Connected Vehicle Pooled Fund Study

U.S. Department of Transportation Update

May 6, 2025

U.S. Department of Transportation

Photos courtesy of iStock

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Overview

1. Vehicle-to-Everything (V2X) Accelerator Program
2. V2X Technical Assistance Resources
3. Federal Communications Commission's (FCC) Final C-V2X Technical and Service Rules and Licensing Process
4. Traveler Information Message (TIM) Best Practices and Next Gen Wireless Communications Update

V2X Accelerator Program

V2X Accelerator Program Goals

Deploy, operate, and showcase integrated, advanced interoperable deployments.

02

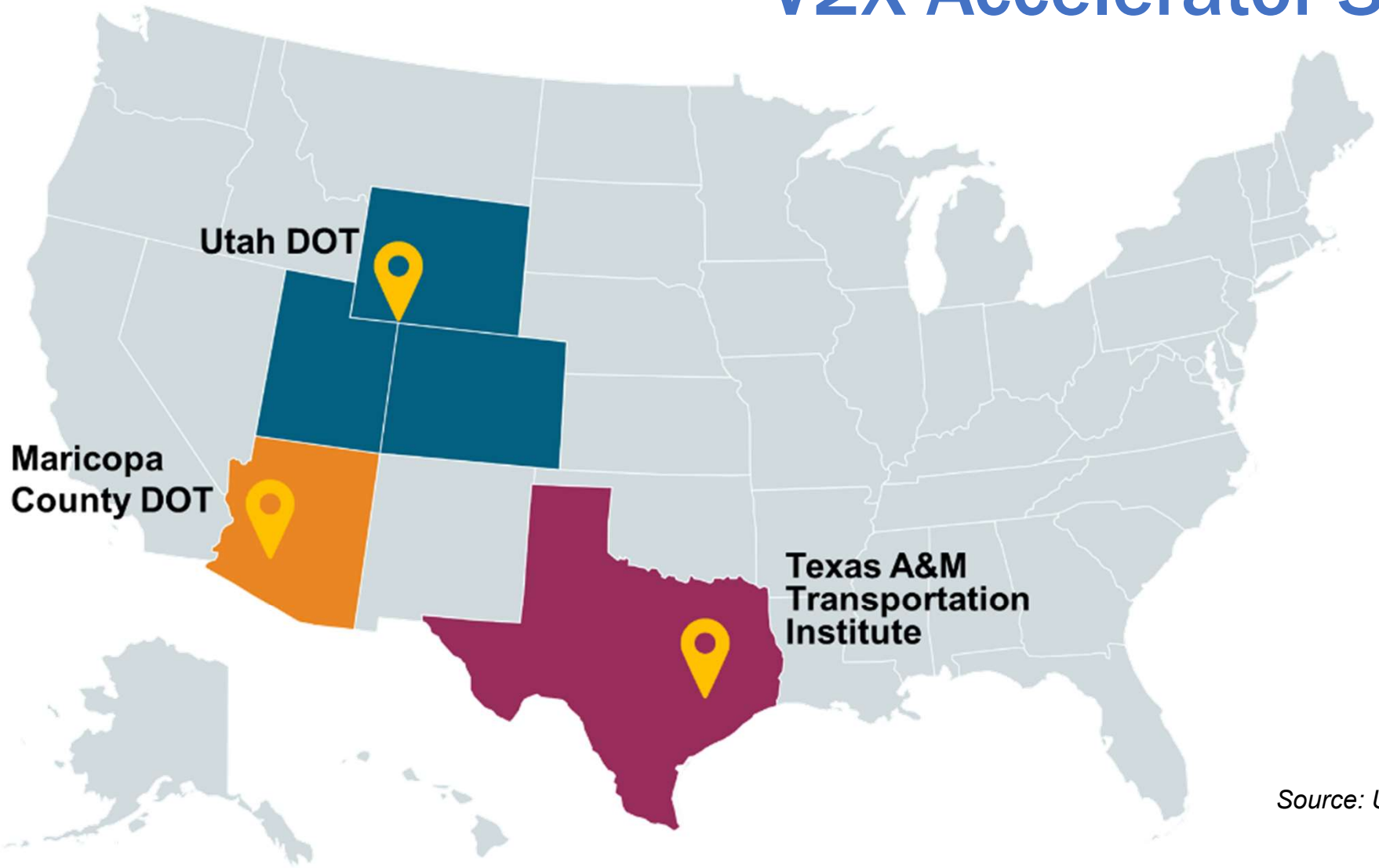
Inform and educate the ITS community and the general public regarding these impacts.

03

Support the development, evaluation, and documentation of a suitable reference implementation.

Current Structure and Phasing

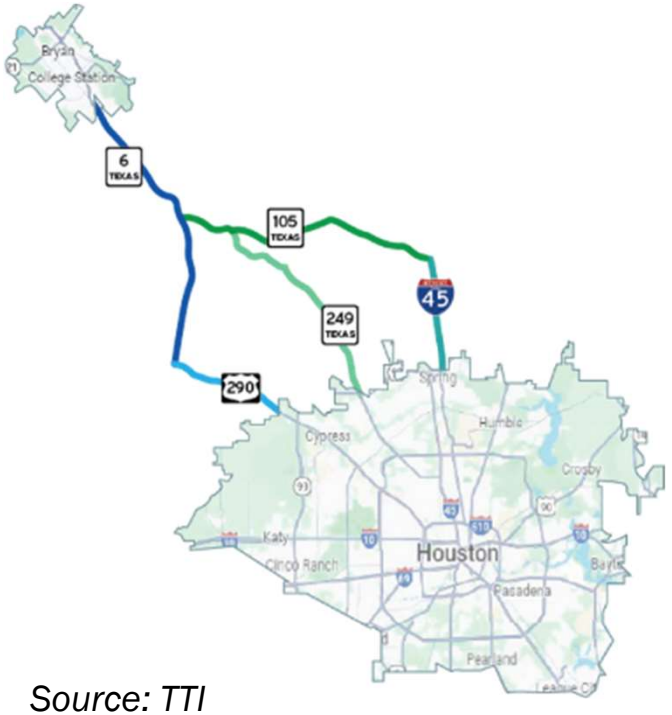
V2X Accelerator Sites



Source: USDOT

TTI Deployment Overview

- **Lead Agency:** Texas A&M Transportation Institute (TTI)
- **Total Funding:** $24.02M
- **Objective:** Address safety and mobility challenges with pedestrians, transit, emergency vehicles, construction and special event traffic, flooding, and hurricane evacuation.



Source: TTI

TTI Proposed Applications and Devices

Applications / Use Cases
• Signal Phase and Timing (SPaT)-enabled Intersections for Vulnerable Road User (VRU) Identification & Protection • Roadway Flood Warning • Right Turns on Red Warning of VRU Crossing • Red Light Violation Warning • Wrong Way Driving Detection • Emergency Vehicle Response Time & Safety • Incident Management/Hurricane Evacuation • Adverse Weather Events/Flooding • Planned Construction and Special Events • Enhanced Corridor Situational Awareness • Traffic Signal Preemption and Priority • Transit Fleet Integration • Every Day a Game Day • Enhanced Highway Construction Worker Safety • Curve Speed Warning

~1,100

Roadside Units (RSUs)

1,000+ existing and 65 new units

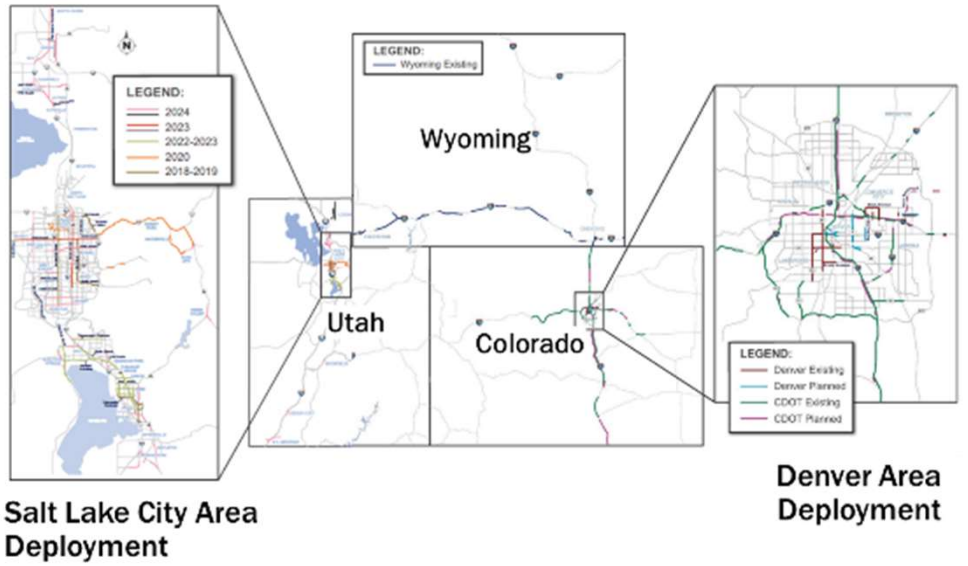
275-300

Onboard Units (OBUs)

100 fleet vehicles, 100 private vehicles, and 75-100 bicycles

Utah DOT Deployment Overview

- **Lead Agency:** Utah Department of Transportation (UDOT)
  - **Partner Agencies:** Colorado DOT (CDOT) and Wyoming DOT (WYDOT)
- **Total Funding:** $29.04M
- **Objective:** Address needs at intersections, in work zones, and along rural corridors.



Source: Utah DOT

UDOT Proposed Applications and Devices

Applications / Use Cases

- Transit Signal Priority
- Emergency Vehicle Preemption
- Snowplow Preemption
- Spot Weather Impact Warning
- Curve Speed Warning
- Traveler Information Alerts
- Vulnerable Road User Safety System
- Disabled Vehicle Alerts
- Red Light Violation Warning
- Intersection Movement Assist
- Left Turn Assist
- Wrong-Way Driving
- Traffic Jam Alert

2,437 Roadside Units (RSUs)

1,028 existing, 659 in progress, and 750 new units

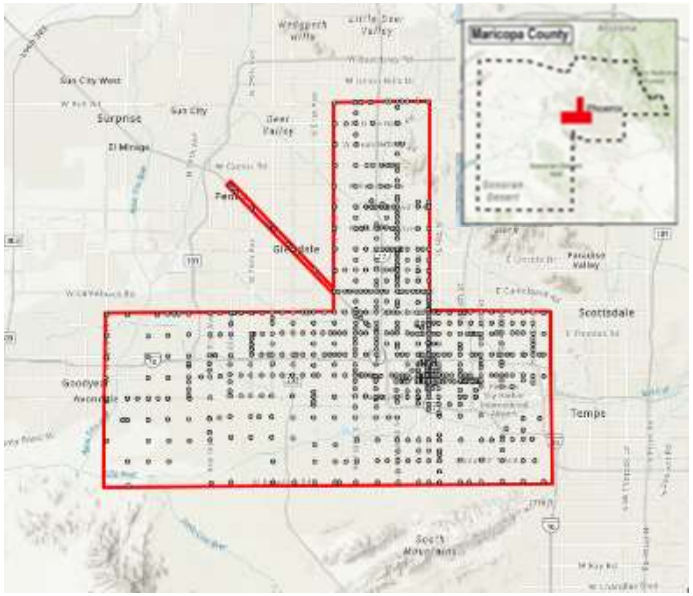
215 Onboard Units (OBUs)

115 buses, 25 snowplows, 15 emergency vehicles, 30 incident management vehicles, and 30 other fleet vehicles

20 Pedestrian Detection Systems

Maricopa County DOT Deployment Overview

- **Lead Agency:** Maricopa County Department of Transportation (MCDOT)
- **Total Funding:** $27.45M
- **Objective:** Improve the safety of vulnerable roads users as well as the efficiency of transit, emergency, and freight fleets.



Source: MCDOT

MCDOT Proposed Applications and Devices

Applications / Use Cases

- VRU Detection
- Emergency Vehicle Preemption
- Transit Signal Priority
- Freight Signal Priority

750 Roadside Units (RSUs)

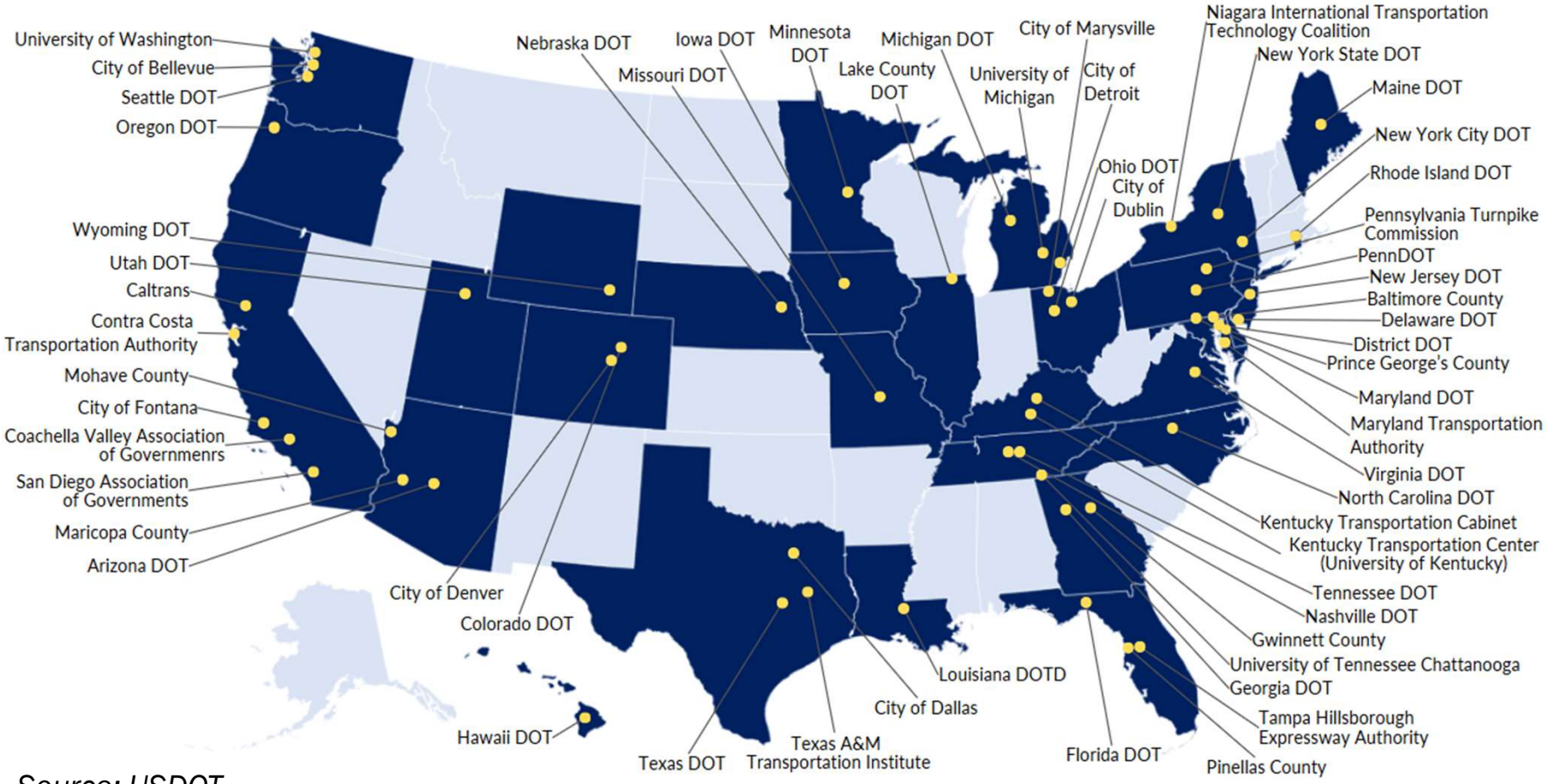
650 physical RSUs and 100 virtual RSUs

400 Onboard Units (OBUs)

All OBUs will be on fleet vehicles

V2X Technical Assistance Resources

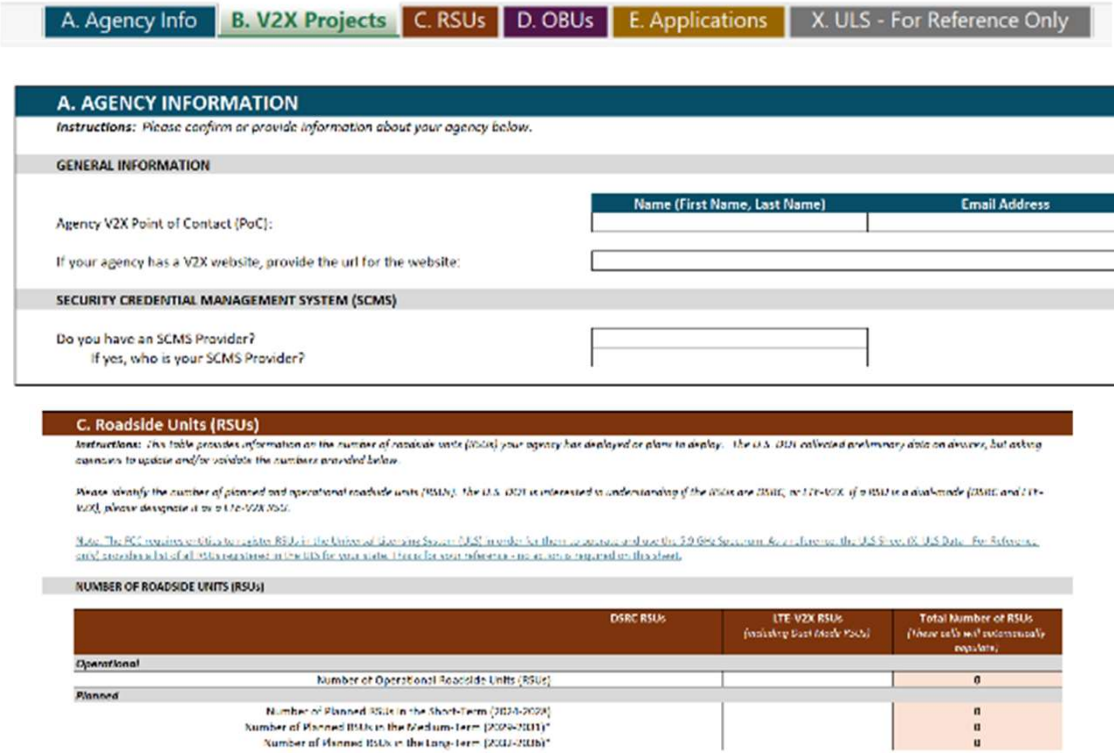
58 Cohort Members



Source: USDOT

V2X Deployment – Data Call

- Data Calls sent to each cohort members in late February to collect information about:
  - V2X Deployments
  - Number of RSUs and OBUs
  - Applications/Use Cases
- Responses are voluntary
- If you have data, and are willing to share information, contact: John.Schneeberger@dot.gov



TENTATIVE V2X Deployment Data

Note: The more responses we get from the Cohort Data Call (column ii), the more accurate the National V2X Deployment Data is (column iii)

	(i) Initial, Unverified V2X Deployment Data	(ii) Verified Data from Cohort Data Call *(a subset of all deployments)*	(iii) Tentative / Estimated National V2X Deployment Data *(Verified + Unverified Data as of April)*
Number of States	36	Responses in 14 states	36
Number of Agencies	76	Responses from 24 agencies	76
Projects	141	70	173
Operational RSUs	4,366	2,925	11,308
Planned RSUs		6,449	
Operational OBUs	1,465	713	2,359
Planned OBUs		1,045	

Initial V2X Deployment Data | Use Cases

Top Existing Use Cases

1. Red Light Violation Warning
2. Traffic Signal Priority
3. Emergency Vehicle Preemption
4. Pedestrian in Signalized Crosswalk Warning
5. Traffic Signal Optimal Speed Advisory (SPaT-related)
6. Road Weather Data Collection

Top Planned Use Cases

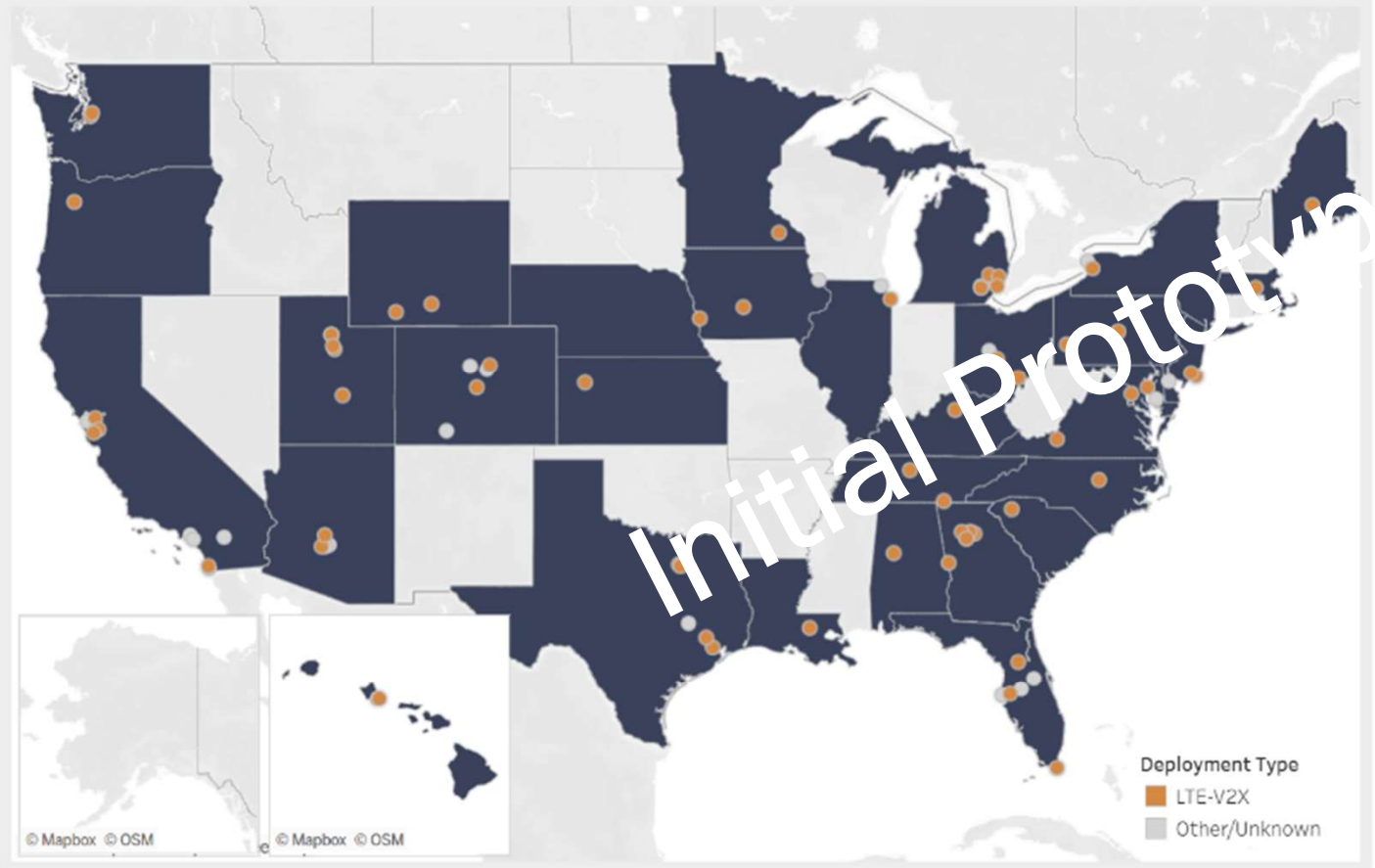
1. Work Zone Advisories and Warnings
2. Traffic Signal Priority
3. Incident and Road Closure Advisories and Warnings
4. Pedestrian in Signalized Crosswalk Warning
5. Road Weather Advisories and Warnings
6. Emergency Vehicle Preemption
7. Curve Speed Warning
8. Pedestrian in Signalized Crosswalk Warning

Vehicle-to-Everything (V2X) Deployments

V2X Applications | Licensing and Devices

Click a state to view more details

October 22, 2024



Click switch to filter dashboard

All Deployments | Cohort Members

Estimated V2X Devices

Roadside Units (RSUs) XX

Onboard Units (OBUs) XX

XX States Deploying V2X Technologies

XX Agencies Deploying V2X Technologies

XX Number of V2X Projects

XX Number of FCC Licenses

Source: USDOT

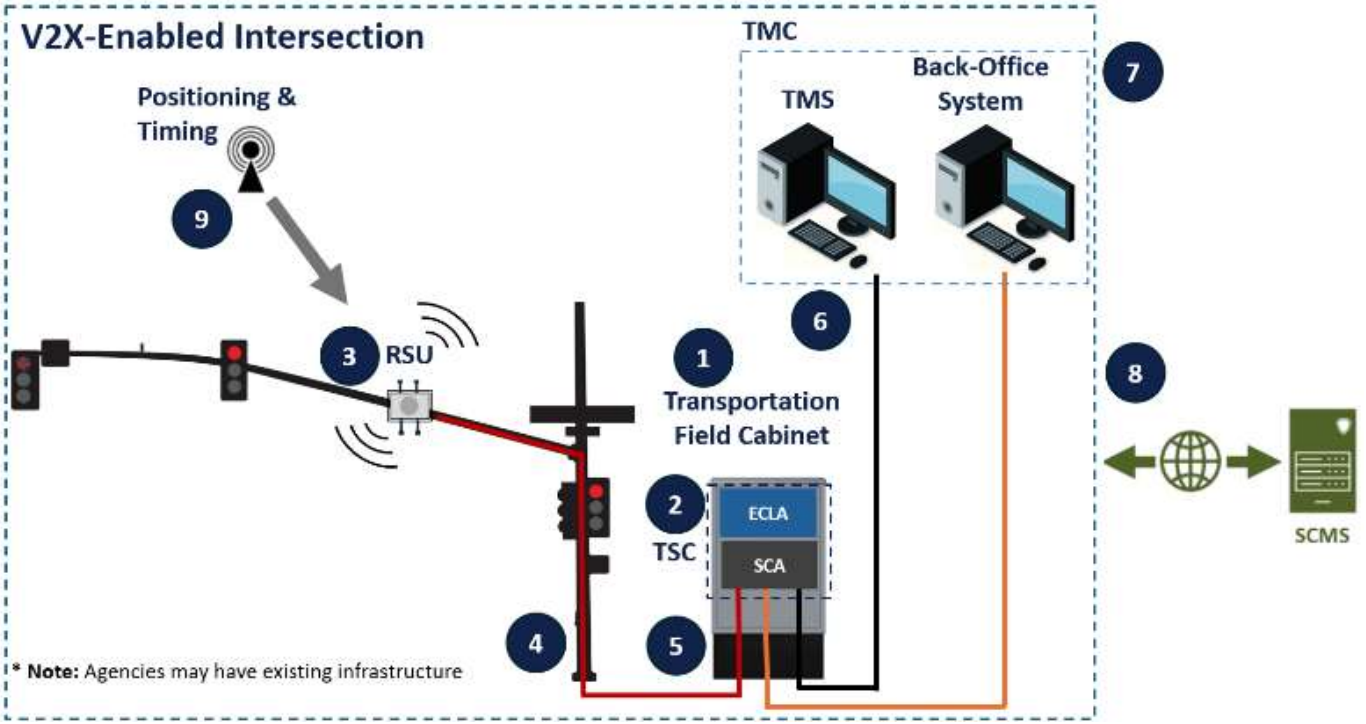
U.S. Department of Transportation

V2X Briefs (in Development)

- USDOT is working on reference materials discussing:
  - Roadside Unit (RSU) Licensing with the FCC
  - Direct and Network V2X Communications
  - V2X-Enabled Intersection Components & Costs
  - V2X Standards

V2X-Enabled Intersection Components and Costs

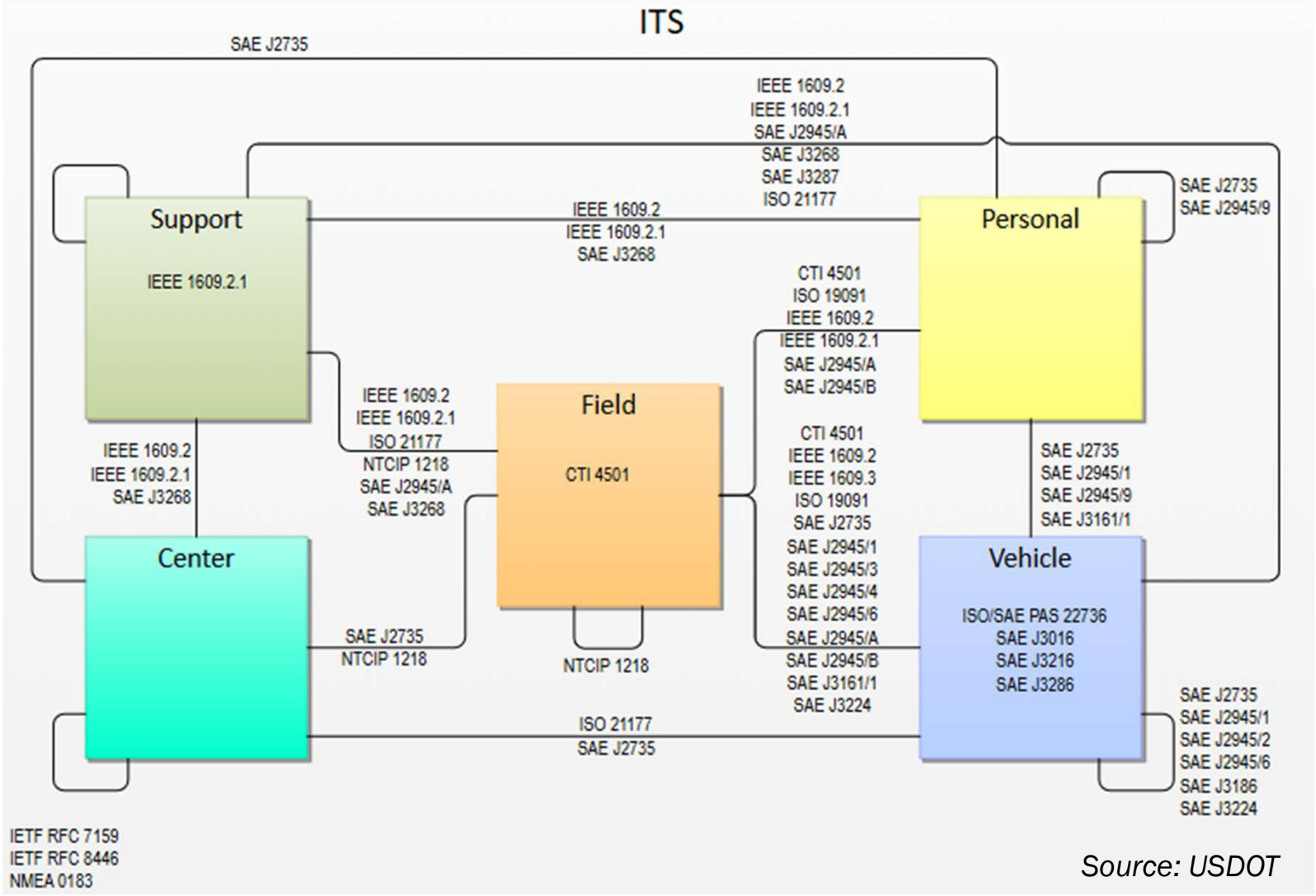
Components for a V2X-enabled Intersection



V2X-enabled Intersection Components

1. Transportation Field Cabinet
2. Traffic Signal Controller
3. Roadside Unit (RSU)
4. Equipment Pole
5. Power
6. Backhaul Network Infrastructure
7. Back-office Systems
8. Security
9. Positioning and Timing

Source: USDOT



Source: USDOT

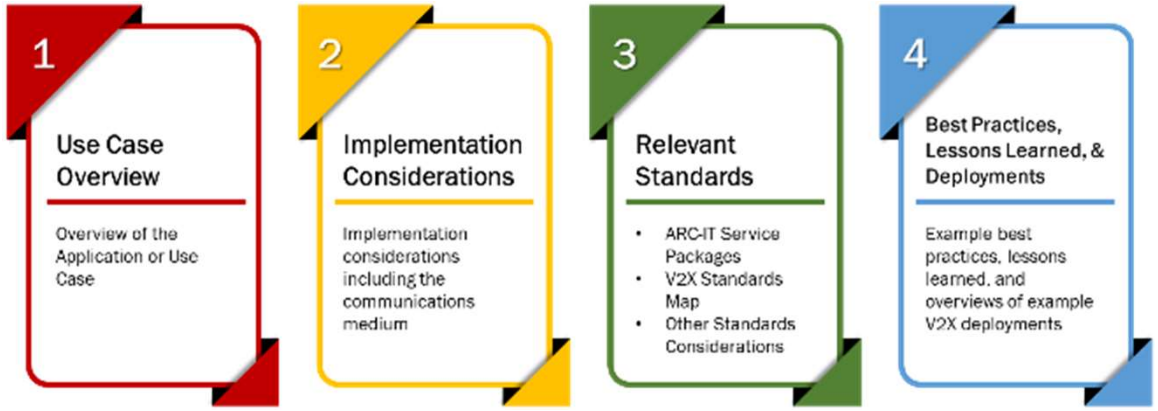
www.arc-it.net/html/standards/standardsmap.html

Potential V2X Standards Briefs

Potential V2X Standards Briefs for the following use cases:

1. Signal Priority and Preemption
2. Traffic Advisories and Traveler Information Messages
3. VRU Safety Applications at Intersections
4. SPaT and MAP Applications

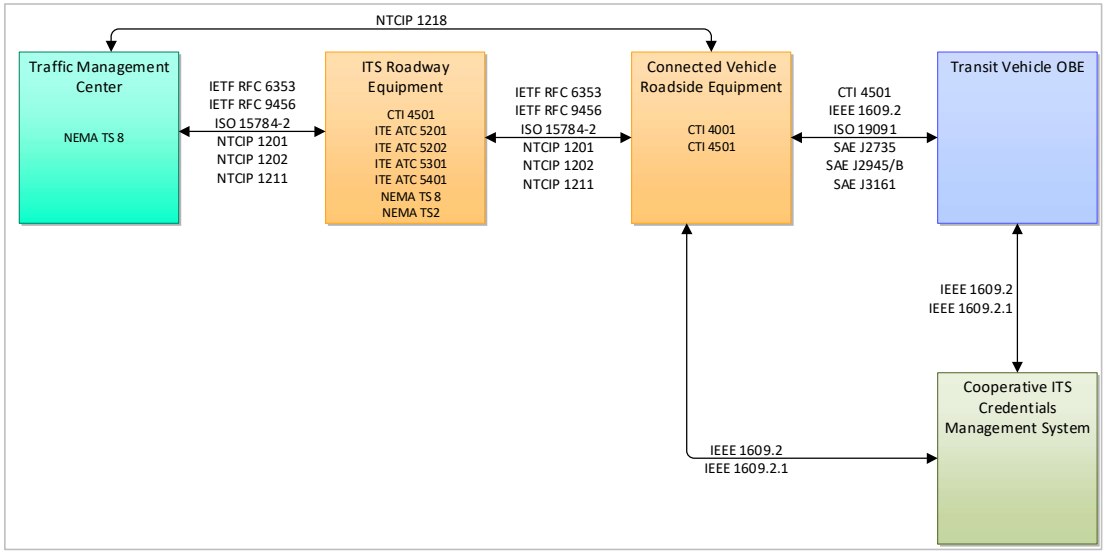
Components of a V2X Standards Brief



Source: USDOT

V2X Standards Brief | Signal Priority & Preemption

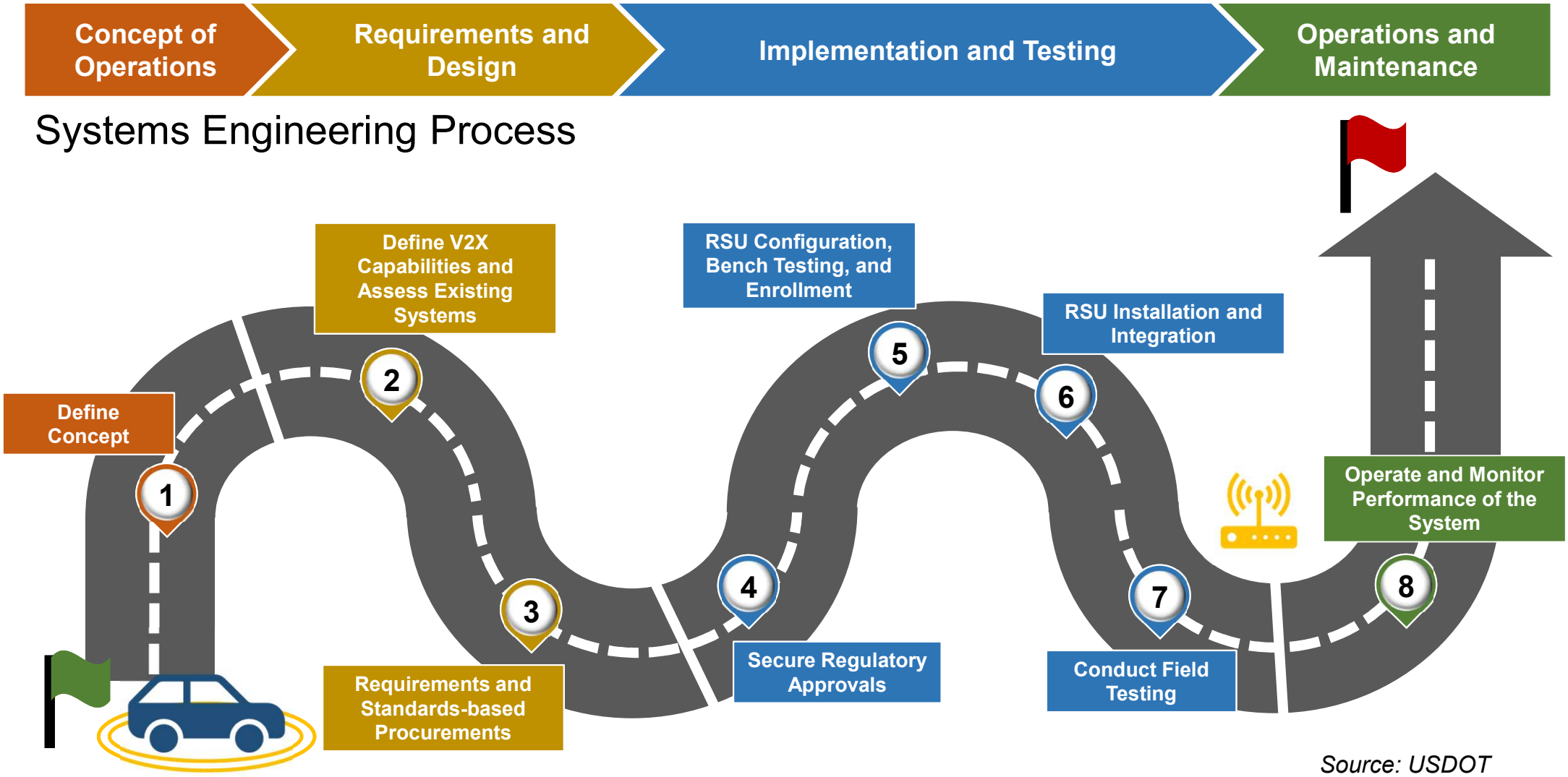
- Will provide an overview of relevant standards deployers should consider to advance interoperable deployments
  a) Relevant ARC-IT Service Packages (PT09, PS03, CV006, & MC-11)
  b) Use Case Specific Standards Map
  c) List and Description of the applicable standards for:
     a) Physical Objects
     b) Interfaces
  d) Other Standards Considerations (SSPs and WSAs)



Source: USDOT

V2X Training

- Foundational V2X Training (V2X 101)
  - **Target Audience:** Intended for participants that are new to V2X, as well as individuals interested in refreshing their knowledge of key V2X concepts.
  - **Delivery:**
    - Delivered 13 in-person technical trainings between April & December 2024
    - Investigating options for delivery in 2025
- Tentative: Planning, Deploying, and Operating V2X Infrastructure (V2X 20X)
  - **Target Audience:** Intended for a technical audience responsible for deploying V2X infrastructure in the field.
  - **Delivery:** To be Determined (TBD)



Source: USDOT

Start with a Foundational Understanding of:

- Vehicle-to-Everything (V2X)
- Systems Engineering (SE)

V2X Tools and Resources

- Smart Community Resource Center (SCRC)
- USDOT Open-Source Tools
  - V2X Hub, MAP Creation Tool, TIM Tool, and 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

FCC Final C-V2X Technical and Service Rules and FCC's Licensing Process

New C-V2X-based Rules

- New C-V2X-based rules became effective on February 11, 2025.
  - https://www.federalregister.gov/documents/2024/12/13/2024-28980/use-of-the-5850-5925-ghz-band
  - ET Docket No. 19-138: https://docs.fcc.gov/public/attachments/DA-25-125A1.pdf
- Except for early adopters who received waiver authorization to operate C-V2X-based RSUs, all other RSUs previously registered continue to be authorized for dedicated short-range communications (DSRC) operation.
- Prior to operating C-V2X-based RSUs, ITS licensees should add or modify existing RSUs specifically for C-V2X operation.
  - Licensees with legacy DSRC systems can either:
    (1) modify existing RSUs for C-V2X operation (in cases where they intend to convert immediately from one technology to the other) and convert those DSRC RSUs to C-V2X in the ULS database,
    (2) register new C-V2X RSUs and delete the DSRC RSUs when no longer needed (in cases of operating both systems in parallel for a period of time).
  - In either case, Bureaus will remove DSRC RSUs from all ITS licenses on December 14, 2026.

Modifying Existing DSRC RSUs in the ULS

ITS licensees who wish to modify existing DSRC-based RSUs to C-V2X-based RSUs should submit their modification applications in ULS as follows:

- File FCC Form 601 Schedule M electronically in ULS to modify an existing DSRC RSU.
- The application should include an attachment specifying that this is a request for a C-V2X RSU using the attachment type "C-V2X RSU Registration."
- Applicants should select the entire upper 30 megahertz of the 5.9 GHz band (5.895–5.925 GHz) (i.e., applicants should select the combination of DSRC channels 180, 181, 182 or 184 up to the full 30 MHz of bandwidth) when registering C-V2X RSUs and where applicable, de-select the channels associated with the lower 45 megahertz of the 5.9 GHz band (5.850–5.895 GHz). All other technical specifications must comply with the applicable C-V2X rules.

Registering a New C-V2X RSU in the ULS

ITS licensees with an IQ/QQ geographic area license that wish to register new C-V2X-based RSUs

- File FCC Form 601 Schedule M electronically in ULS to register a new C-V2X RSU.
- The application should include an attachment specifying that this is a request for a C-V2X RSU using the attachment type "C-V2X RSU Registration."
- Applicants should select the entire upper 30 megahertz of the 5.9 GHz band (5.895–5.925 GHz) (i.e., applicants should select the combination of DSRC channels 180, 181, 182, or 184 up to the full 30 MHz of bandwidth) when registering C-V2X RSUs. All other technical specifications must comply with the applicable C-V2X rules.
- Note that this registration form relates to a fixed site location for each individual RSU. You can also use this form to request a geographic area license, such as a State, but you will still have to go back and fill out details for each individual site.

USDOT's Brief on the Licensing Process

- In collaboration with the FCC, USDOT is developing a brief on the licensing process.
- The document will address:
  - What RSU deployers need to do in terms of filling out the form.
  - A discussion of the FCC's waiver-to-license transition.
  - Filing Instruction Checklist.

FCC Form 601 Schedule M

FCC Form 601 Schedule M collects the following information for each RSU to guard the RSU against interference and make other operators aware of the RSU's existence:

1. **Call sign:** Assigned by FCC.
2. **Licensee name:** Designated by registrant. Use name on charter or articles of incorporation or similar documentation.
3. **RSU identification number:** Assigned by FCC.
4. **RSU site coordinates:** Surveyed or otherwise determined by registrant.
5. **Channel number(s):** Provided by registrant. Registrants should refer to the recent rulemaking at: https://www.fcc.gov/document/use-5850-5925-ghz-band.
6. **Equipment class:** Provided by registrant. Based on relevant "communications zone" of RSU transmissions at proposed site.
7. **Power:** Provided by registrant.
8. **Antenna height:** Provided by registrant.
9. **Antenna manufacturer and model:** Provided by registrant.
10. **Antenna gain:** Provided by registrant.
11. **Antenna azimuth:** Provided by registrant.
12. **Antenna elevation angle:** Provided by registrant.
13. **Registration data:** Provided by registrant.

FCC Licensing Process

Questions and Discussion

1. Do you have resources (or a document) to assist your team in gathering the information required to file for an FCC License?
   - Are you able and willing to share this information with the broader stakeholder community? If so, please forward to Justin.Anderson@dot.gov and John.Schneeberger@dot.gov.
2. What lessons learned do you have regarding how best to collect site information and fill out Form 601?
3. Is there any additional information (including best practices) that you need regarding this licensing process? Or questions for FCC?

TIM Best Practices and Next Gen Wireless Communications Update

TIM Best Practices Discussions (1 of 4)

- Held three TIM Best Practices Discussions on March 14, 17 and 31
  - Future discussions will occur during Interoperability Technical Working Group (ITWG) meetings
  - ITWG meets Thursdays at 2:00 PM Eastern
- Key Discussions on Traveler Information Section:
  - Clarified msgCnt/MsgCount use in versioning of TIMs
  - Recommend timeStamp/MinuteOfTheYear be Mandatory
  - Recommend packetID/UniqueMSGID be Mandatory and unique
    - Discussed using GNIS codes in the 1st three bytes of packetID and using the last six bytes for unique message identifiers

TIM Best Practices Discussions (2 of 4)

- Key Discussions on Traveler Data Frame Part 1:
  - Recommended setting TravelerDataFrame.frameType to 2 if State/local deployment agency is generating message or 3 if a commercial entity is creating the message
  - Recommended using TravelerDataFrame.msgId.furtherInfoID and setting to 0 and not using TravelerDataFrame.msgId.roadSignID
  - Recommended making TravelerDataFrame.startYear mandatory
  - Recommended using TravelerDataFrame.durationTime as the key element for indefinite duration TIMs and using 32000 to signify that
  - Recommended using TravelerDataFrame.priority as a mechanism for infrastructure owners and operators (IOOs) to provide their priority for messages with the following additions:
    - Setting to 0 if IOO doesn't want to use prioritization
    - Reserving 7 for only most critical warnings (e.g. – Wrong Way)

TIM Best Practices Discussions (3 of 4)

- Key Discussions on Traveler Data Frame Part 2:
  - Clarified the use of geometries/geofences
  - “Path” – path(OffsetSystem) with closedPath = False
    - Use for single road TIMs
    - Use TravelerDataFrame.regions.directionality(DirectionOfUse)
  - “Polygon” – path(OffsetSystem) with closedPath = True
    - Use for messages with multiple roads
    - Complicated road structures like cloverleafs
    - Use TravelerDataFrame.regions.direction(HeadingSlice) if there is a heading restriction
  - “Circle” – geometry (GeometricProjection)
    - Do not use TravelerDataFrame.regions.direction(HeadingSlice) or TravelerDataFrame.regions.directionality(DirectionOfUse)
    - Use TravelerDataFrame.regions.description.geometry.direction(HeadingSlice) in GeometricProjection

TIM Best Practices Discussions (4 of 4)

- Key Discussions on Traveler Data Frame Part 3:
  - Content categories are not especially important and recommended just having one content category
  - Defined a number of International Traveler Information Systems (ITIS) code phrases for common TIM messages
  - Examples will include Manual on Uniform Traffic Control Devices (MUTCD) sign examples in the best practices document

Next Generation Wireless Communications

- Continue to conduct Network V2X testing to characterize performance for ITS Use Cases
  - Started testing with LGE Network V2X system that utilizes T-Mobile
  - Continue to test with Verizon ETX solution and application
    - Added the ability to include SPAT and MAP messages in application
- Have developed the next Interoperability Test Plan focused on connected intersections capabilities
  - Will test SPAT, MAP, Signal Request Message (SRM), and Signal Status Message (SSM)
  - Date for testing is TBD

For More Information

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