Work Zone SPDCOMPWZ
 - Oversize Vehicle **Compliance** OVC
 - Prohibited Vehicle (Parkways)
 - Overheight
- V2I applications based on existing demonstrations and/or modifications to prior developments and documentation*
- Emergency Communications and Evacuation Information (Using the traveler information features) EVACINFO



Other Applications

- Mobile Accessible Pedestrian 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*



Application Distribution by Fleet



CV Application	Vehicle Fleet					
	Vehicles	Taxi & Limousine	NYC DOT / Sanitation	MTA / NYCTA Buses	Commercial Vehicle	Pedestrian
	Qty Pct	7500 75%	500 5%	1500 15%	500 5%	TBD TBD
Speed Compliance	Yes	Yes	Yes	Yes	Yes	No
Curve Spd Compliance	Yes	Yes	Yes	Yes	Yes	No
Speed/work zone Compliance	Yes	Yes	Yes	Yes	Yes	No
Frwd Crash Warning	Yes	Yes	Yes	Yes	Yes	No
Emer Elec Brake	Yes	Yes	Yes	Yes	Yes	No
Blnd Spot Warning	Yes	Yes	Yes	Yes	Yes	No
Ln Change Warning	Yes	Yes	Yes	Yes	Yes	No
Int Mvmt Assist	Yes	Yes	Yes	Yes	Yes	No
Vehicle Turning in Front of Bus	No*	No*	Yes	No*	No	No
Red Lt Violation Warning	Yes	Yes	Yes	Yes	Yes	No
PED in Sig Xwalk	Yes	Yes	Yes	Yes	Yes	Yes
PED-SIG	No	No	No	No	No	Yes
Oversize Veh Compliance	No	Conditional			No	No
EVAC Info	Yes	Yes	Yes	Yes	Yes	No
I-SIGCVDATA	No	No	No	No	No	No

* Only warns the Bus



Back Office Processing



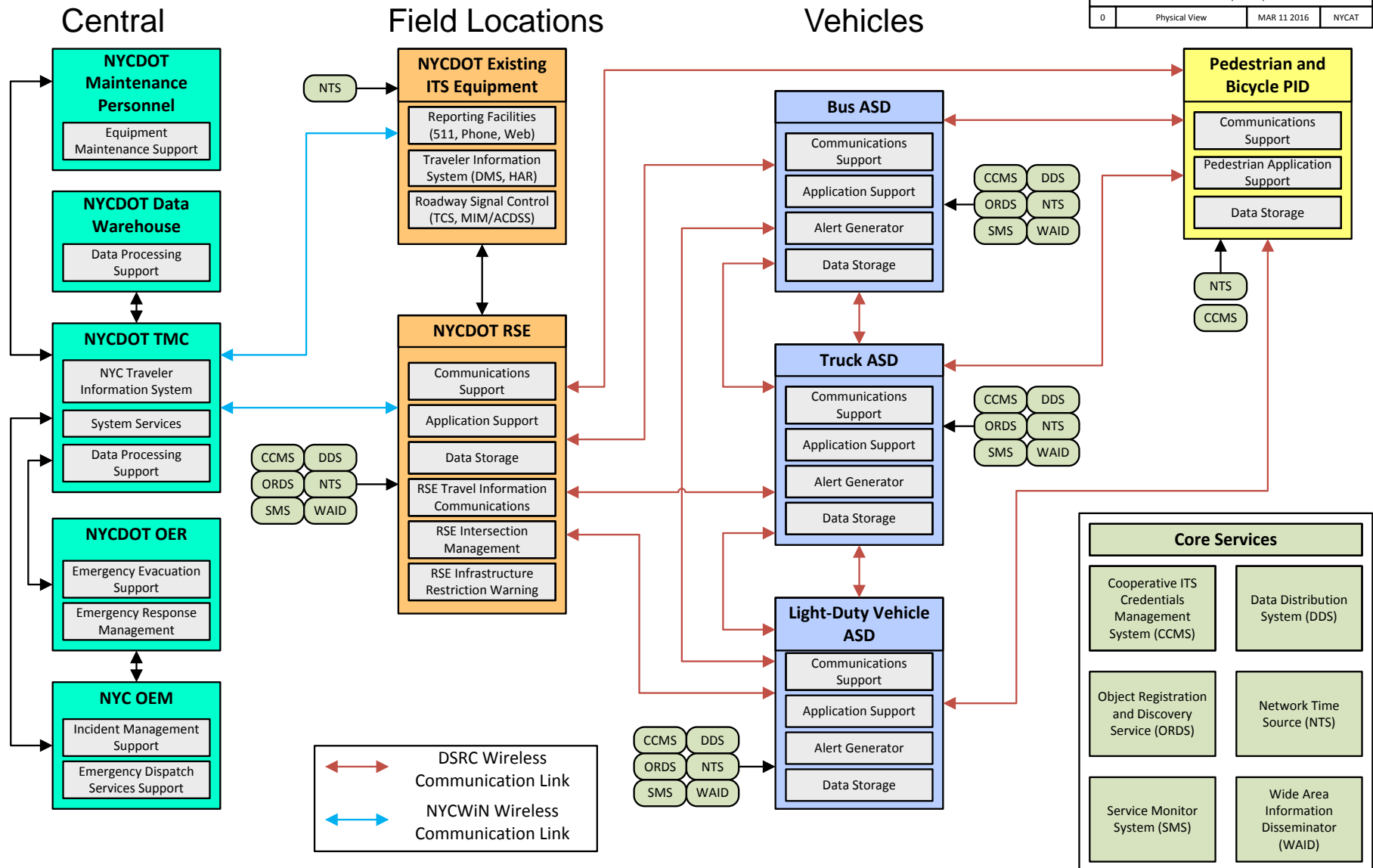
- SCMS* - managing Security Credentials for Infrastructure Components **Security Credential Management System*
- Analysis of RF data to track ongoing RF performance
- Analysis of vehicle “events” for performance metrics
 - Crash avoidance data
 - Evaluation of alarm data
 - Normalization (anonymization) for future storage/export
- Management & adjustment of application parameters
- Working with equipment vendors to support OTA updates
- Registration of disabled pedestrians and management of their security credentials **Midtown-in-motion*
- Analysis of traffic data for input to MIM* adaptive control
- Interface to RDE and the Independent Evaluator (USDOT)



Overall Physical Architecture



0: NYC CV Physical Layer 0			
0	Physical View	MAR 11 2016	NYCAT



Standards Based Approach

Future Interoperability & Sustainability



- Focus on the standard messages for the safety applications using latest version of SAE J2735
 - Basic Safety Message (BSM)
 - Signal Phase and Timing (SPaT) from the traffic controller
 - Geometric information for the intersections (MAP)
 - Signal Request Message (SRM) for pedestrian priority
 - Signal Status Message (SSM) for interaction with the pedestrian
 - Traveler Information Message (TIM) for evacuation messages
- Focus on SAE J2945/1 for V2V safety applications
- Use final versions of IEEE 1609.x as they are completed
- Stay with IEEE 802.11p
- Working with the traffic controller NTCIP updates for 1103, 1201, 1202, 1211
- Stay connected with the standards programs (SAE, NTCIP, IEEE)



Adding project oriented

RF Measurements

data collection



- Vehicles: collect the “first” and “last” SPaT message and the vehicle location from each RSE they “hear”
- RSEs: collect the “first” and “last” BSM message from vehicles they “hear”
Supports statistical analysis of “communications” zone around each RSE and each vehicle.
- Vehicles: collect the BSM for each “new” vehicle they “hear” anywhere;
Allows us to see how frequently vehicles encounter each other throughout the City.
- Data containing potential PII is encrypted at the time of recording.
- Data recorded in-vehicle is collected by RSE at entry to garage or similar “bottleneck”
- Data is sent to back office server for anonymization, analysis, and distribution



Adding project oriented data collection

Event Data



- Note on additional sensors:
ASD will include accelerometers (X, Y, Z) as well as an interface to the CAN bus or OBD2 bus (steering wheel angle, brake status, heading, speed)
- Vehicles continuously record (0.1 sec.) the BSM data and ASD data in a “rotating buffer”.
- Whenever a configurable event occurs, the data prior to the event (for a configurable time) is stored in the ASD (***pre-event data***).
- Following the event (for a configurable time) the same type of data is also stored (***post event data***)
- Both are combined and encrypted into what becomes an ***“event” record***.
- Data recorded in-vehicle is collected by an RSE at entry to garage or similar “bottleneck”
- The encrypted data is sent to back office server for analysis, anonymization, and aggregation – and ultimate export to USDOT





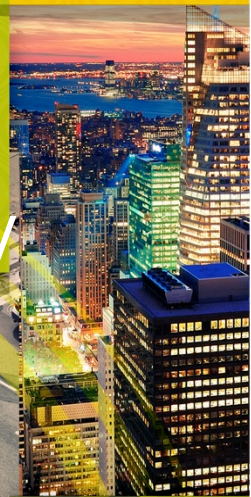
- Note on scalability:
Fleet size and backhaul bandwidth limits data collection. Not practical to collect every BSM from every active vehicle and RSE and those heard by every other active vehicle.
- Vehicles continuously log BSMs into their local buffer at a configurable rate (expect 1 sec. or configurable distance, whichever is less).
- Data is encrypted as stored – can only be decrypted at TMC
- Whenever vehicle passes any RSE, the data will be uploaded to the TMC
- Data at TMC will be analyzed and compared to the travel times received from the ETC
- Goal: to determine if and how this data can replace the current RTMS and ETC data

Next Steps (CV Technology)



- Using ConOps as basis for detailed system requirements
 - Use *Security Management and Operations Plan* – inputs to SyRS
 - Use *Performance Management Plan* – inputs to SyRS
 - Use *Safety Management Plan* – inputs to SyRS
- Working with Vendors to establish parameters that can be configured
 - V2V and V2I applications
- Refining data analysis software to use CV data
- Evaluation of Driver Interface options – audio
 - Tones vs. verbal direction/alert
- Developing the IPv6 network support approach for NYCWiN and CV networks





New York City Stakeholder Engagement Summary

David Benevelli,
System Engineering Lead

Stakeholders



The NYC CVPD program has worked with the following stakeholders to understand their needs and concerns.

Presented the CV Safety Applications “available”

- NYCDOT Bureau of Traffic Operations
- NYCDOT Fleets
- Department of Sanitation Fleet Operations
- Metropolitan Transit 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)



Stakeholder Input workshops



- Multiple concept reviews with stakeholders in November, 2015
- Concept of Operations review in February, 2016
- Concept of Operations review in March, 2016

General Comments and Concerns/user needs

- Minimize introduction of additional **driver distractions**
 - Stakeholders liked the concept of an audio interface
- Ensure **privacy** for the drivers
- Minimize union concerns for fleet drivers – *performance monitoring*
- Manage CV applications for the changing (daily) traffic environment
- Concern over how to support the installation
 - Taxi – special high tech shops
 - UPS – they will do their own
 - MTA/DOT – likely in their own garage
- Stakeholder interaction to determine defective equipment



Ongoing Contract Work



- NYCDOT is continuing to move forward with the various concept documents
 - Security Management and Operations Plan
 - Performance Measurement and Evaluation Plan
 - Safety Management Plan
 - Maintenance and Operations Plans – still in review
 - Installation and testing/certification plans – will impact the SyRS
- Iterating changes to the ConOps and System Requirements Specification

The ConOps is a “living document” and will be further modified and refined

- Review with vendors
 - feasibility
 - cost models (looking toward Phase 2)



Stakeholder Q&A



- 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

Join us for the *Getting Ready for Deployment Series*

- Discover more about the 2015 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>

Public ConOps Webinars:

- [ICF/Wyoming Pilot Site](#)
2/5/2016, 1:00 – 2:00 pm ET
- [Tampa \(THEA\) Pilot Site](#)
2/8/2016, 2:00 – 3:00 pm ET
- [NYC Pilot Site](#)
4/1/2016, 1:00 – 2:00 pm ET

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

Future Site-Specific Public Webinars:

- [Performance Measurement Plan Webinar – June 2016 \(TBD\)](#)
- [Comprehensive Deployment Plan Webinar – August 2016 \(TBD\)](#)

Please visit the CV pilots website for announcements of future public webinars.

