New York City's Connected Vehicle Program

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

NYC CV Pilot will evaluate

- Safety benefits of CV technology using DSRC technology
- Address CV deployment challenges
  - With a Large Number of Vehicles & Types

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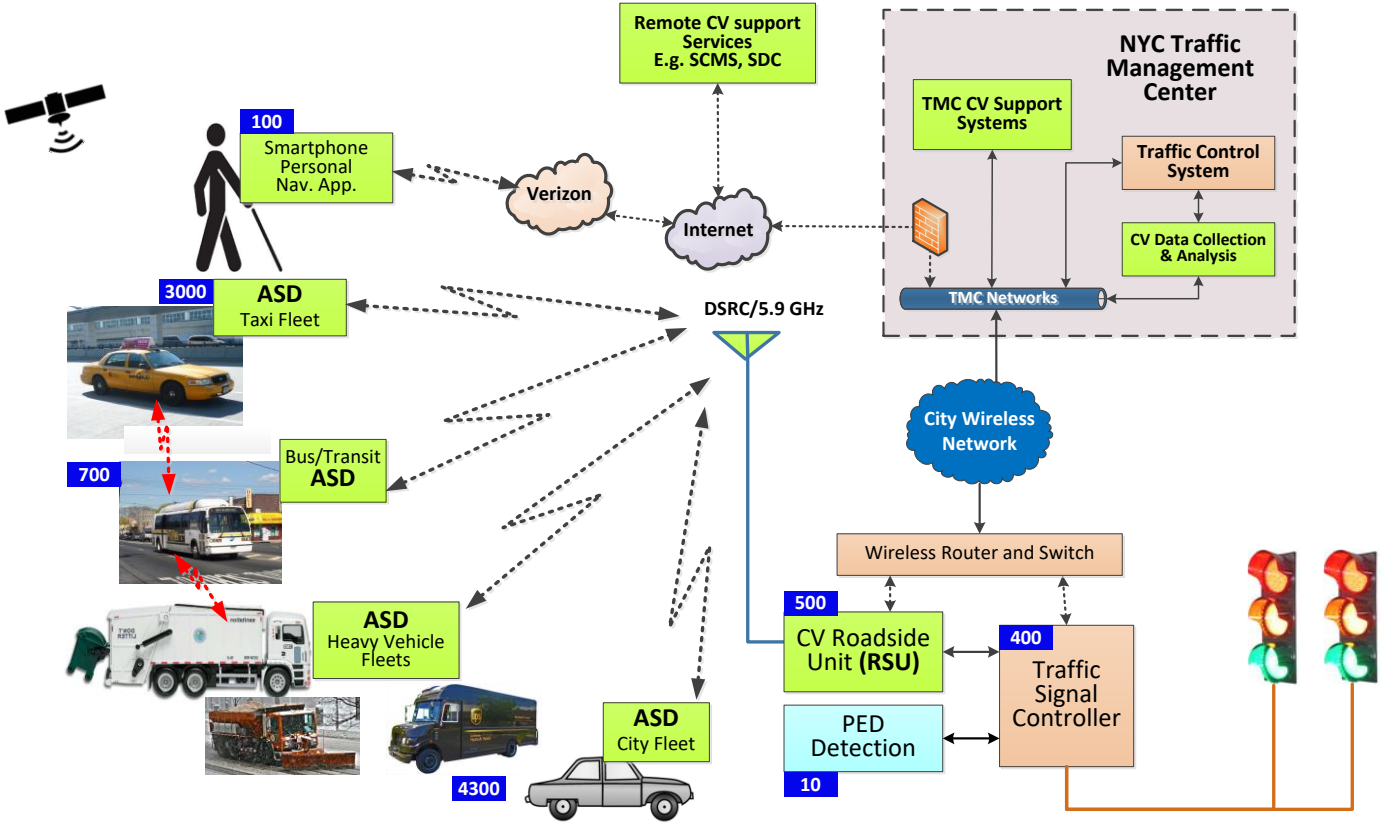
Overall Deployment Concept



ASD: Aftermarket Safety Device

NYC CV 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

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

Pedestrian Applications

- Pedestrian in Crosswalk (RSU)
- Visually Impaired Crossing (PID)

Customized Applications

Operations, Maintenance, and Performance Analysis

- OTA Firmware Update
- OTA Uploading of Data Collected
- Application Parameter Modifications (Tuning)
- CV Data for Intelligent Traffic Signal System
- RF Monitoring
- Traffic data collection
- Event History Recording
- Privacy protection

DSRC 5.9 GHz Spectrum Utilization

- We are using 6 of the 7 channels
  - 172 – Safety Channel - BSM, SPaT, MAP
  - 178 – Control Channel – WSA, TIM (also supports RSU triangulation)
  - 174 – Service Channel
  - 176 – Service Channel
  - 180 – Service Channel
  - 182 – Service Channel
  - *184 – Reserved for future*

→ *Using the 6 channels is necessary due to the density of RSUs with 250 foot block spacing*

OTA Software Updates
OTA Data Collection from Vehicles
OTA Application "tuning" for NYC Urban Environment
SCMS Security certificates

- NY system uses the IEEE 1609.2 CV Security
  - Live updates from SCMS
  - Only 1 week Certificate life
  - Only 2 weeks of certificates onboard
  - Certs used for encryption and authentication

At some critical locations we are installing 2 RSUs to support the volume of uploaded data.

RSUs – City's 5.9 GHz Infrastructure

- Developed RSU installation procedures
  - Mast Arm mounting for line of sight
  - Cross Intersection wireless ethernet link
  - Use of Lidar database for accurate Lat/Lon/Elevation
- 105 RSUs installed - continue 12-20 / week
- Delivery & installation of 500 units by the 4th quarter
- Established communications links through City networks
  - SCMS – to obtain security cert updates weekly
  - ITS security improved to meet CV requirements
  - Installing new network devices for CV deployment
- Using the RSUs for edge computing
  - Backhaul throughput limited – store and forward & analysis
  - RSU provides data collection for maintenance
  - RSU supports OTA broadcast software updates for large fleet

Backhaul Loading

Event logging estimate:

6-300 GB/day/RSU*

*Assuming 40 RSUs collecting Log Data

OBUs – The City's Mobile 5.9 GHz Investment

- Developing, testing, evaluating installation procedures for 8,000 vehicles
  - 7 installation contractors under contract
  - Approximately 300 different make/models/years
  - Includes hybrid vehicles – light duty trucks, buses, taxis
- Worked with vendors - improve location accuracy in urban canyons
  - RSU triangulation – time of flight where GPS & IMU are not enough
  - Evaluation and testing of V2X-Locate from one of the vendors
- Worked with vendor - passive CAN bus interface
  - Provides 10 Hz vehicle speed for improved vehicle location accuracy
  - Allows ASD operation where other systems already installed (Geotab)
- RF propagation analysis and testing
- Developed antenna mounting
  - Roof on light vehicles -
  - Through the glass for MTA
- Extensive V2V and V2I application testing

Summary

- NYCDOT has invested 3+ years – developing the largest Safety Oriented testing of the CV applications – using the 5.9 GHz spectrum
- We are addressing the challenges of the urban environment
  - DSRC/5.9 reliability
  - Scalability of the DSRC/5.9 and CV technology
  - Location accuracy challenges using the CV infrastructure
- Our CV investment is focused on V2V and V2I crash reduction
- The NY project is tackling the transition from R&D to practical deployment
  - O&M support, Security, DSRC/5.9 channel utilization, Overall reliability
  - Evaluating product maturity
- Addressing **After Market** CV deployment – essential for CV adoption
- Pilot performance is being evaluated by 3 major research centers