The Role of Interoperable Connectivity (V2X) in the CAV EcoSpace

April 26, 2024

Maryland CAV Working Group Meeting

U.S. Department of Transportation

Overview

- What is Interoperable Connectivity (V2X)
- Benefits of V2X
- Technologies in Today's Vehicles
- Value of V2X in Addressing Challenges
- USDOT Program Resources

Interoperable Connectivity (V2X)

Source: U.S. DOT

Technology that saves lives and enhances safety and mobility by enabling transportation system users (including vehicles, transit, pedestrians, cyclists, etc.) to communicate with each other, and with the roadside infrastructure.

What Are the Benefits of V2X?

Safety

Mobility

Environment

"Not only does V2X technology save lives, but it also enhances mobility, bolsters efficiency, and reduces negative environmental impacts."

– *Draft National V2X Deployment Plan*

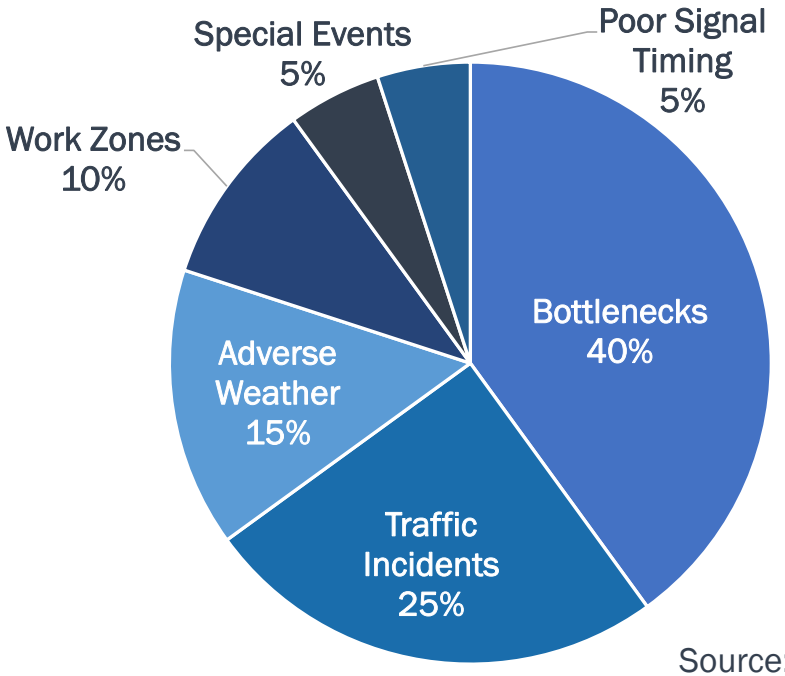
The Safety Problem

- **118 people die** on our roadways every day.
- Roughly **one–quarter of traffic fatalities** and about one–half of all traffic injuries in the U.S. **are at intersections.**
- **Pedestrian and cyclist fatalities** totaled 8,952 (a 2.3% increase from 2021 to 2022).
- The fatality rate is **1.7 times higher in rural areas** compared to urban areas.

Mobility Challenges

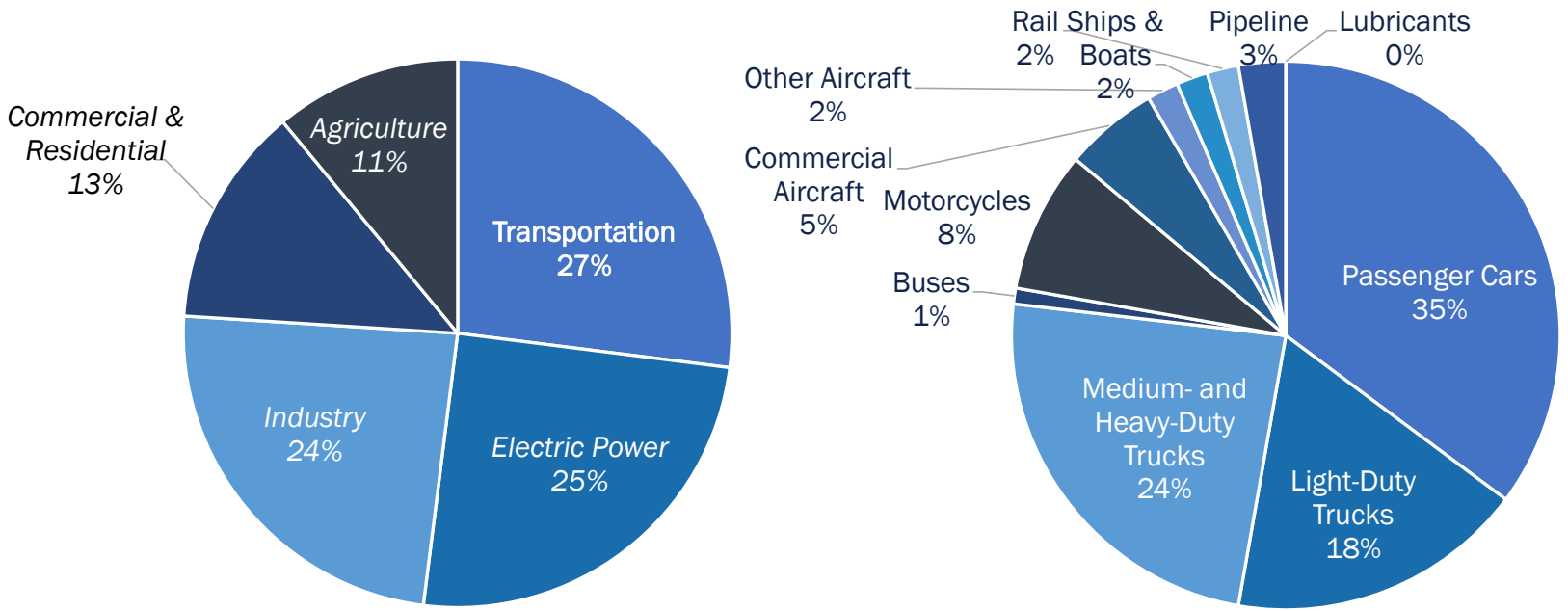
In 2022, traffic congestion led to:

- 51 hours lost in congestion (typical driver) which cost the average driver $869 in lost time (2022 INRIX Traffic Scorecard)
- $81 billion in economic cost to the country (2022 INRIX Traffic Scorecard)
- Increased traffic incidents



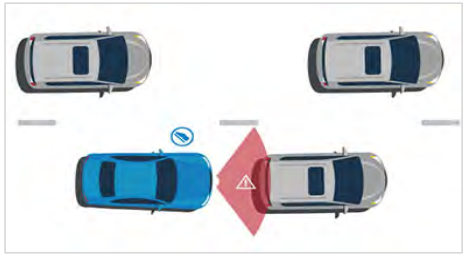
Source: U.S. DOT

Environmental Challenges



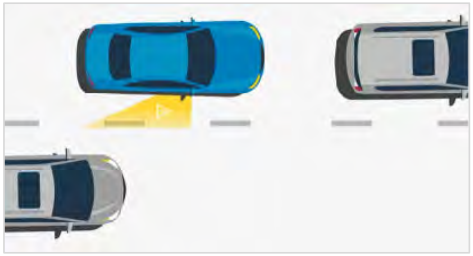
Total U.S. Greenhouse Gas Emissions by Economic Sector in 2020 (left) and Transportation-Related GHG Emissions (right) - Source: EPA

Technologies in Today's Vehicles

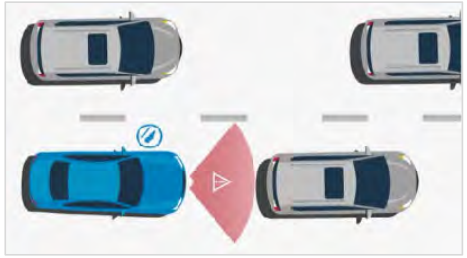


Forward Collision Warning

Lane Departure Warning

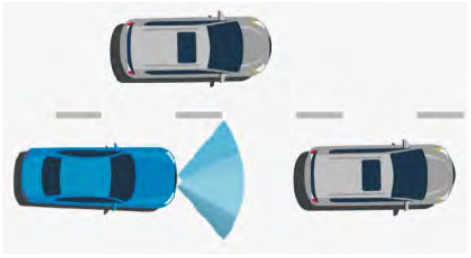


Blind Spot Warning



Automatic Emergency Braking

Pedestrian Automatic Emergency Braking



Adaptive Cruise Control

Technologies in Today's Vehicles

Navigation Systems and Smartphone Applications

- Include real-time information about congestion, incidents, and events; data can be crowdsourced.
- New systems better integrate smartphones in today's vehicles.

Vehicle OEM Data

- Allow access to a plethora of data points generated from the sensors within the car.
- Third-party data aggregators are making these data available to public agencies.

Our Challenges Still Exist

- Even with these technologies, we continue to experience safety, mobility, and environmental challenges
- Why?
- What can we do to further address today's transportation challenges?

Vehicle-to-Everything (V2X)

Vehicle-to-Everything (V2X) is a generic term that covers data communications between vehicles, to and from infrastructure systems, and to pedestrians.

- Vehicle-to-Vehicle (V2V) enables vehicles to wirelessly exchange information about their speed, location, and heading
- Vehicle-to-Infrastructure (V2I) enables vehicles to communicate with infrastructure (roadside units connected to TMCs, traffic signals, etc.)
- Vehicle-to-Pedestrian (V2P) enables vehicles to communicate with pedestrians, bicyclists, wheelchair users, etc.

Example V2X Equipment

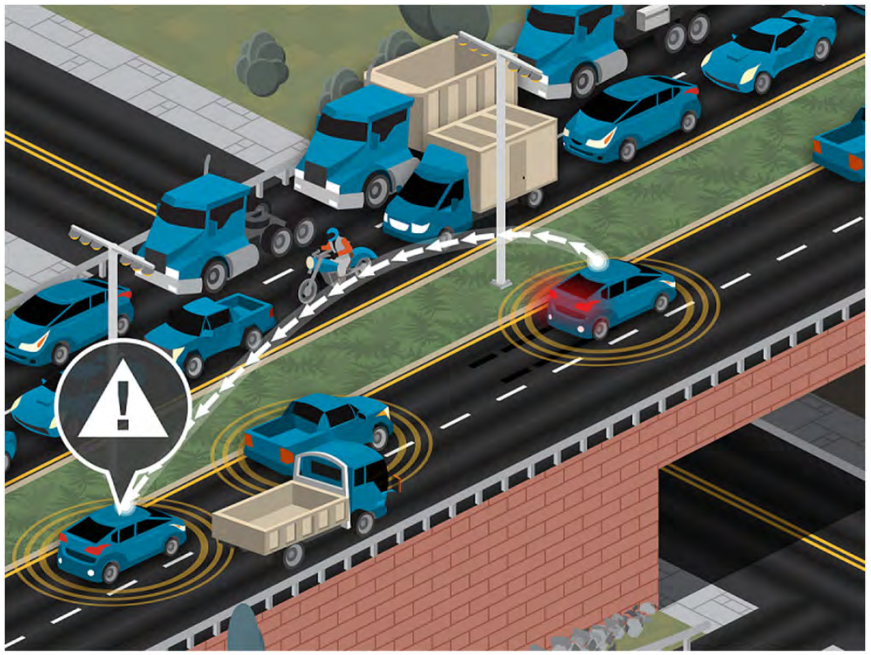
Roadside Unit (RSU)

On-board Unit (OBU)

Human Machine Interface (HMI)

Source: U.S. DOT

Vehicle-to-Vehicle (V2V) Example



Source: U.S. DOT

Emergency Electronic Brake Light (EEBL) Warning

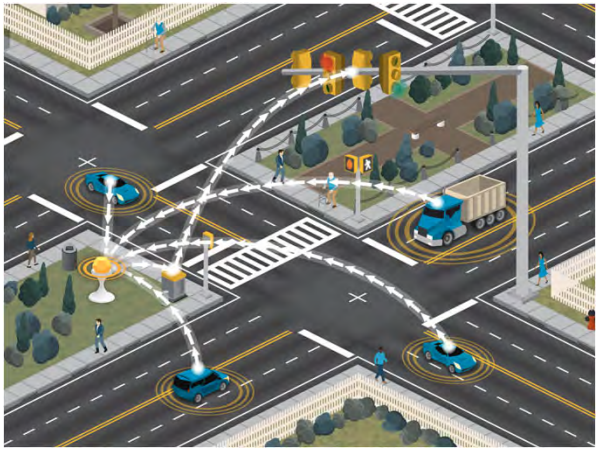
- Presents alerts to the driver of hard braking in the traffic stream.
- By providing these alerts in advance, the driver has additional time to look for and assess situations developing ahead.
- Provides additional safety benefits beyond current sensor-based forward collision warning technologies in today's vehicles.

Vehicle-to-Infrastructure (V2I) Examples

Source: U.S. DOT

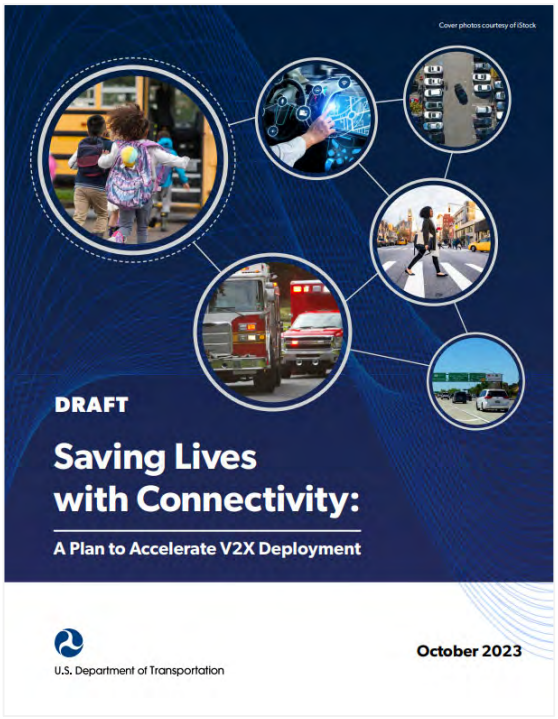
Signal Priority and Signal Preemption

Red-Light Violation Warning



Intelligent Traffic Signals

DRAFT National V2X Deployment Plan



- Defines USDOT's vision, mission and goals for V2X deployment
- Identifies short, mid-term and long-term key milestones and targets for deployment for private sector and public agencies
- States specific actions needed across stakeholder groups
- Summarize resources and assistance available
- Reduce uncertainty

https://its.dot.gov/research_areas/emerging_tech/pdf/Accelerate_V2X_Deployment.pdf

Stakeholder Involvement

Achieving a national, interoperable transportation system requires *collective action* from both public and private sectors

U.S. Department of Transportation

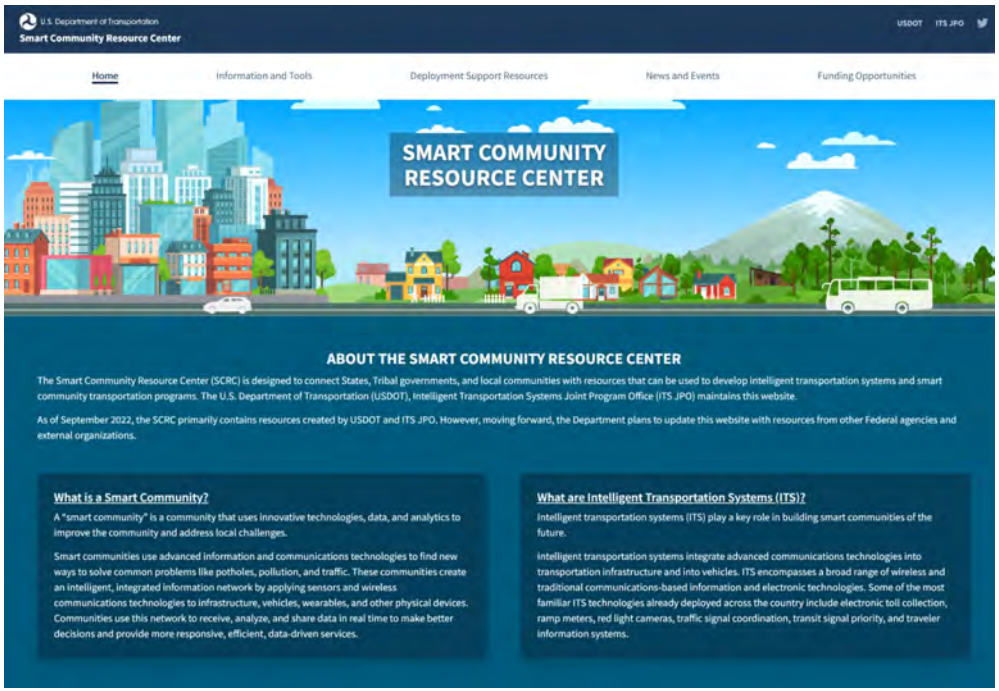
USDOT-Sponsored Activities and Resources

Technical	Stakeholder Engagement	Professional Capacity Building
V2X Mapping Tool	V2X Summits	Smart Community Resource Center
Open Source Connected Vehicle Tools	Support of Working Groups, including Connected Vehicle Pooled Fund Study	Equipment Loan Program and Help Desk
ITS Standards and Architecture	Coordination with USDOT modal administrations and federal agencies	Training and Supporting Materials
USDOT Spectrum Team	Coordination with Deployers and NTIA/FCC	Accelerating V2X Cohort
V2X Deployer Resources *(anticipated early 2024)*	Engagements with Key Industry Associations	Documented Best Practices

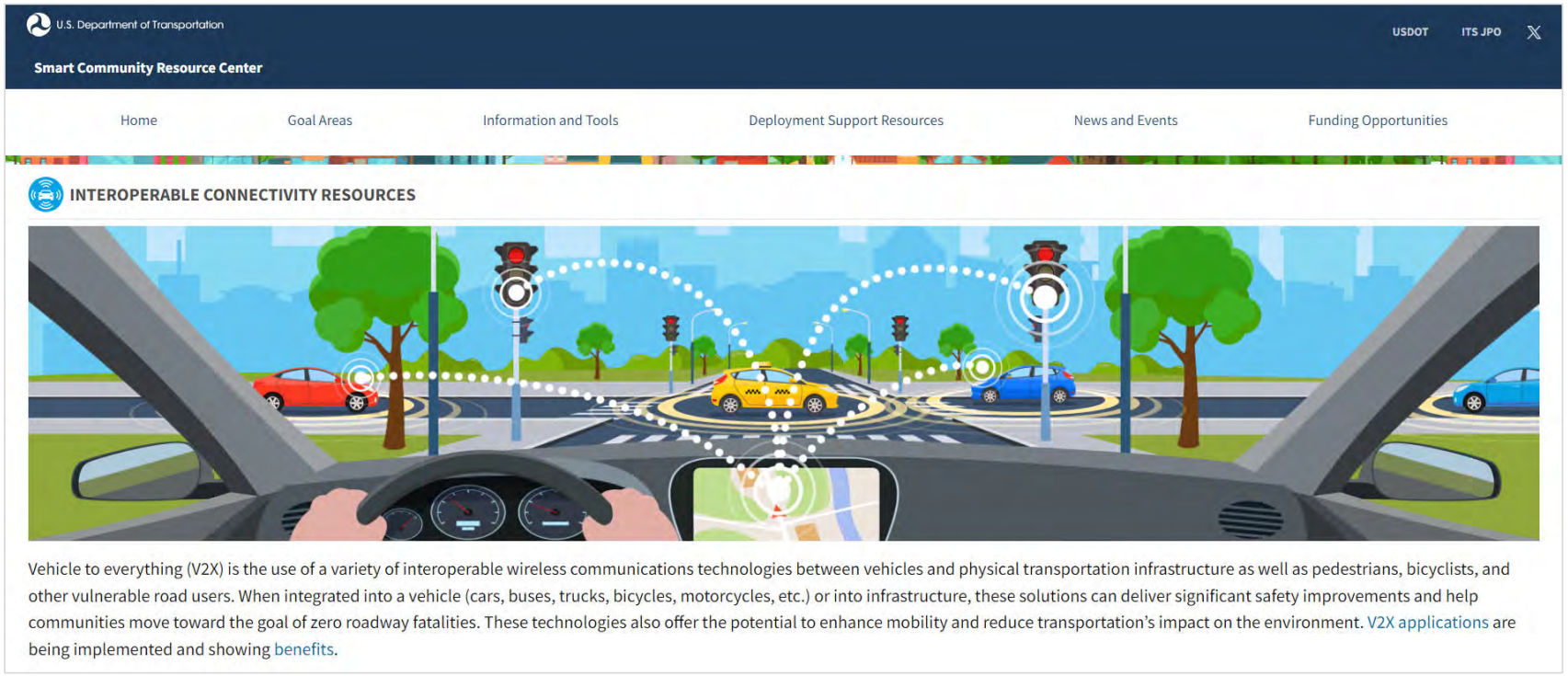
Smart Community Resource Center (SCRC)

- Online resource supporting information sharing and technical assistance related to ITS and Smart Community deployments
- The site will evolve over time to continue being a source of current information, data and tools to support ITS investments

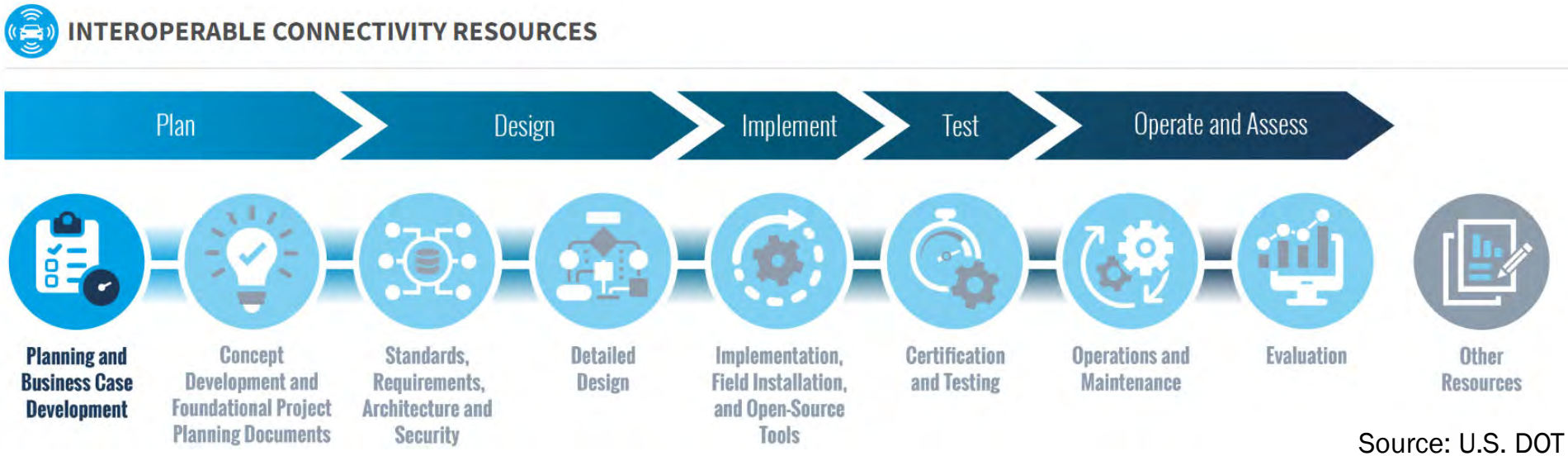
www.its.dot.gov/scrc



SCRC: V2X Page



Interoperable Connectivity (V2X) Resources



Source: U.S. DOT

www.its.dot.gov/scrc/index.html#/ic

V2X Tools and Technical Assistance

- Open-Source Tools
  - V2X Hub, MAP Creation Tool, TIM Tool, Operational Data Exchange (ODE)
- Equipment Loan and Help Desk
  - Roadside Units (RSUs)
  - Onboard Units (OBUs)
  - Packet Sniffers
  - Signal Phase and Timing (SPaT) and MAP Message Test Devices
  - Spectrum Analyzer

For more information, contact:
CAVSupportServices@dot.gov

V2X and CDA Educational Tools

- CAVe-in-a-Box is an interactive learning tool that practitioners and researchers can use to experience connected (CAV) technologies like C-V2X radios, traffic control devices, networking equipment, and the CAV software stack.
- The CDA1Tenth Program expands access to affordable, open-source technologies of cooperative driving automation (CDA) to advance researchers' and students' expertise.

V2X Trainings

Foundational Track

- The Case for Interoperable Connectivity (V2X)
- V2X Basics
- USDOT V2X Technical Assistance Resources

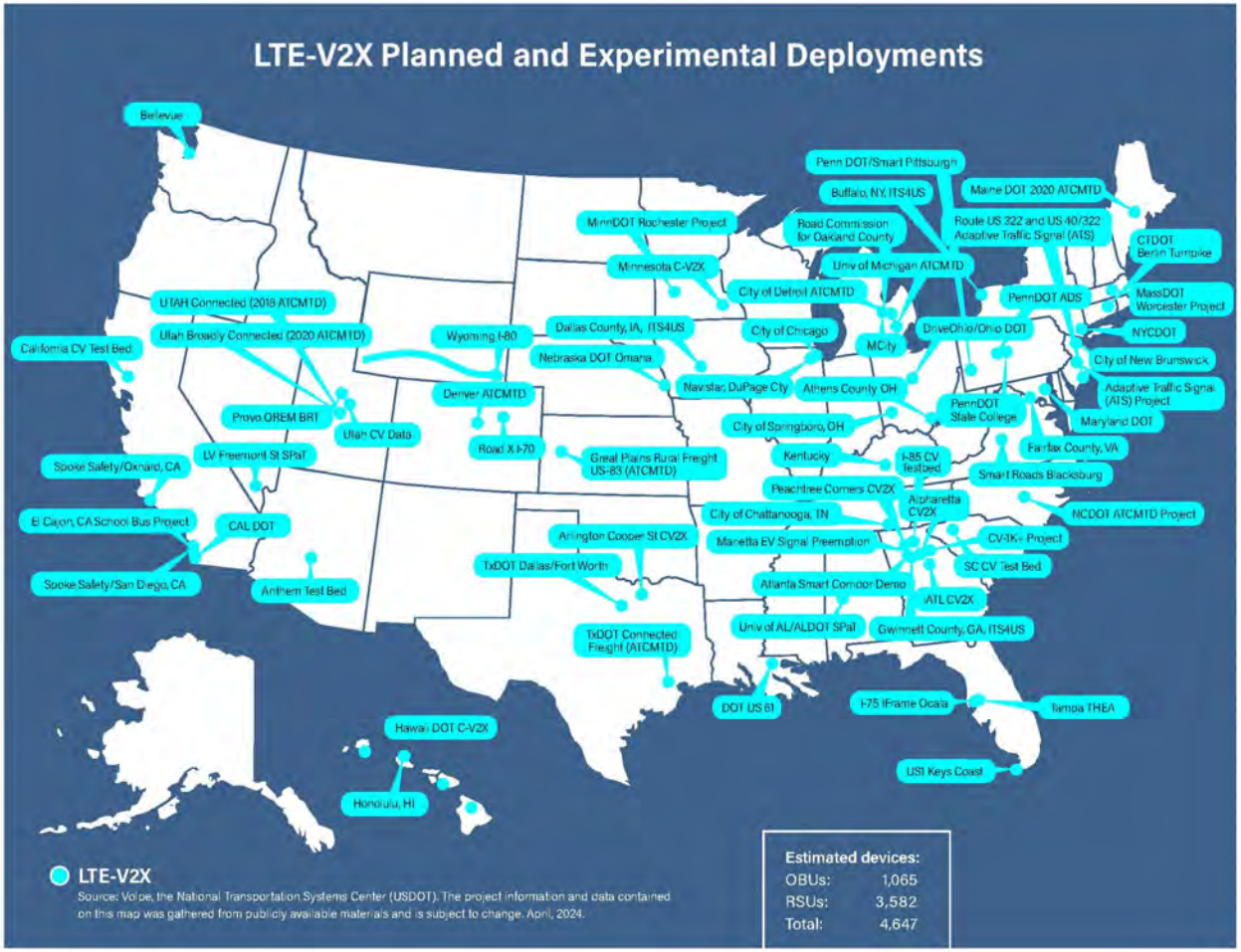
Planning and Systems Engineering Track

- Incorporating V2X into the Transportation Planning Process
- The Business Case for V2X
- Concept Development and Foundational Planning
- Performance Measurement and Evaluation

Detailed Technical Track

- Leveraging ARC-IT and Standards for V2X
- Deploying V2X Infrastructure
- MAP and SPaT Preparation
- SCMS and Security
- Wireless Communication
- Managing V2X Data
- V2X Operations & Maintenance

Agencies are Deploying…



Source: U.S. DOT

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For More Information

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www.its.dot.gov/pcb and www.its.dot.gov/scrc/index.html#/