

# 5.9 GHz “Safety Band” Transportation Communications— Incorporating Secure 5G

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# Many Types and Uses of Communications for Transportation

- Center-to-Center Communications
- Center to Field Communications
- Back Office Communications

- 2G / 3G / 4G
- Fiber
- Internet
- Satellite

- Machine-to-Machine communications:
  - Vehicle-to-Vehicle (V2V) Crash Avoidance
  - Vehicle-to-Infrastructure (V2I, i.e., Signal Priority, Weather, Emergency Response, etc.)
  - Vehicle-to Everything (V2X), i.e., portable devices for pedestrians (vehicle-to-pedestrian, V2P) or vulnerable road users.

- Tailored Broadcast Wi-Fi
- Tailored Broadcast Cellular



Image: LA DOT



Image: US DOT



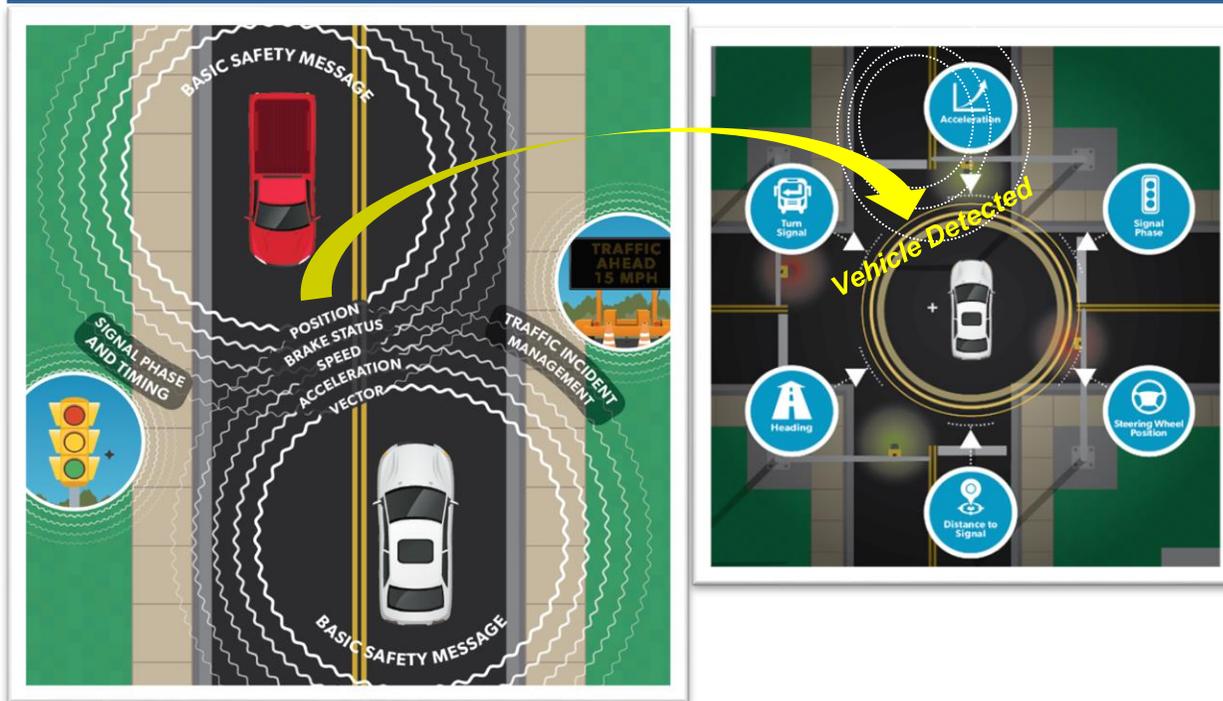
Image: US DOT



Image: US DOT



# V2X: Game Changing Capabilities



- Cooperative automated vehicle maneuvering
- Notify Automated vehicles of approaching police and emergency vehicles
- Send wireless notifications of traffic signal and other roadside messages to enhance situational awareness for automated vehicles
- And other new and innovative features and applications



# Dedicated Band Plan—5.9 GHz Safety Band Spectrum in Use Today

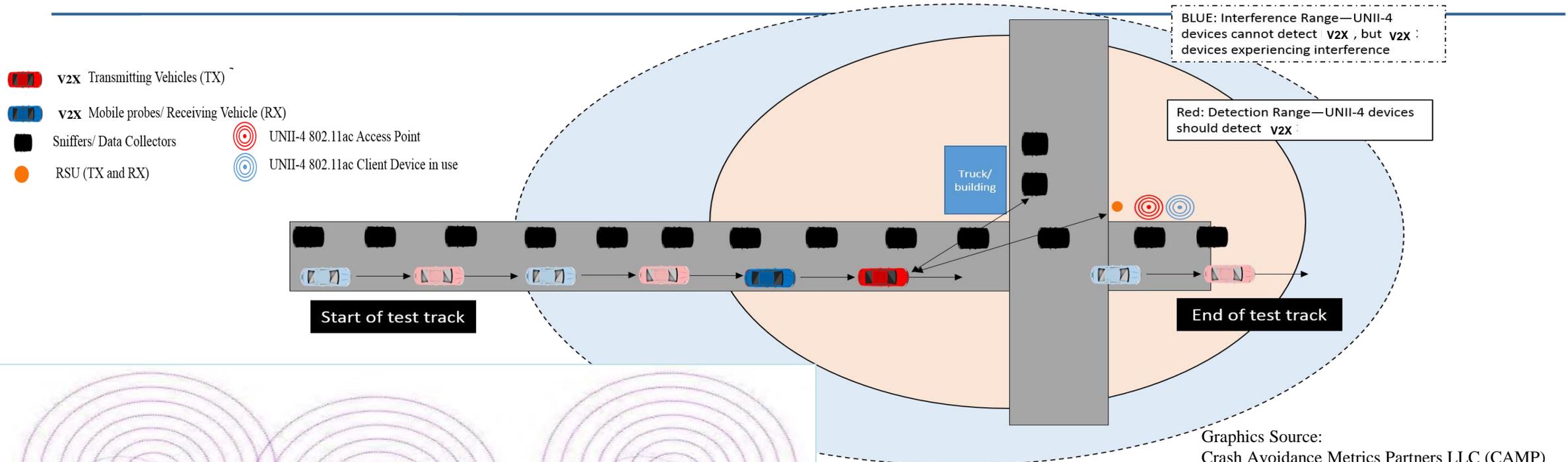
5.850 GHz						5.925 GHz	
		CH 175		CH 181		CH 183	
5850-5855 reserve 5 MHz	CH 172 Service 10 MHz	CH 174 Service 10 MHz	CH 176 Service 10 MHz	CH 178 Service 10 MHz	CH 180 Service 10 MHz	CH 182 Service 10 MHz	CH 184 Service 10 MHz

## Critical Spectrum Requirements

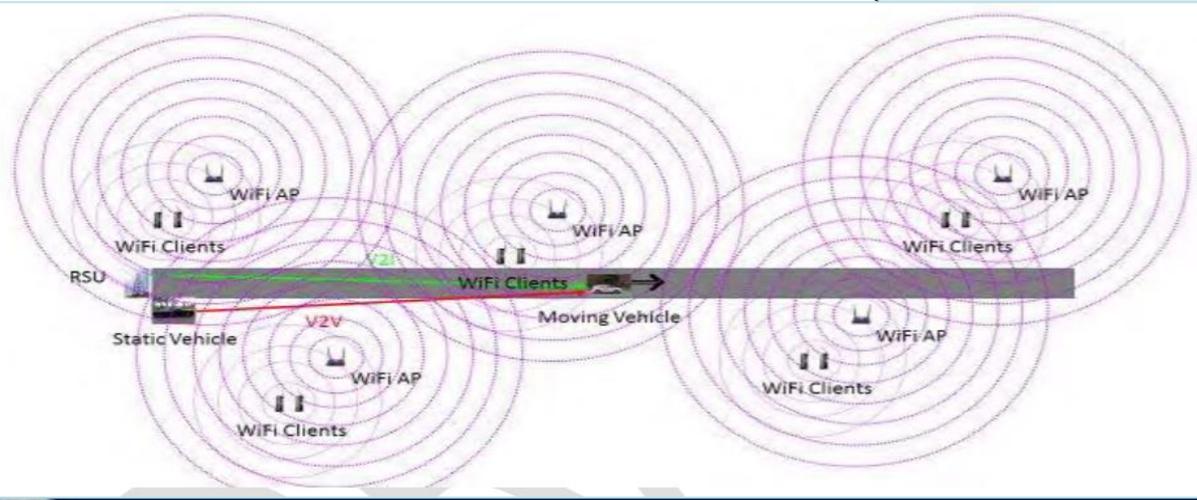
Tailored Communications	Interoperability	Security
<ul style="list-style-type: none"> <li>• Low Latency</li> <li>• Non-Networked—no association time</li> <li>• Channel Access</li> <li>• Information Age / Interpacket Gap</li> <li>• &lt; 90% Packet Completion Rate</li> </ul>	<ul style="list-style-type: none"> <li>• All makes and models of devices can “hear” each other</li> </ul>	<ul style="list-style-type: none"> <li>• V2X messages are trusted and authenticatable</li> </ul>



# Test is Key to Tailoring



Graphics Source:  
 Crash Avoidance Metrics Partners LLC (CAMP)  
 Vehicle Safety Communications 8 (VSC8)  
 Consortium & U.S. DOT



# Moving Toward Zero-Trust

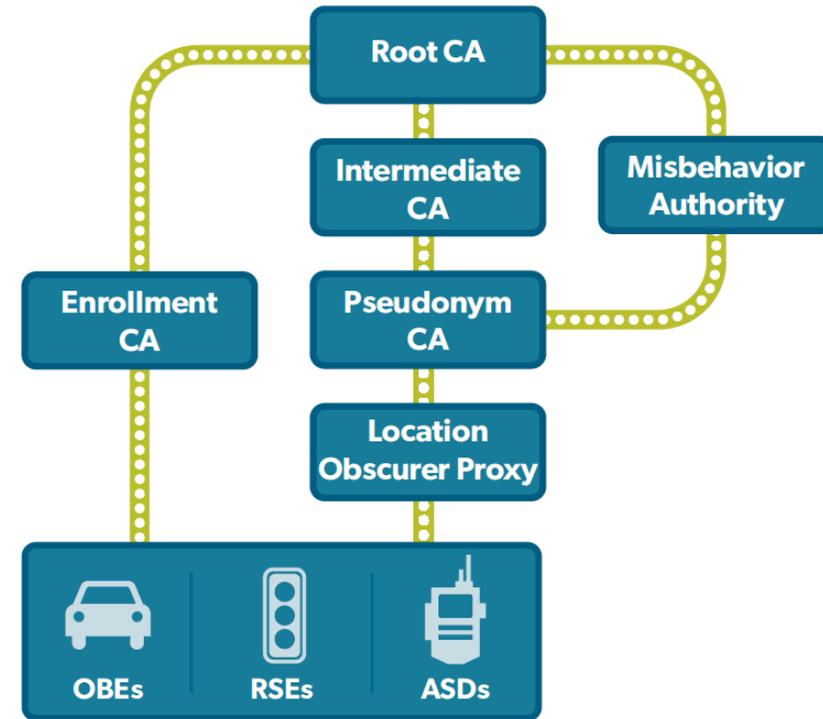
## ▪ Highly Tailored Form of Security

- IEEE 1609.2 Credentials—very low overhead to support authentication from nearby vehicles, infrastructure, and devices up to 10x per second
- Service Specific Permissions
- Security Credential Management System (SCMS)

## ▪ Misbehavior Detection

- Local—devices detect malicious behavior (i.e., spoofing) or failing devices and do not authenticate messages and report problem certificates to local devices
- Global—devices report to SCMS which can revoke certificates

## SIMPLIFIED SCMS ARCHITECTURE DESIGN



## ▪ Strong Privacy Protection

- Randomization of credentials
- Change-out at a minimum of 5 minutes / refresh batches every few weeks or months



# Back-Up Slides

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# Key Performance Metrics Questions

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Testing will examine critical, edge use cases involving 250 devices on a test track with vehicles moving at high speeds and will address the following questions:

- Does LTE-C-V2X conclusively support crash-imminent safety applications in non-network connected V2V mode?
- What is required to prevent interference:
  - Within and between LTE-C-V2X channels?
  - Between LTE-C-V2X and DSRC devices operating on the same channel?
  - Between LTE-C-V2X and DSRC channels?
- Are there LTE-C-V2X performance gaps in high device density scenarios?
- At what level is interoperability possible between LTE-C-V2X and DSRC or among devices from different LTE-CV2X vendors?
- Are the laboratory results able to be validated through field-testing?



# Background: What are V2X Communications?

- Vehicle-to-Everything (V2X) technology is direct, device-to-device wireless messaging between vehicles, infrastructure and mobile devices—and uses 75 MHz of spectrum located at 5.9 GHz (termed the Safety Band) to support safety communications.
- Direct communications between devices (no cell tower needed).
- Machine-to-Machine communications:
  - Vehicle-to-Vehicle or V2V
  - Vehicle-to-Infrastructure or V2I
  - Vehicle-to Everything (V2X) i.e., portable devices for pedestrians (vehicle-to-pedestrian, V2P) or vulnerable road users.



# Infrastructure and Vehicle Density

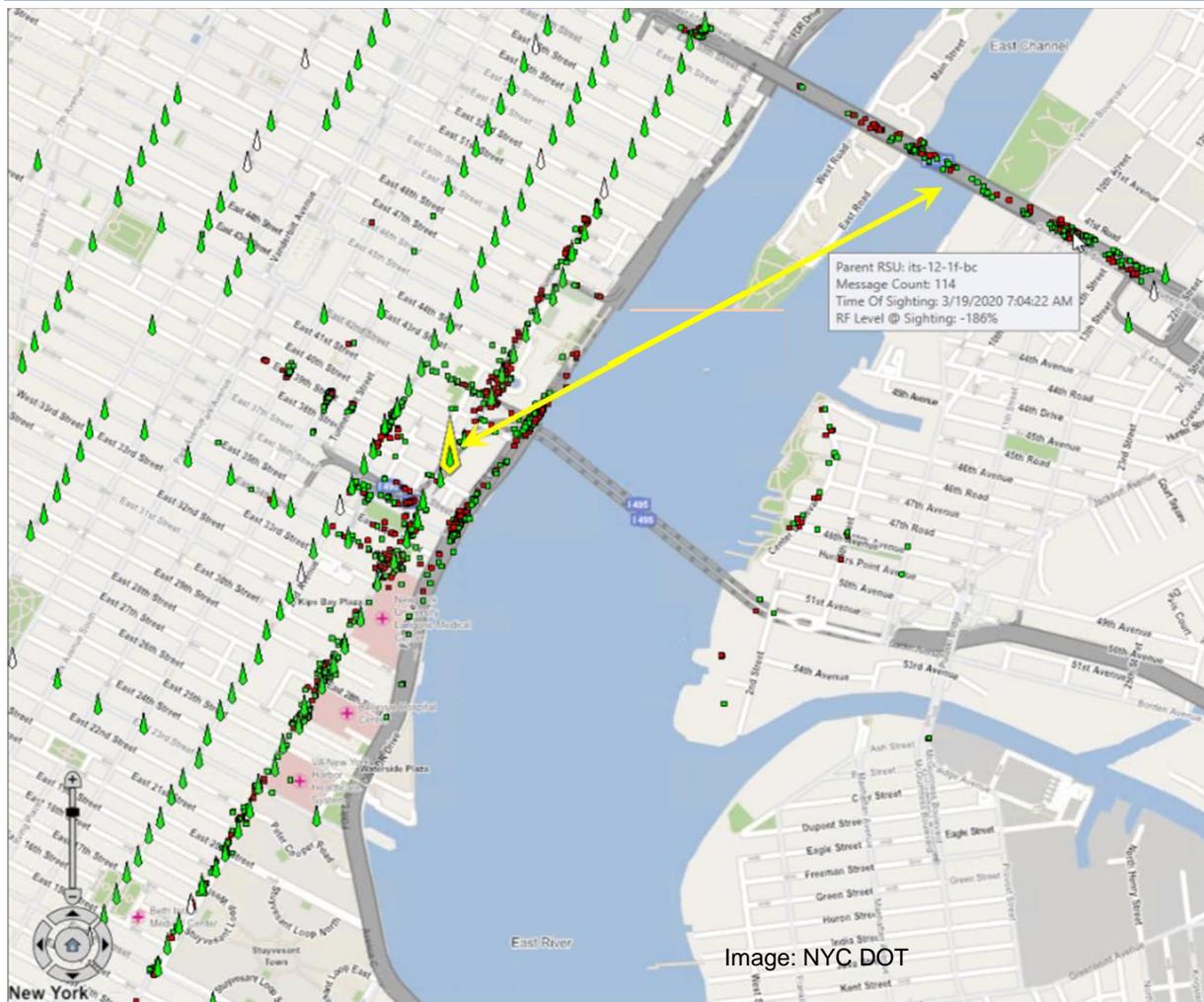


Image: NYC DOT



Image: LA DOT

