V2X Summit Speaker

Brian Cronin

Director
Office of Safety and Operations
Research and Development
Federal Highway Administration

U.S. Department of Transportation
Federal Highway Administration

Turner-Fairbank Highway Research Center

CARMA

Connectivity for a Safe, Efficient, Equitable, and Resilient Transportation System

Brian Cronin

Federal Highway Administration (FHWA)

August 24, 2022

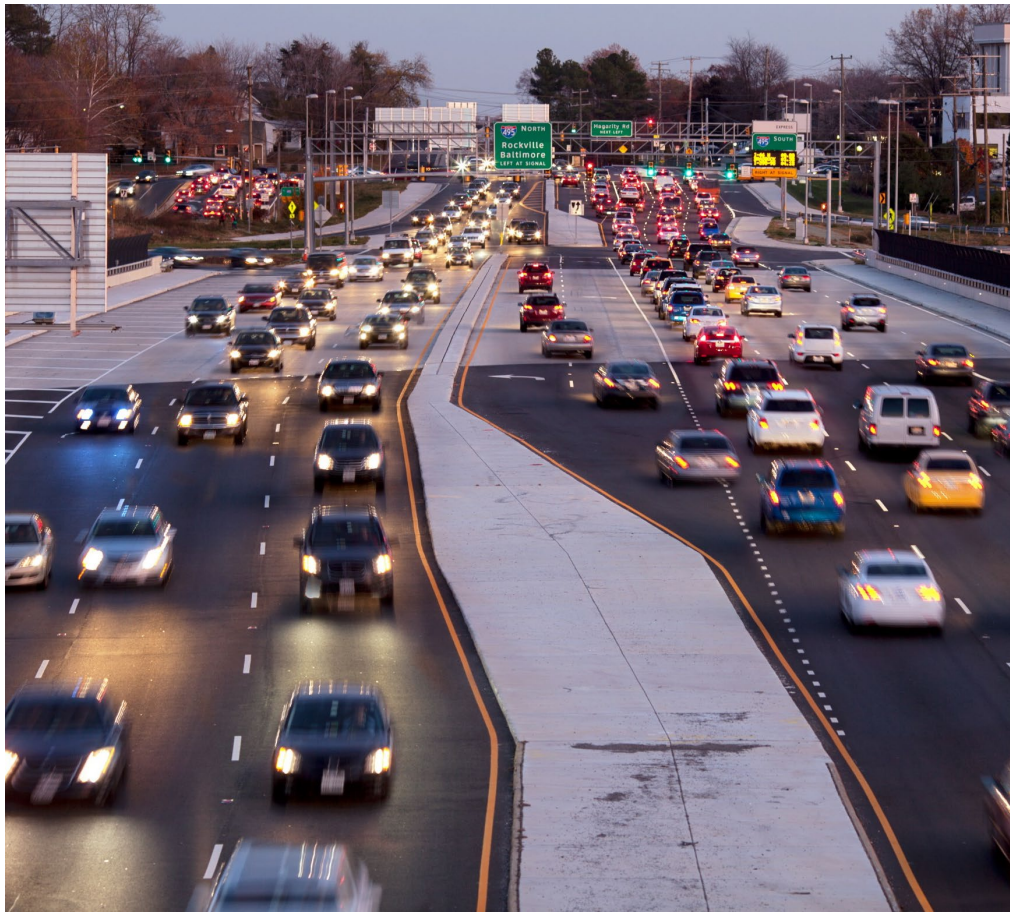
Top left: © 2016 Sportpoint / iStock. Top right and bottom photos source: FHWA.

What Is Our Role?

The industry is actively delivering new technologies—that are designed to work independently—to the transportation system.

Without cooperation from infrastructure and road users beyond just automated vehicles, these technologies will not be optimized for greater safety and efficiency.

THIS IS OUR ROLE.



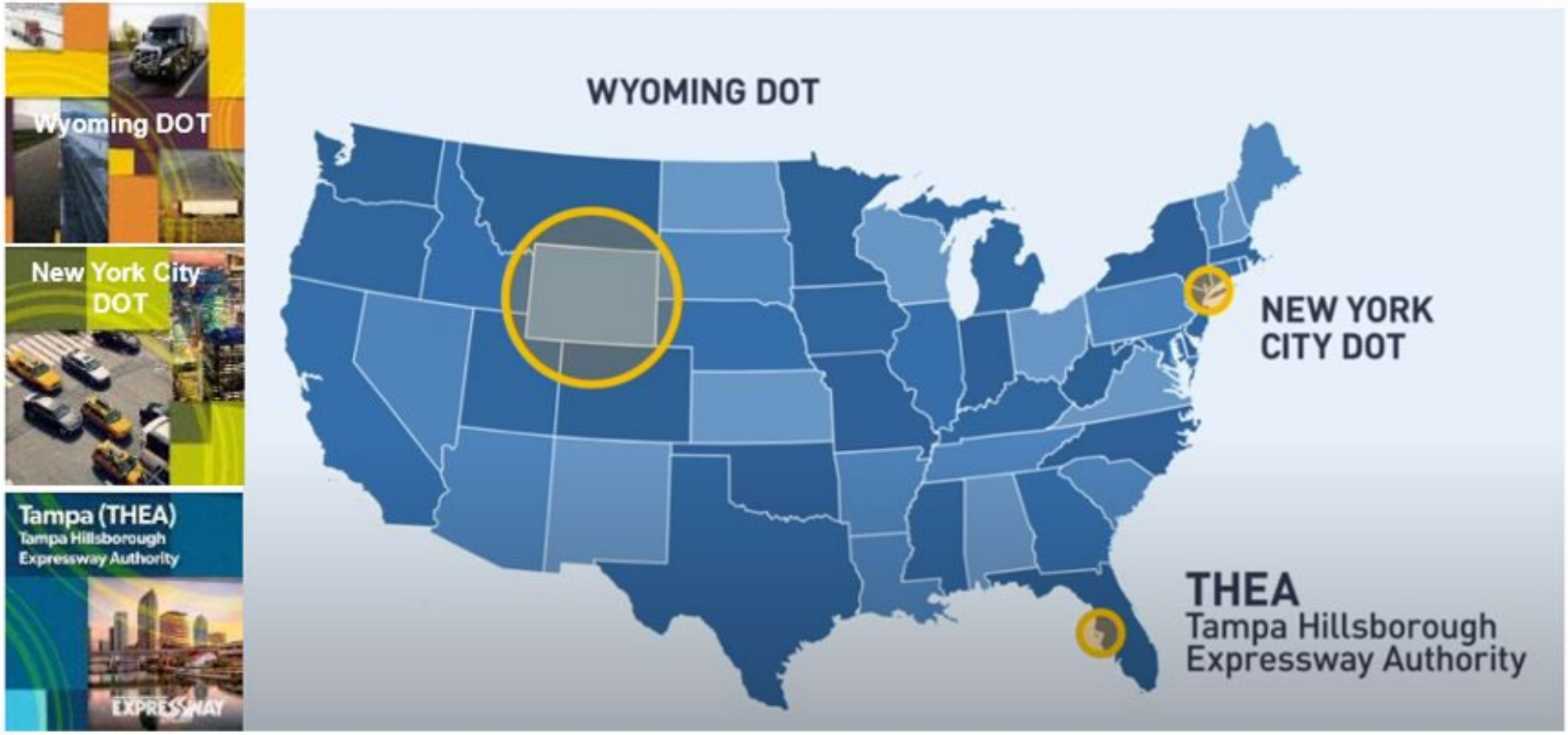
© Getty Images.

Major Efforts Completed

- Connected Vehicle (CV) Pilot deployment projects.
- Connected intersections (red light violation warning).
- MAP guidance/emerging standards.
- Security credentialing management systems.
- Work zone data exchange.

Happening in the middle of spectrum uncertainty.

CV Pilot Sites: 2015–2022



Source: USDOT.

DOT = department of transportation.

Overview of Pilot Deployment CV Applications

Category	WYDOT—CV Application
V2V Safety	Forward Collision Warning (FCW)
V2I/I2V Safety	I2V Situational Awareness[1,2]
V2I/I2V Safety	Work Zone Warnings[1]
V2I/I2V Safety	Spot Weather Impact Warning[1]
V2I and V2V Safety	Distress Notification[2,3]

Category	Tampa (THEA)—CV Application
V2I Safety	End of Ramp Deceleration Warning[2]
V2I Safety	Wrong Way Entry[2]
V2I Safety	Pedestrian Collision Warning
V2V Safety	Emergency Electronic Brake Lights (EEBL)
V2V Safety	FCW
V2V Safety	Intersection Movement Assist (IMA)
V2V Safety	Vehicle Turning Right in Front of a Transit Vehicle
Mobility	Intelligent Traffic Signal System
Mobility	Transit Signal Priority

[1]These applications have mobility/efficiency as a secondary benefit.

[2]*These applications do not directly map to any of the USDOT-sponsored applications.*

[3]*These applications work partially or exhibited inconsistent performance or anomalies.*

Category	NYCDOT—CV Application
V2I/I2V Safety	Speed Compliance
V2I/I2V Safety	Curve Speed Compliance
V2I/I2V Safety	Speed Compliance/Work Zone
V2I/I2V Safety	Red Light Violation Warning
V2I/I2V Safety	Oversize Vehicle Compliance[2]
V2I/I2V Safety	Emergency Communications and Evacuation Information
V2V Safety	FCW
V2V Safety	EEBL
V2V Safety	Blind Spot Warning[3]
V2V Safety	Lane Change Warning/Assist
V2V Safety	IMA
V2V Safety	Vehicle Turning Right in Front of Bus Warning[3]
V2I/I2V Pedestrian	Pedestrian in Signalized Crosswalk[3]
V2I/I2V Pedestrian	Mobile Accessible Pedestrian Signal System[3]
Mobility	Intelligent Traffic Signal System

I2V = infrastructure-to-vehicle; NYCDOT = New York City DOT; V2I = vehicle-to-infrastructure; V2V = vehicle-to-vehicle; WYDOT = Wyoming DOT.

Current Number of CV Deployments

Type of Development	Planned Sites	Operational Sites**	Total
Projects	101	70	171
Vehicle-Based Devices*	3,743	20,174	23,917
Infrastructure	3,627	9,648	13,275

*Includes aftermarket devices.
**Includes devices in phased deployments.

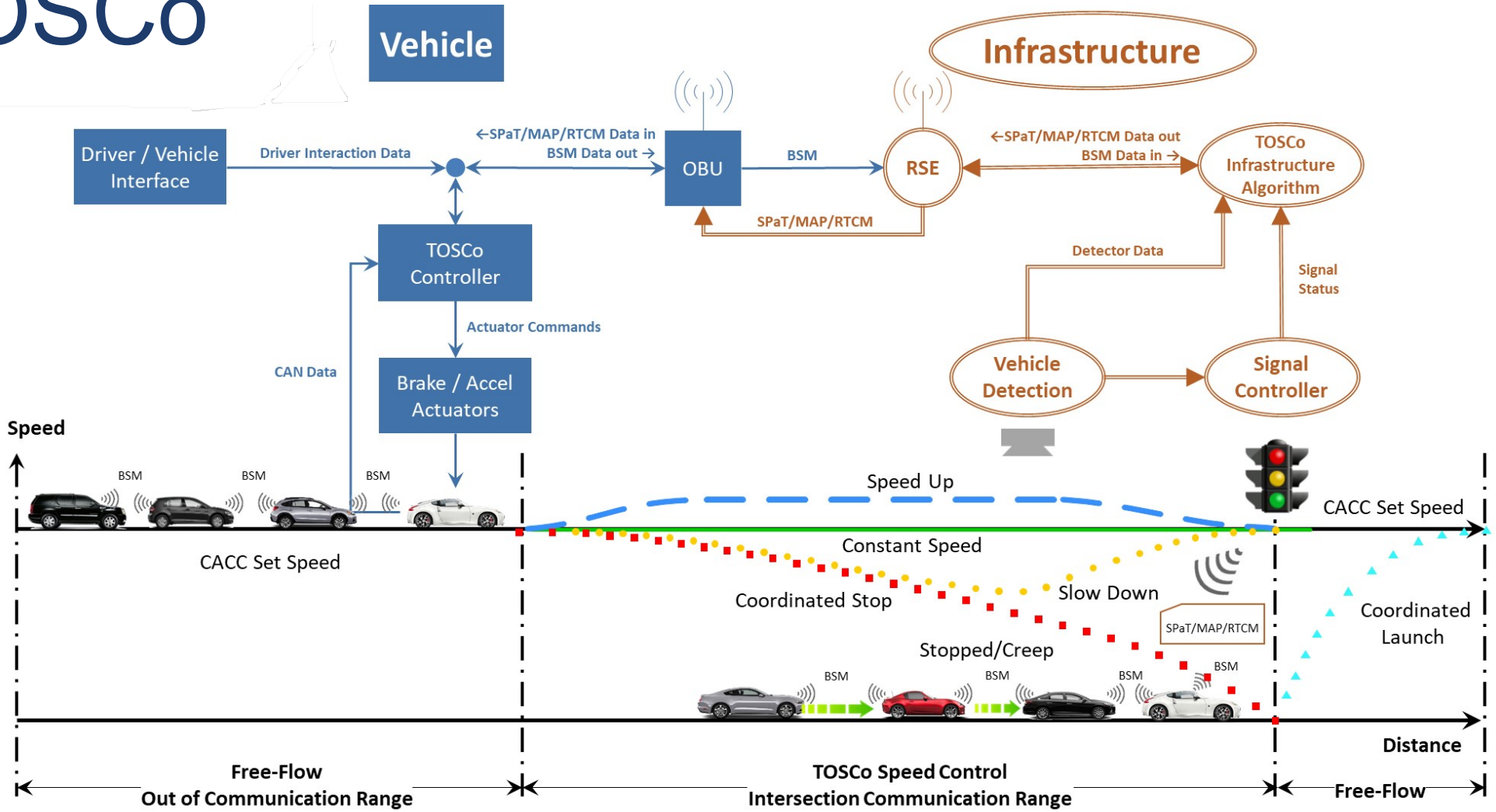
The project information was gathered by the Volpe National Transportation Systems Center from publicly available materials as of June 2022 and is subject to change.

Merging Connected and Automated Vehicles

- Industry establishes level 1 and 2 systems[1] on the market as a catalyst.
- FHWA launches level one connected and automated research:
  - GlidePath (light vehicles through intersections).
  - Cooperative adaptive cruise control (CACC) (light vehicles in platoons).
  - Traffic optimization for signalized corridors (TOSCo) (light vehicles in platoons on arterials).
  - Truck platooning.
  - CARMA integrated highway prototype.

[1]SAE International. 2021. *Recommended Practice: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles.* SAE J3016™-202104, 2021-04-30 revision. Warrendale, PA: SAE International.

TOSCo



Accel = accelerate; BSM = basic safety message; CAN = controller area network; OBU = onboard unit;
RSE = roadside equipment; RSM = roadside safety message; RTCM = Radio Technical Commission for Maritime Services.

© Crash Avoidance Metrics Partners, LLC.

Early Industry Adoption of Level 4 Automation

The automotive industry has begun to investigate the possibility of level 4 automated vehicles[1] and discovered challenges with dynamic roadway environments:

- Lane closures.
- Speed limit changes.
- Traffic signal timing pattern changes.

© kozmoat98, iStock/Getty Images Plus.

[1]SAE International. 2021. *Recommended Practice: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles.* SAE J3016™-202104, 2021-04-30 revision. Warrendale, PA: SAE International.

2020–2022: Changing Transportation System

- Pedestrian fatality crisis.
- Work zone fatality crisis.
- Speed increase.
- Equity.
- Climate.
- Workforce development.

Advance Safety Through Connectivity: Cooperative Perception (CP)

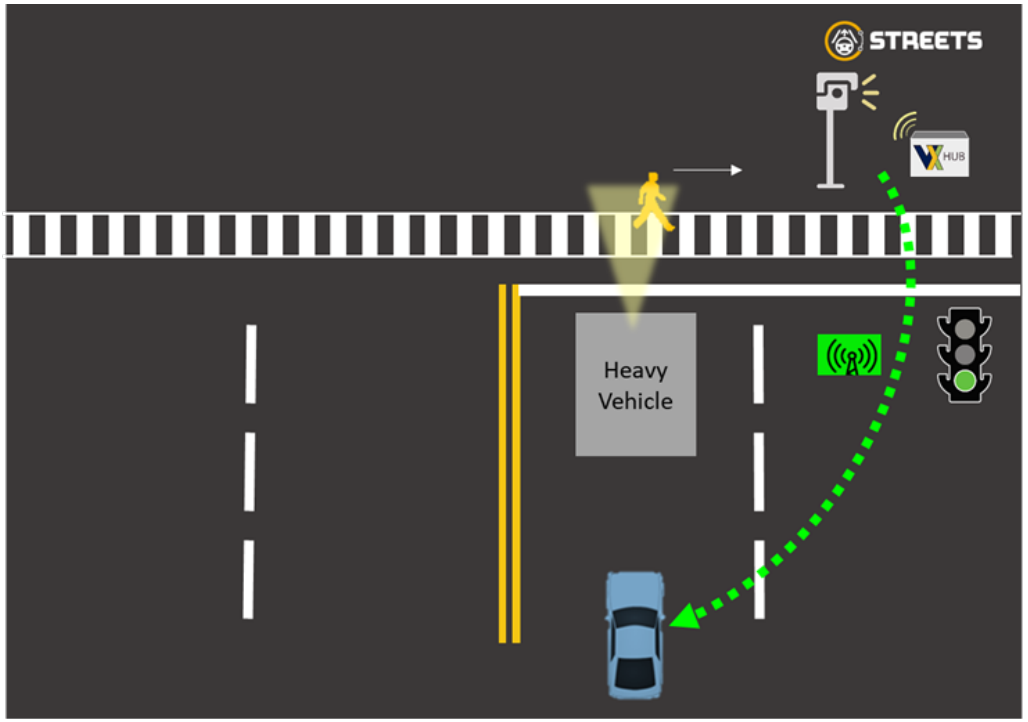
Roadway and infrastructure entities share perception data about the driving environment for improved situational awareness, with applications in:

- Immediate collision avoidance, especially for vulnerable road users.
- Safer trajectory planning.
- Path and trajectory planning for improved mobility and energy performances.

Cooperative Driving Automation CP

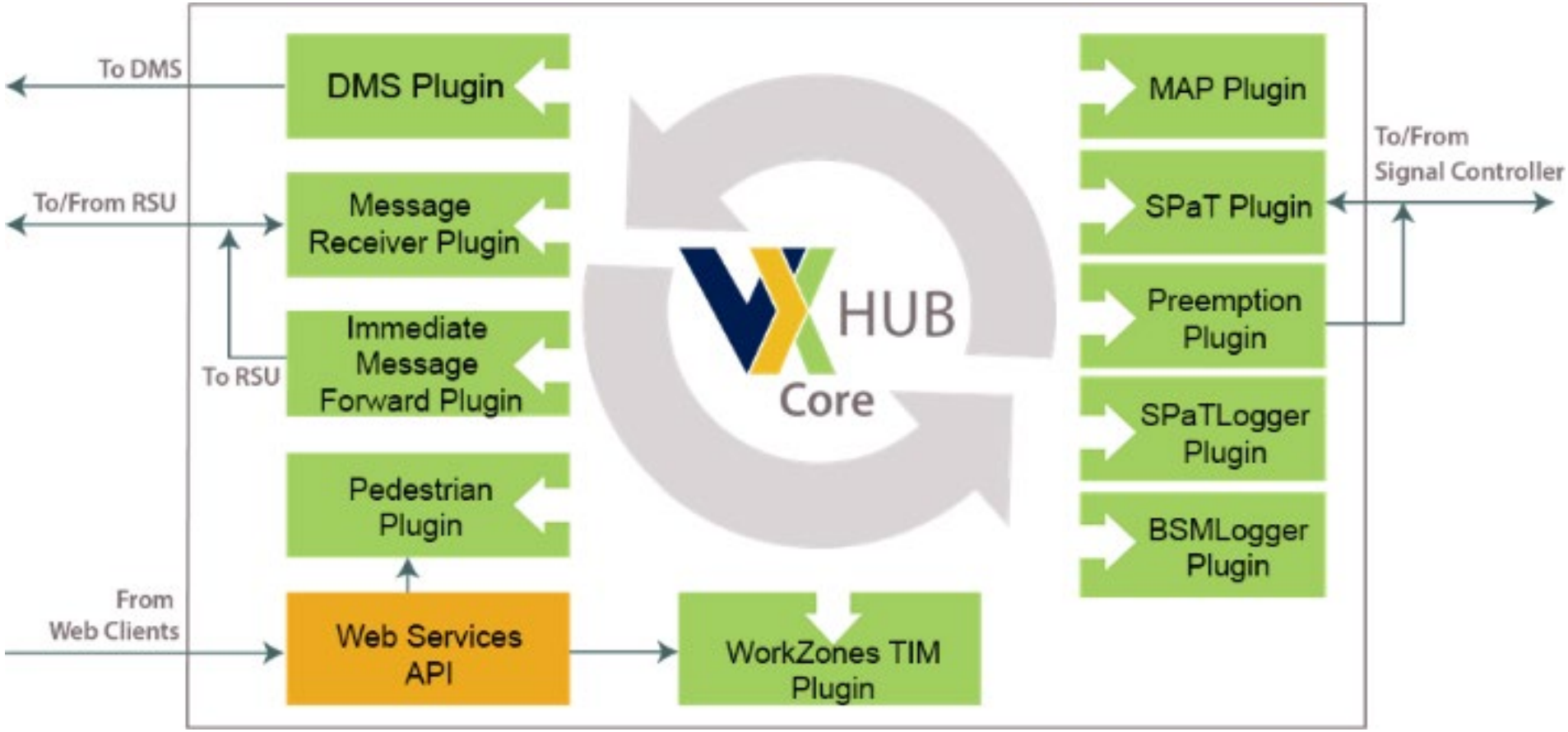
Development work is underway for a proof-of-concept CP demonstration using infrastructure-based sensing.

Source: FHWA.



Source: FHWA.

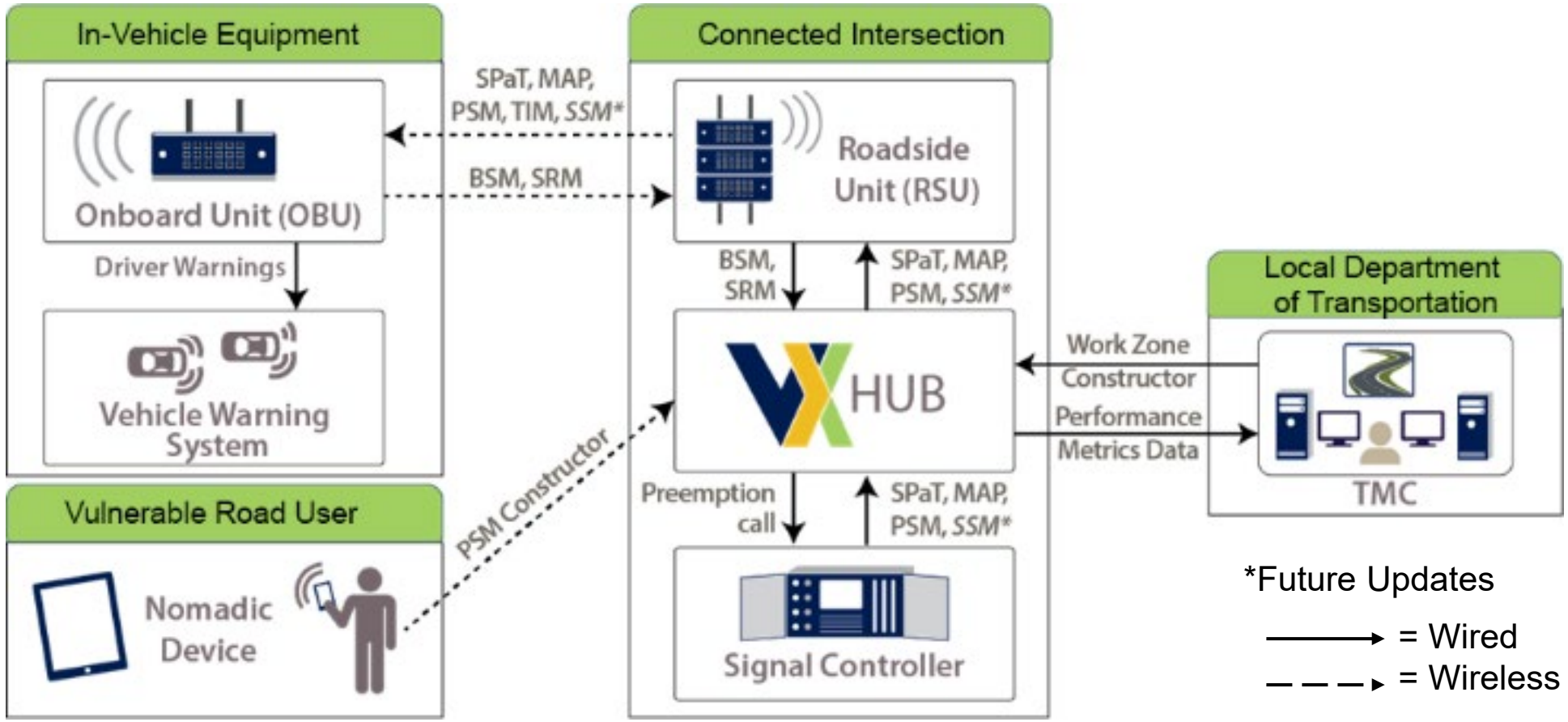
Vehicle-to-Everything (V2X) Hub Plugins Overview



Source: FHWA.

API = application programming interface; DMS = dynamic message sign; MAP = map data; RSU = roadside unit; TIM = traveler information message.

V2X Hub in Intelligent Transportation System



PSM = personal safety message; SRM = service request message; SSM = signal status message; TMC = traffic management center.

Source: FHWA.

Workforce Development: CAVe-In-A Box and CARMA 1Tenth

Mobile Kit

Source: FHWA.

Infrastructure Kit

Source: FHWA.

Source: FHWA.

CONNECTED AND AUTOMATED VEHICLES SUPPORT SERVICES

Source: FHWA.

CAVe = connected and automated vehicle education.

Contact

Brian Cronin

brian.cronin@dot.gov

(202) 493-3269

U.S. Department of Transportation
Federal Highway Administration

cda | CARMA

Turner-Fairbank
Highway Research Center

© Peeterv / iStock.

Disclaimer

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this presentation only because they are considered essential to the objective of the presentation. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.