



FHWA Connected Vehicle Pilot Deployment (CV Pilots) Program

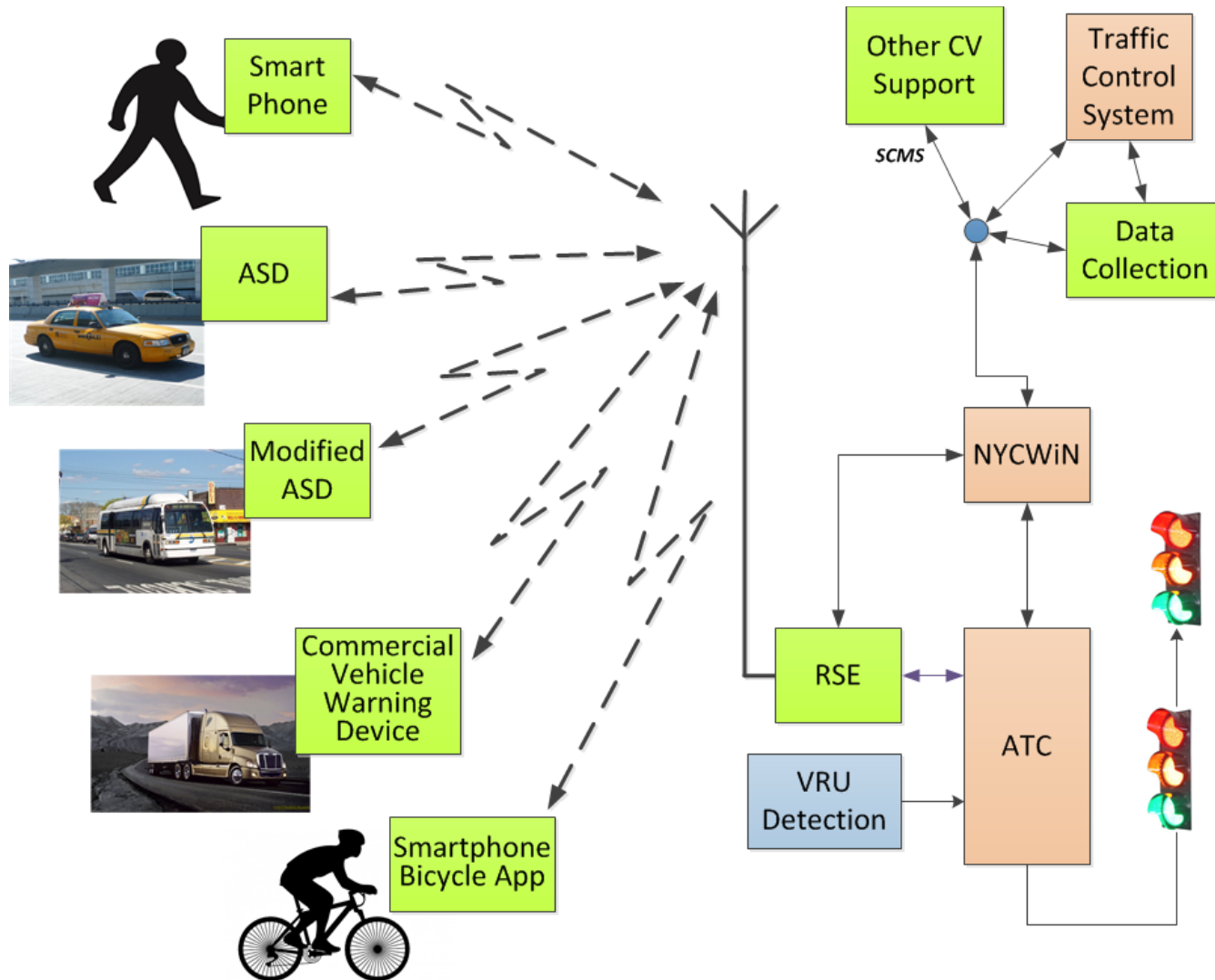
NYC CV Pilot Deployment Presentation 9.30.2015



Agenda

- NYC CV Pilot Vision (Vision Zero)
- Pilot Deployment Site Overview
- Synergies
- Mobility and Safety Needs
- Proposed CV Applications
- Potential Performance Measures
- Risk and Mitigation Measures
- CV Pilot Deployment Team
- NYCDOT Contact Information

NYC CV Pilot Vision (Vision Zero)



Pilot Deployment Site Overview

Three corridors

- Manhattan Grid
- Manhattan FDR Dr.
- Brooklyn Flatbush Ave.



Pilot Deployment Site – Manhattan Grid



- Grid (600' x 250')
- Day vs. Night conditions
- Residential/commercial mix
- High accident rate arterials (2012-2014)
 - 20 fatalities
 - 5,007 injuries
- 204 intersections

Pilot Deployment Site – Manhattan FDR



- Limited access highway
- Excludes trucks/buses
- Short radius curves
- Over-Height restrictions
- \$1,958,497 in Over-Height incident delay costs (2014)
 - 24 % of City-wide total

Pilot Deployment Site - Flatbush



- Over-Height restrictions
 - Tillary St.
 - Brooklyn Bridge
- High accident rate arterial 2012-14 (red dots)
 - 1,128 injuries
 - 8 fatalities
- Average speed 15 mph (AM inbound)
- 35 intersections

Synergies – NYC has much to leverage

- 12,700 Advanced Solid-state Traffic Controllers (ASTCs) designed to accept multiple data inputs
 - BSM from ASDs
 - Develop travel times and queue lengths to further improve Midtown-in-Motion signal timing
- CV backhaul communication implemented over NYCWiN will minimize operating costs
- Existing ***Manhattan Traffic Simulation Model*** can accept CV data for on-going benefit and comparison analysis
- NYCDOT has the experience in installing new, high tech systems (MIM, wireless networks, RFID readers, ATC, etc.) – which is required for the procurement and installation of ASD's and RSE's for phase 2

Synergies - Infrastructure



Advanced Solid-State Traffic Controller (ASTC)

Note: Ethernet ports available for connection to CV units



NYCWiN Wireless Router

Note: Ports available for RSE

Mobility and Safety Issues



Commercial truck incidents are an issue in NYC.



Pedestrian injuries are an issue.

Mobility and Safety Issues to be Addressed

No.	Mobility and Safety Issues
1	Discourage spot speeding
2	Reduce Accidents at High Incident Intersections
3	Improve Pedestrian Safety and Reduce Bus Related Crashes on Heavily Traveled Bus Routes
4	Improve Safety of for Disabled Pedestrians (V2P)
5	Improve Truck Safety
6	Address Bridge Low Clearance Issues
7	Enforce Truck Route Restrictions
8	Improve Work Zone Safety
9	Balance Mobility in Heavily Congested Areas
10	Reduced crashes, injuries and delays

CV Applications

No	NYCDOT Needs	CV Application
1	Discourage spot speeding	<u>Modified</u> Eco-Speed Harmonization
2	Reduce Accidents at High Intersection Locations	Red Light Violation Warning
3	Improve Pedestrian Safety on Heavily Traveled Bus Routes	Pedestrian in Signalized Crosswalk Warning
		Vehicle Turning Right in Front of Bus Warning
4	Improve Safety of Visually Impaired Pedestrians	Mobile Accessible Pedestrian Signal System (PED-SIG)

CV Applications (cont'd)

No	NYCDOT Needs	CV Application
5	Improve Truck Safety	Curve Speed Warning
6	Address Bridge Low Clearance Issues	Freight-Specific Dynamic Travel Planning and Performance
7	Enforce Truck Route Restrictions	
8	Improve Work Zone Safety	Reduced Speed/Work Zone Warning
9	Balance Mobility	Intelligent Traffic Signal System (I-SIG) In-Vehicle Information Potential

CV Applications (cont'd)

Potential V2V (depending on final ConOps and ASD)

No.	NYCDOT Needs	<u>Potential</u> CV Application
10	Reduced crashes, injuries and delays	Forward Collision Warning (FCW)
11		Emergency Electronic Brake Light (EEBL)
12		Blind Spot Warning (BSW)
13		Lane Change Warning/Assist (LCA)
14		Intersection Movement Assist (IMA)
15		Stationary Vehicle Ahead (SVA)

CV Application Fleet Distribution

CV Application	Proposed Vehicle Fleet					
	Vehicles Qty	Taxi & Limousine 7500	NYC DOT / Sanitation 500	MTA / NYCTA Buses 1500	Commercial Vehicle 500	Pedestrian TBD
1 Speed Mgt.		Yes	Yes	Yes	Yes	No
2 Red Violate		Yes	Yes	Yes	Yes	No
3 PED Safety		Yes	Yes	Yes	Yes	Yes
4 Veh-RT Bus		No	No	Yes	No	No
5 ADA-PED		No	No	No	No	Yes
6 Curve Warn		Yes	Yes	Yes	Yes	No
7 CVO Apps.		No	Yes	Yes	Yes	No
8 Speed Zone		Yes	Yes	Yes	Yes	No
9 I-SIG		Yes	Yes	Yes	Yes	No

Potential Performance Measures

No	NYCDOT Needs	CV Application	Performance Measure Metrics
1	Discourage spot speeding	<u>Modified</u> Eco-Speed Harmonization	<ul style="list-style-type: none"> • Average stop • Average speed • Average emission • Number of hard acceleration/deceleration events
2	Reduce Accidents at High Incident Intersections	Red Light Violation Warning	<ul style="list-style-type: none"> • Reduction of signal violations • Reduction of accidents at intersections

Potential Performance Measures

No	NYCDOT Needs	CV Application	Performance Measure Metrics
3	Improve Pedestrian Safety on Heavily Traveled Bus Routes	Pedestrian in Signalized Crosswalk Warning	<ul style="list-style-type: none"> Reduction of pedestrian collisions with transit buses Number of warnings generated
		Vehicle Turning Right in Front of Bus Warning	<ul style="list-style-type: none"> Number of warnings generated
4	Improve Safety of Visually and Audibly-Impaired Pedestrians	Mobile Accessible Pedestrian Signal System (PED-SIG)	<ul style="list-style-type: none"> Waiting time at intersections for crossing Number of pedestrian crossing violation reductions

Potential Performance Measures

No.	NYCDOT Needs	CV Application	Performance Measure Metrics
5	Improve Truck Safety	Curve Speed Warning	<ul style="list-style-type: none"> • Reduction in accident at ramps • Number of warnings generated
6	Address Bridge Low Clearance Issues	Freight-Specific Dynamic Travel Planning and Performance	<ul style="list-style-type: none"> • Number of warnings generated
7	Enforce Truck Route Restrictions	Freight-Specific Dynamic Travel Planning and Performance	<ul style="list-style-type: none"> • Reductions in truck route violations • Improvement of truck load/offload zone delays • Truck travel times

Potential Performance Measures

No	NYCDOT Needs	CV Application	Performance Measure Metrics
8	Improve Work Zone Safety	Reduced Speed/Work Zone Warning	<ul style="list-style-type: none"> • Average speed at work zone compared to posted speeds
9	Balance Mobility in Heavily Congested Areas	Intelligent Traffic Signal System (I-SIG)	<ul style="list-style-type: none"> • Average speed • Average wait time at stops • Average travel time • Average throughput at intersections • Number of hard accelerations/decelerations



Potential Performance Measures

No.	NYCDOT Needs	CV Application	Performance Measure Metrics
10-15	V2V safety applications	All	<ul style="list-style-type: none"> • Crash incidence • Injury incidence • Property damage costs • Comparisons between instrumented and non-instrumented arterials
16	Evacuation and unusual situation alerts	In-vehicle information	<ul style="list-style-type: none"> • Acceptance and driver interviews

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Risk and Mitigation Measures

- Technical
 - Common CV deployment risks for NYC environment
- Institutional
- NYC potential CV application-specific deployment risks
- Details in proposal and to be developed in the Risk Management Plan



Common CV Deployment Risks

Technical Risk	Mitigation Approach
<ul style="list-style-type: none"> Excessive or false alarms 	<ul style="list-style-type: none"> Tuning of applications and thresholds Driver education
<ul style="list-style-type: none"> Inaccurate geo-positioning 	<ul style="list-style-type: none"> Utilization and calibration of dead reckoning technology
<ul style="list-style-type: none"> RF connectivity (V2X) 	<ul style="list-style-type: none"> Careful design and validation Systematic and regular infrastructure testing and maintenance Proper installation techniques with special care given to antenna placement
<ul style="list-style-type: none"> Security credential management (includes CRL & misbehavior detection) 	<ul style="list-style-type: none"> Work with SCMS developers/operators

Common CV Deployment Risks

Technical Risk	Mitigation Approach
<ul style="list-style-type: none"> Privacy concerns 	<ul style="list-style-type: none"> Full SCMS to protect identity (by others) Stakeholder buy-in/outreach
<ul style="list-style-type: none"> Network attacks for publicity/security purposes (Black Hat) 	<ul style="list-style-type: none"> Use network security best practices following ISO 27000 and others Prohibit transmission and storage of personal or sensitive information
<ul style="list-style-type: none"> IPv6 Support for NYCWiN 	<ul style="list-style-type: none"> Work with DoITT and NYCWiN operations as needed, or tunneling
<ul style="list-style-type: none"> DSRC Saturation Algorithm 	<ul style="list-style-type: none"> TBD (USDOT)
<ul style="list-style-type: none"> 5.9 GHz interference 	<ul style="list-style-type: none"> TBD (USDOT)



Common CV Deployment Risks



Technical Risk	Mitigation Approach
<ul style="list-style-type: none">• Stable Standards	<ul style="list-style-type: none">• Schedule• Backward compatibility required starting 2016+
<ul style="list-style-type: none">• Equipment obsolescence	<ul style="list-style-type: none">• Assess technology advancements early on during Phase 1 via a team of experts• Craft flexible requirements that can accommodate equipment evolution
<ul style="list-style-type: none">• Interoperability	<ul style="list-style-type: none">• Use standard message formats between all system nodes to communicate

Common CV Deployment Risks

Institutional Risk	Mitigation Approach
<ul style="list-style-type: none">Phase 2 procurement processes lead time	<ul style="list-style-type: none">Advance procurement document development to Phase I

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Red Light Violation Warning Risks

Technical Risk	Mitigation Approach
<ul style="list-style-type: none">• Traffic conditions (bumper-to-bumper) makes violation prediction difficult – excessive alarms	<ul style="list-style-type: none">• Tuning of the applications and thresholds based on vehicle speed and traffic density to avoid excessive alarms
<ul style="list-style-type: none">• Traffic controller firmware modifications	<ul style="list-style-type: none">• Work with Peek Traffic Corporation, a project stakeholder, and supplier of NYCDOT TCS ATC's to identify firmware revisions as necessary

Pedestrian in Signalized Crosswalk Warning Risk

Technical Risk	Mitigation Approach
<ul style="list-style-type: none">Density of pedestrians creates continuous alarms prohibiting any turning movement	<ul style="list-style-type: none">Establish a priority to equip high-risk and agency-owned vehiclesTuning of the applications and thresholds based on vehicle speed and traffic density to avoid excessive alarms
<ul style="list-style-type: none">Detecting pedestrian location on crosswalk with accuracy	<ul style="list-style-type: none">DGPS or large buffer zones to compensate PGS position inaccuracies
<ul style="list-style-type: none">Malicious use of the system to provide false warnings to drivers	<ul style="list-style-type: none">Simulation of algorithms in appropriate environment before deploymentData source validation via certificates

Vehicle Turning Right in Front Risk

Technical Risk	Mitigation Approach
<ul style="list-style-type: none">• Ability to predict collisions in dense traffic	<ul style="list-style-type: none">• Tuning of the applications and thresholds based on vehicle speed and traffic density to avoid excessive alarms

REPORT

Mobile Accessible Pedestrian Signal System (PED-SIG) Risk






Technical Risk	Mitigation Approach
<ul style="list-style-type: none">Smartphone orientation may not be the actual orientation of the user	<ul style="list-style-type: none">Get user direction confirmation



Freight-Specific Dynamic Travel Demand and Performance Risk

Technical Risk	Mitigation Approach
<ul style="list-style-type: none">ASD's may have limited vehicle interface	<ul style="list-style-type: none">Check list to ensure proper data inputPhase I due diligence to document information needs/requirements for Phase II procurement specifications

CV Pilot Deployment Team Project Management

Agency / Firm	Team Member	Position
	Steven Galgano, P.E.	Project Management Lead (PML)
	David Benevelli, P.E.	System Development Lead (SDL)
	Robert Rausch, P.E.	Concept Development Lead (CDL)





Project Team

Firm	Primary Project Role
	<ul style="list-style-type: none"> ● Program Management Lead ● Stakeholder Coordination ● Performance Measurement and Evaluation Support Plan ● Participant Training and Stakeholder Education Plan ● Outreach Plan
	<ul style="list-style-type: none"> ● Concept Development Lead ● System Development Lead ● ConOps ● Pilot Deployment System Requirements ● Application Deployment Plan ● Comprehensive Pilot Deployment Plan ● Deployment Readiness Summary

Project Team – Principle Subcontractors

Firm	Primary Project Role
	<ul style="list-style-type: none"> • Safety Management Plan • Pilot Deployment System Requirements • Application Deployment Plan • Human Use Approval
	<ul style="list-style-type: none"> • Performance Measurement and Evaluation Support Plan • Pilot Deployment System Requirements • Application Deployment Plan • Partnership Coordination and Finalization
	<ul style="list-style-type: none"> • Security Management Operating Concept

Supporting Project Team

Firm	Support Project Role
	<ul style="list-style-type: none"> • ConOps • Performance Measurement and Evaluation Support Plan • Pilot Deployment System Requirements
	<ul style="list-style-type: none"> • Performance Measurement and Evaluation Support Plan
	<ul style="list-style-type: none"> • ConOps • Pilot Deployment System Requirements • Application Deployment Plan • Technology Assessment
	<ul style="list-style-type: none"> • ConOps • Pilot Deployment System Requirements • Application Deployment Plan • Technology Assessment

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CV Pilot Deployment Stakeholders

Key Stakeholders	Project Role
MTA NYCT	<ul style="list-style-type: none"> • ConOps Stakeholder Review Panel • Support Application Deployment, Human Use Approval, Participant Training and Stakeholder Education, Partnership Coordination and Finalization, Outreach and CPD Plans
NYC Taxi and Limousine Commission	
City of New York Department of Sanitation	
New York State Truck Motor Association	
United Parcel Service	
Verizon	
NYC Department of Information Technology (DoIT)	<ul style="list-style-type: none"> • Ensure NYCWiN supports the NYC CV Pilot project and provides the requisite access and support

Stakeholders (cont'd)

Key Stakeholders	Project Role
New York City Fire Department	<ul style="list-style-type: none">• ConOps Stakeholder Review Panel
New York City Police Department	
TRANSCOM	
Pedestrians for Accessible and Safe Streets (PASS)	<ul style="list-style-type: none">• ConOps Stakeholder Review Panel• Support Outreach Plan
I-95 Corridor Coalition	<ul style="list-style-type: none">• Regional Outreach coordination
Peek Traffic Corporation	<ul style="list-style-type: none">• Modify existing controllers for CV applications