ITS Michigan

Lunch & Learn

C-V2X

ITS MICHIGAN
Intelligent Transportation Society

INTEGRAL BLUE
COMMUNICATIONS ENGINEERING & SYSTEMS INTEGRATION

V2X
THE CONCEPTS

INTEGRAL BLUE
COMMUNICATIONS ENGINEERING & SYSTEMS INTEGRATION

V2X CONCEPTS

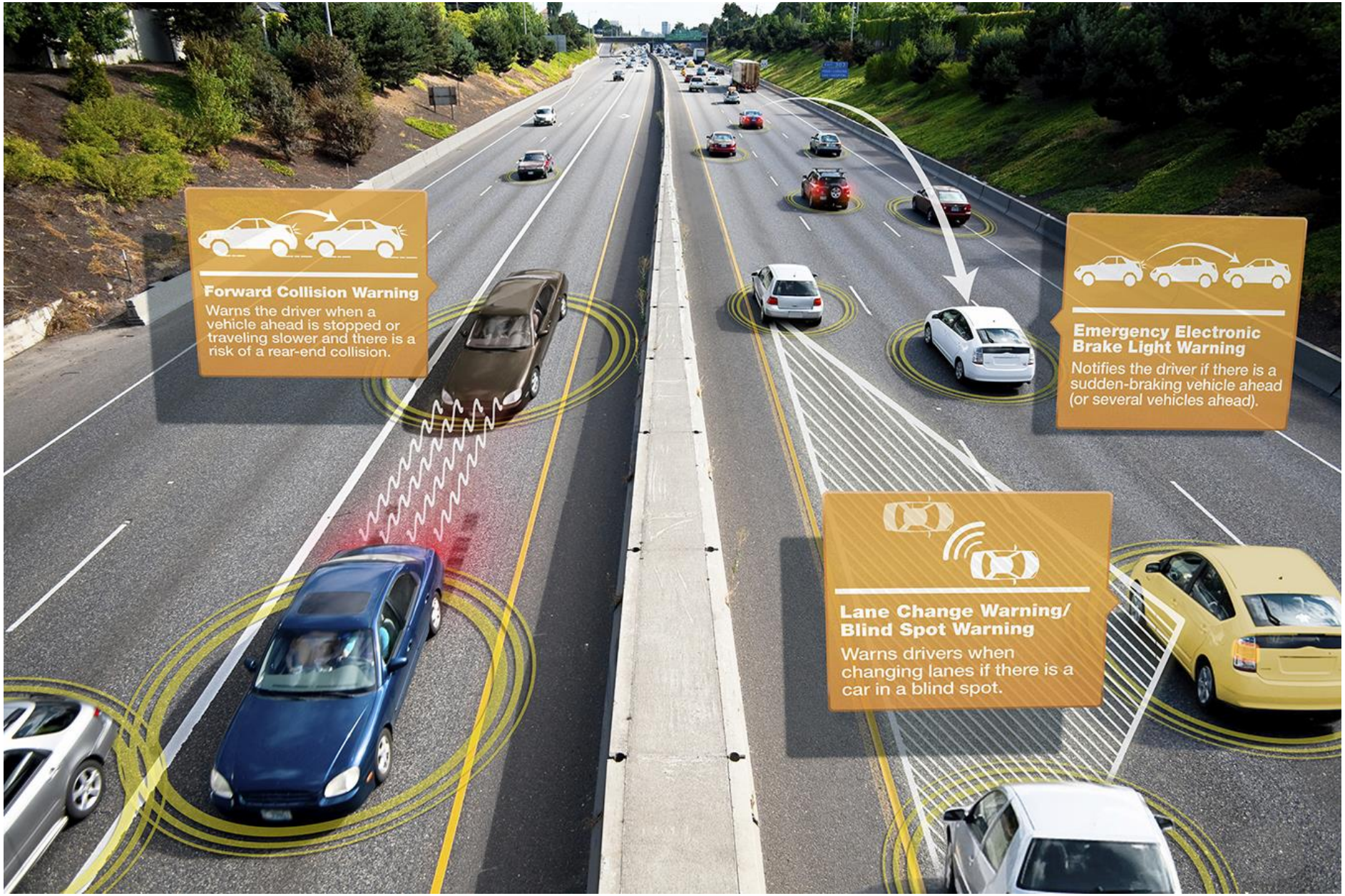


Image Source: USDOT

ITS MICHIGAN
Intelligent Transportation Society

INTEGRAL BLUE
COMMUNICATIONS ENGINEERING & SYSTEMS INTEGRATION

V2X CONCEPTS

Image Source: elenabsl/Adobe Stock, http://www.rand.org/t/RRA569-1

V2X CONCEPTS

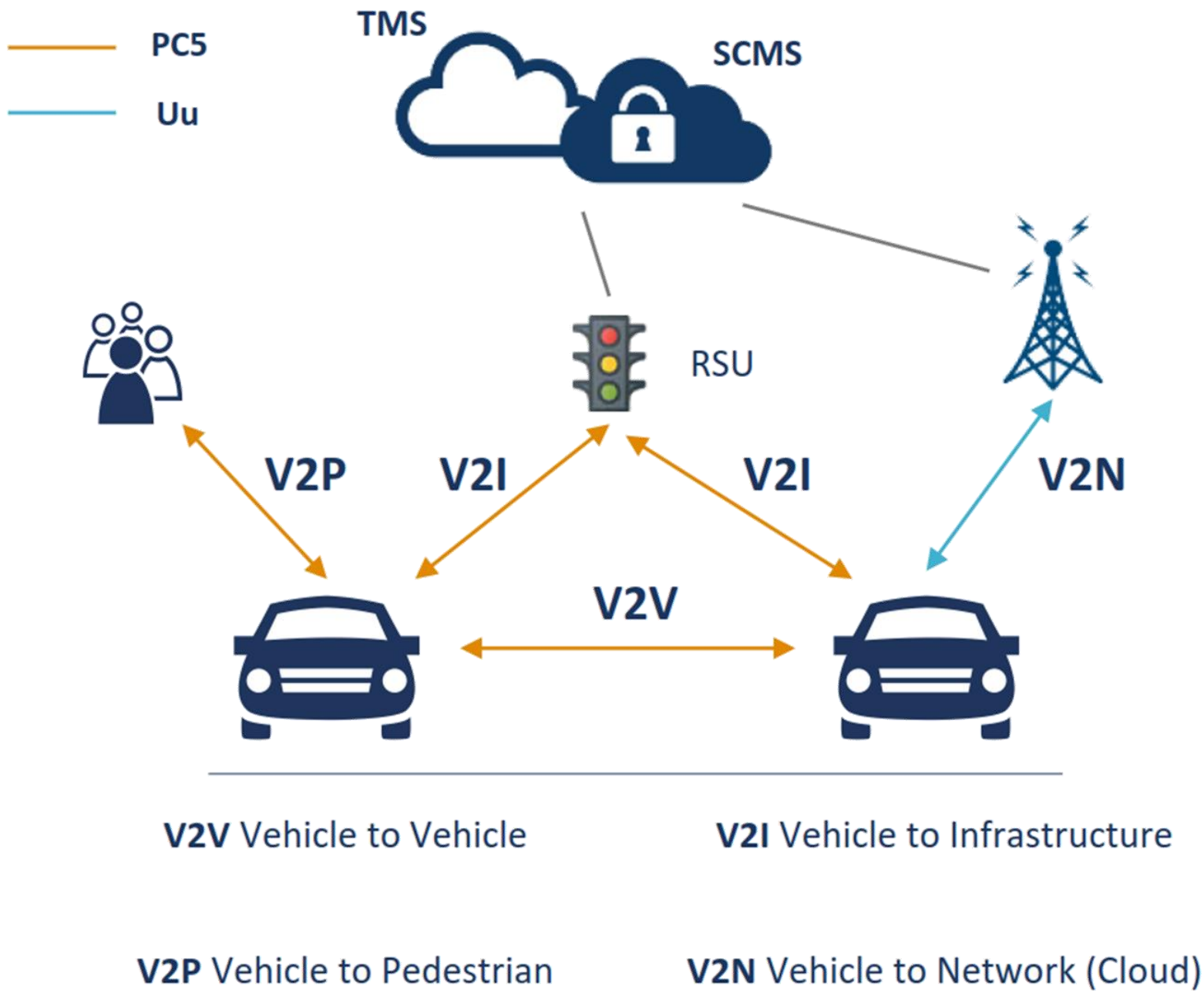


Image Source: P3 North America

V2X CONCEPTS

Image Source: Qualcomm.com

DSRC vs C-V2X
INTEGRAL BLUE
COMMUNICATIONS ENGINEERING & SYSTEMS INTEGRATION

Networking 101

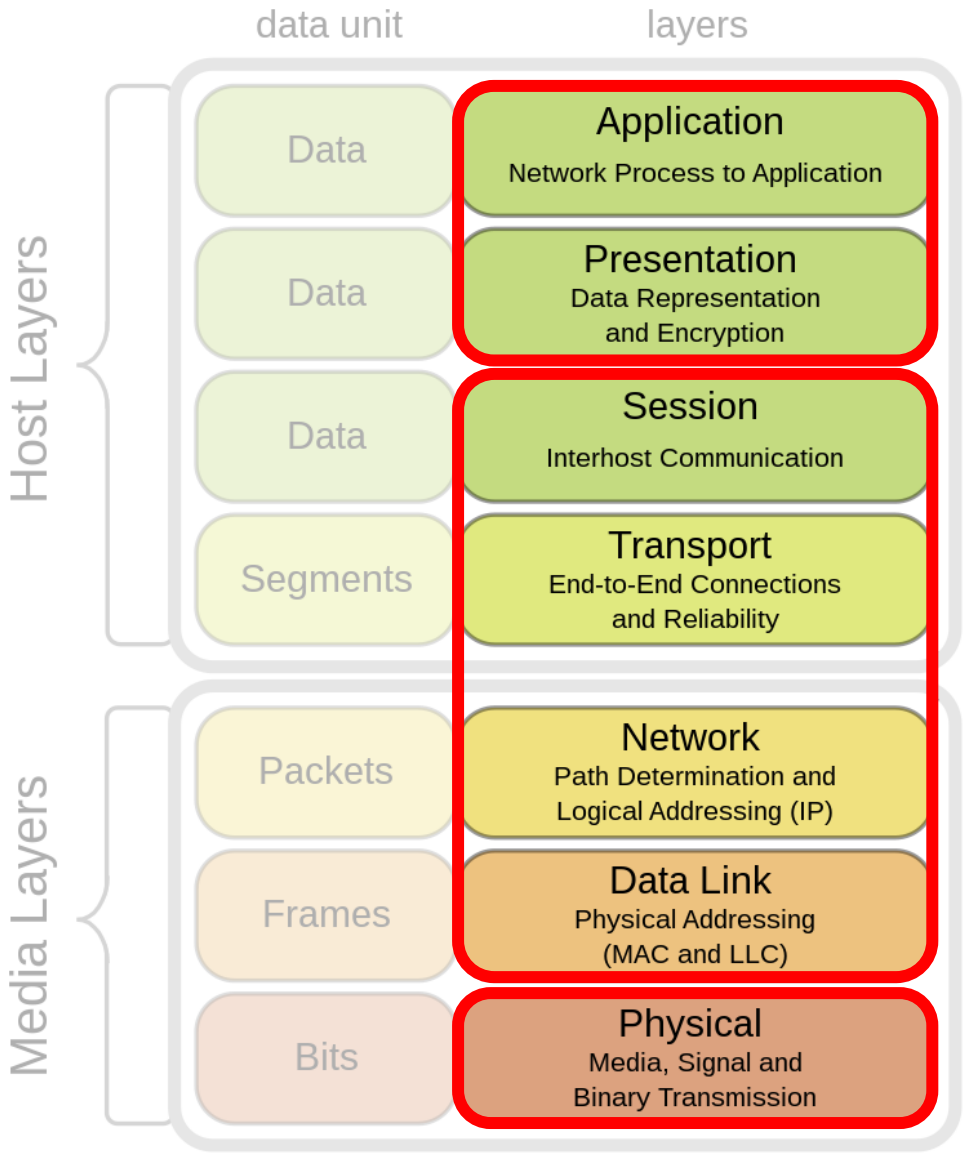


Image Source: Wikipedia, Public Domain

DSRC Networking Stack

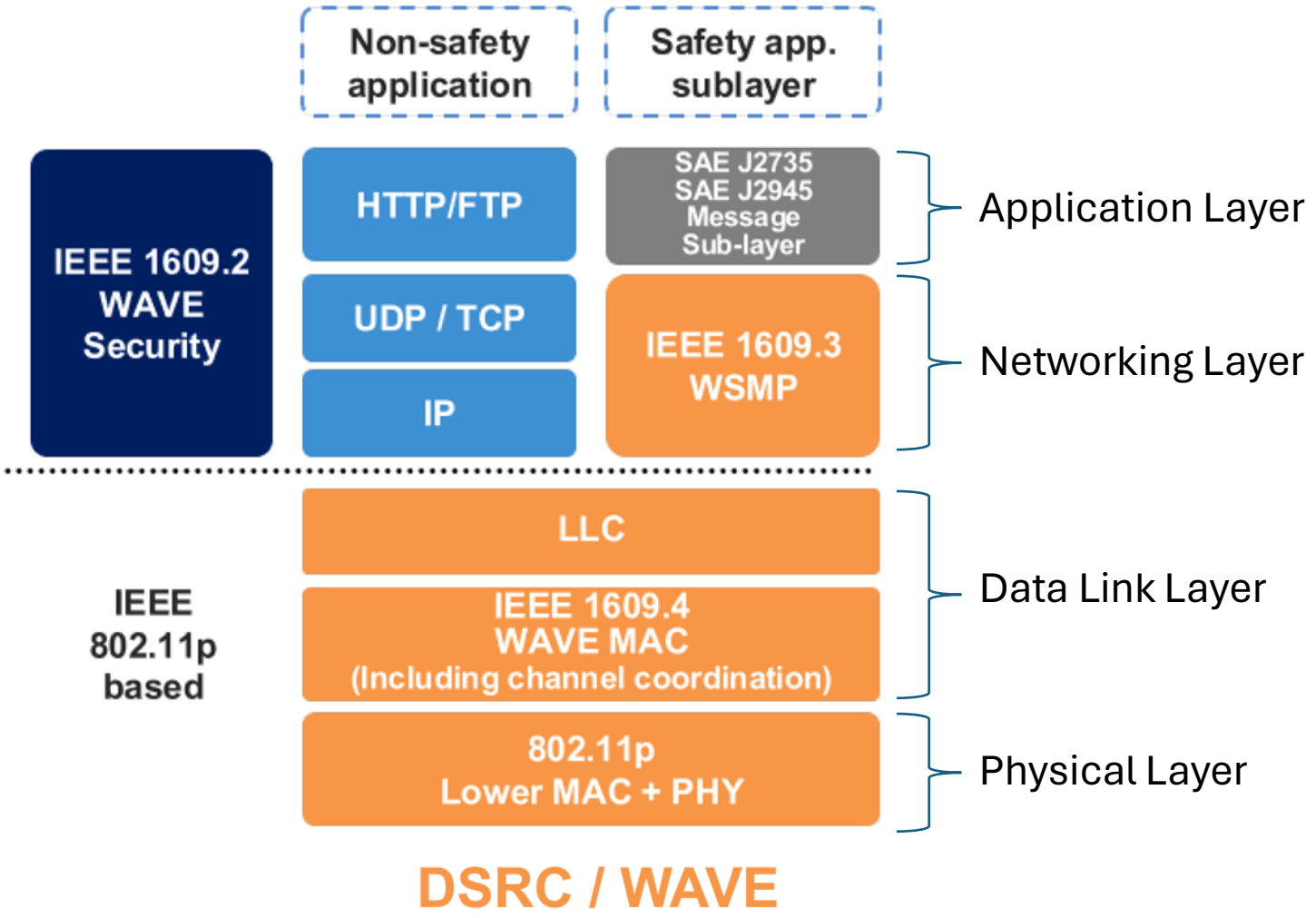
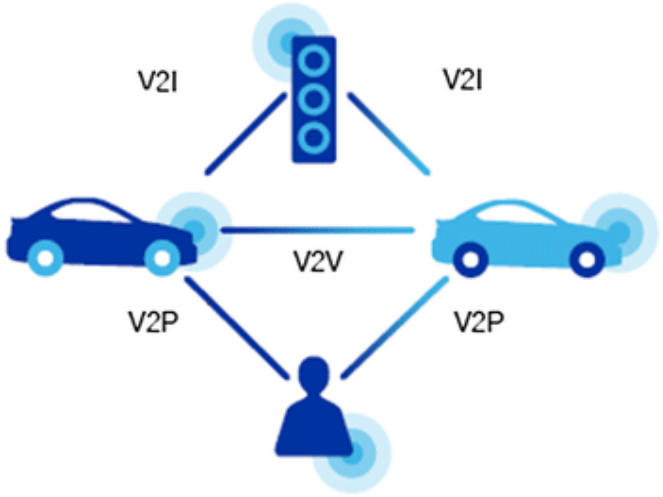


Image Source: https://doi.org/10.3390/s23031421

C-V2X Overview

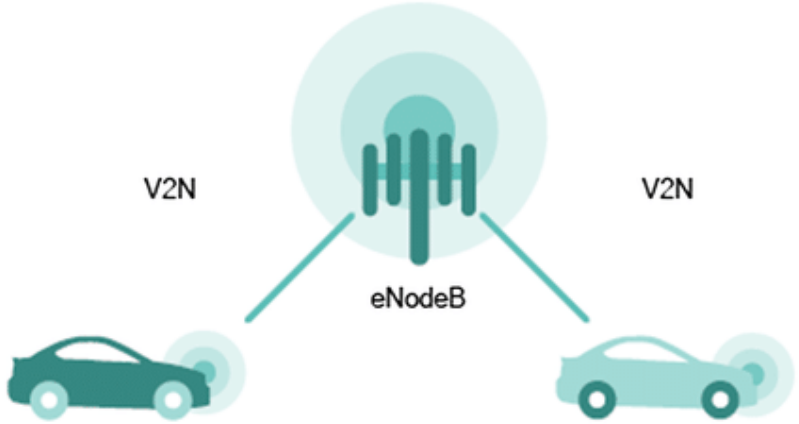
Direct safety communication independent of other networks

V2X Interface



Network communications for complimentary services

Network interface



PC5 Sidelink	Uu Network Link
Message-focused	Network-focused, aka “V2N”
Low-latency, short-range, high speed	Typical cellular LTE/5G connectivity
No tower communications	Higher latency, higher bandwidth apps
No SIM card / subscription	Requires tower and subscription

Image Source: Qualcomm.com

C-V2X Networking Stack

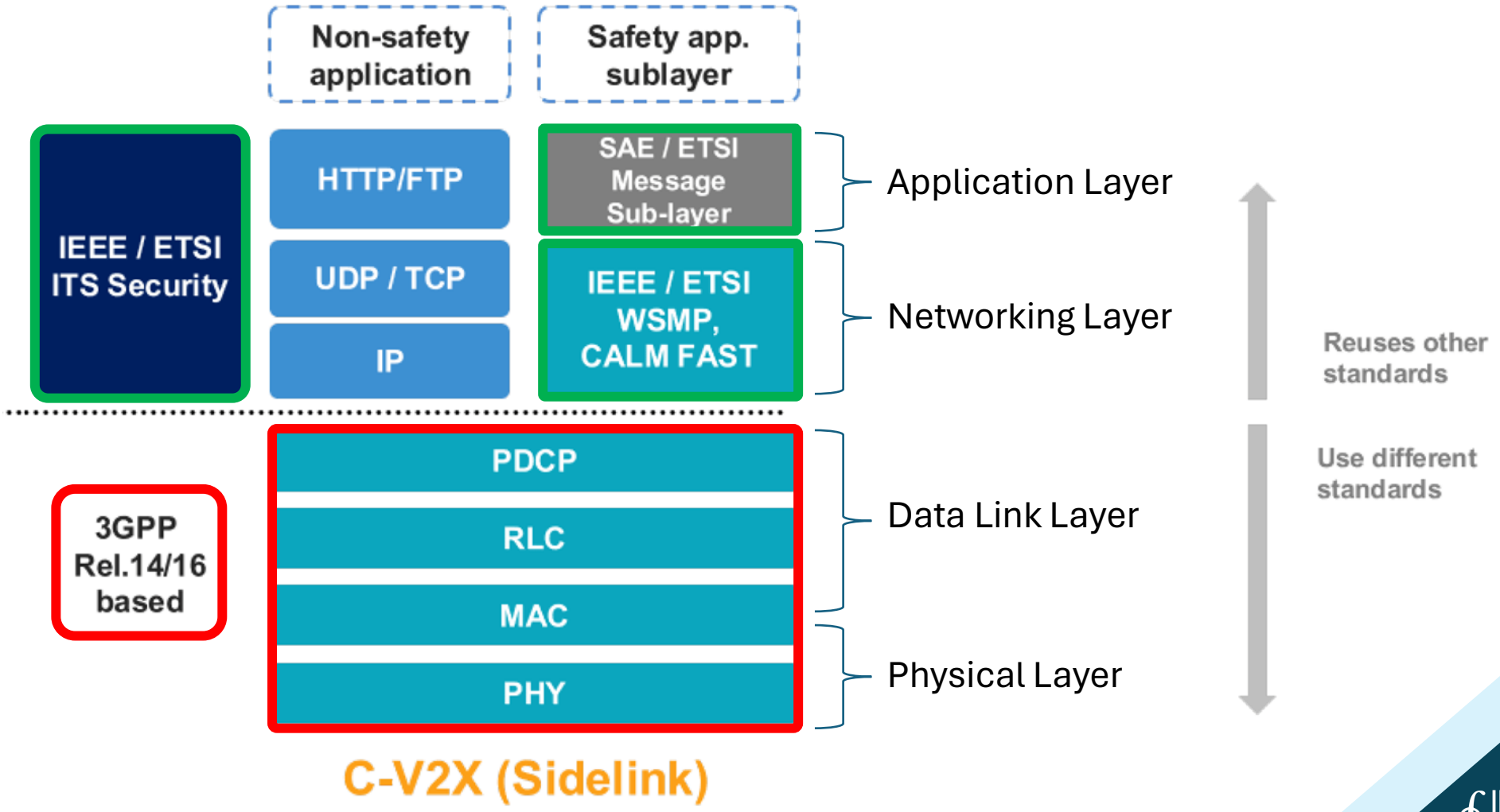
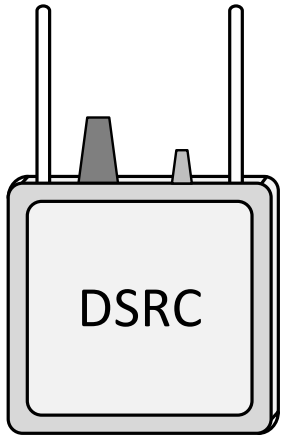
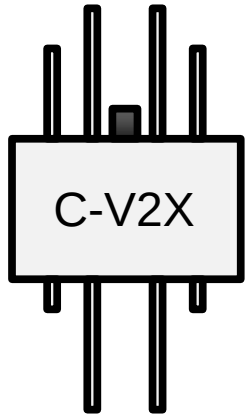


Image Source: https://doi.org/10.3390/s23031421

Differences Summary

DSRC	C-V2X
Range: 1000m (proven)	Range: Up to 1400m (purportedly)*
Limitations of Wi-Fi transceivers	Purportedly Higher Performance
Direct-only Mode	Direct and Network-Based Modes
Older, years of proven performance	Newer, has undergone less testing
“Dead-end” fork of Wi-Fi family	Ever-evolving cellular standards
Mature product (WSA example)	Still has components in development
Heavy adoption in Europe / Japan	Heavy adoption in China





*https://ieeexplore.ieee.org/document/9866543

INTEGRAL BLUE

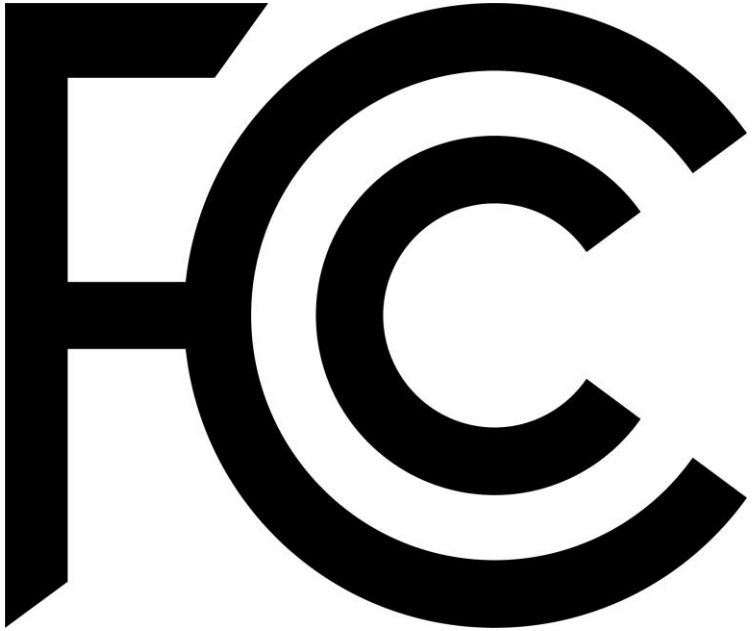
COMMUNICATIONS ENGINEERING & SYSTEMS INTEGRATION

Spectrum Rules

- **Need:** Dedicated spectrum, no interference
  - 75MHz reserved for “safety spectrum” (1999)
  - Rules specifically referenced “DSRC”

- **Problem:** OEMs never mandated to include it
  - FCC re-assessed the spectrum in 2019
  - Determined 75Mhz not adequately used

- **Result:** NPRM issued in December 2019 to shrink the spectrum and endorse C-V2X
  - Ignored comment from industry and IOOs
  - NPRM passed in 2020
  - No new official rules yet



Spectrum Rules

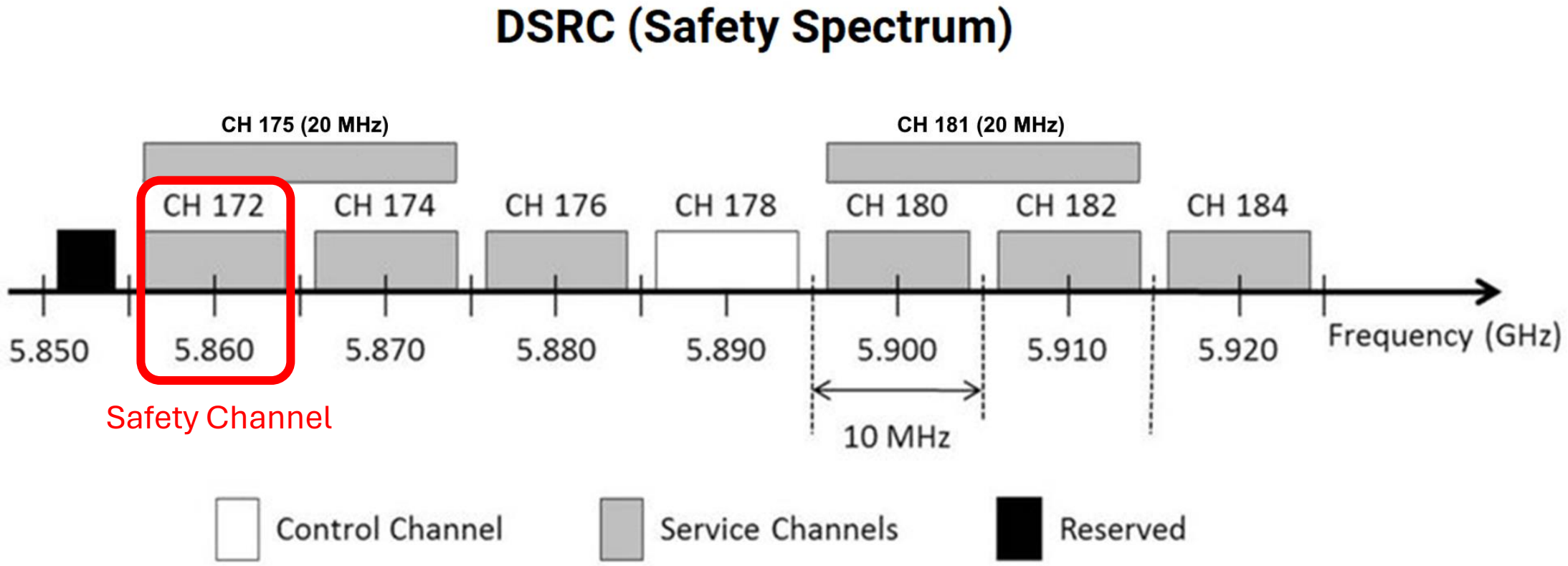


Image Source: DOI:10.1088/1757-899X/477/1/012052, CC 3.0

SPECTRUM

Spectrum Rules

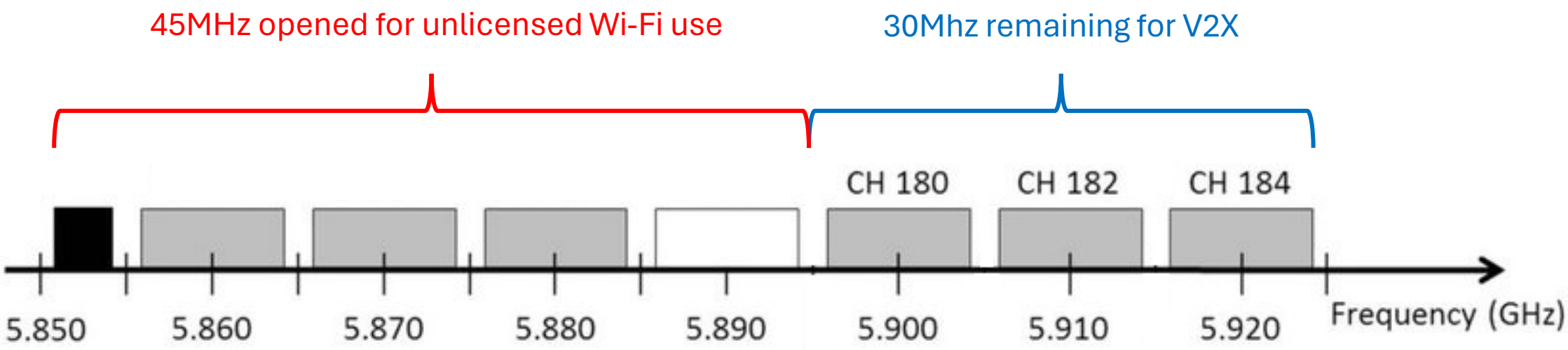
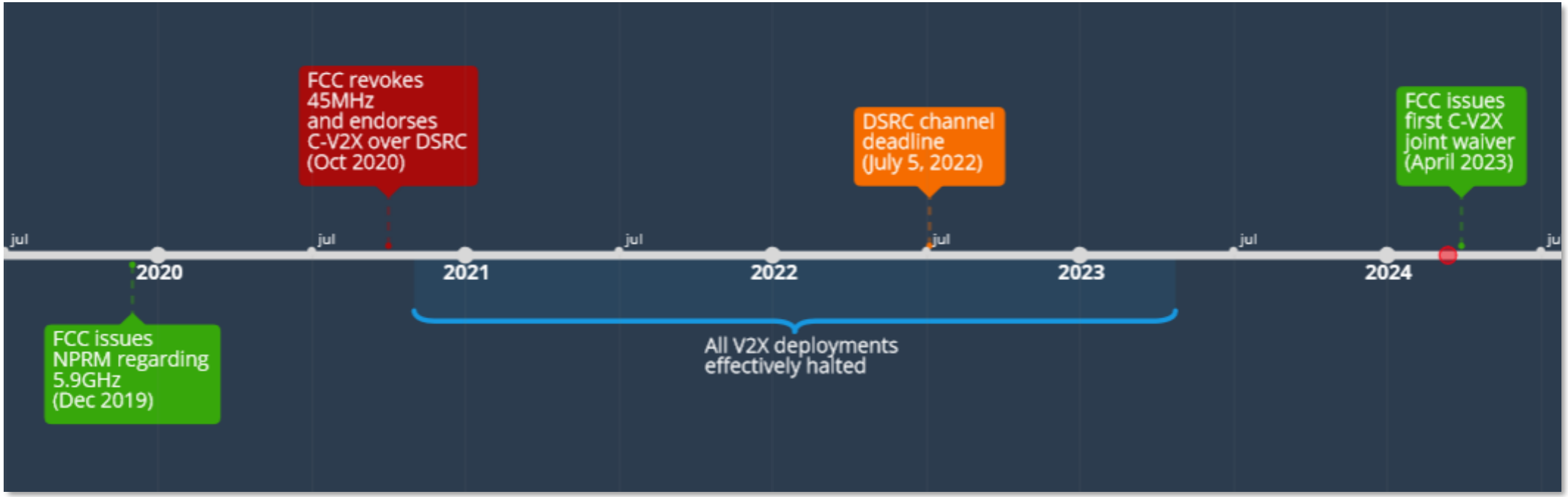


Image Source: DOI:10.1088/1757-899X/477/1/012052, CC 3.0

Spectrum Timeline



Spectrum Rules

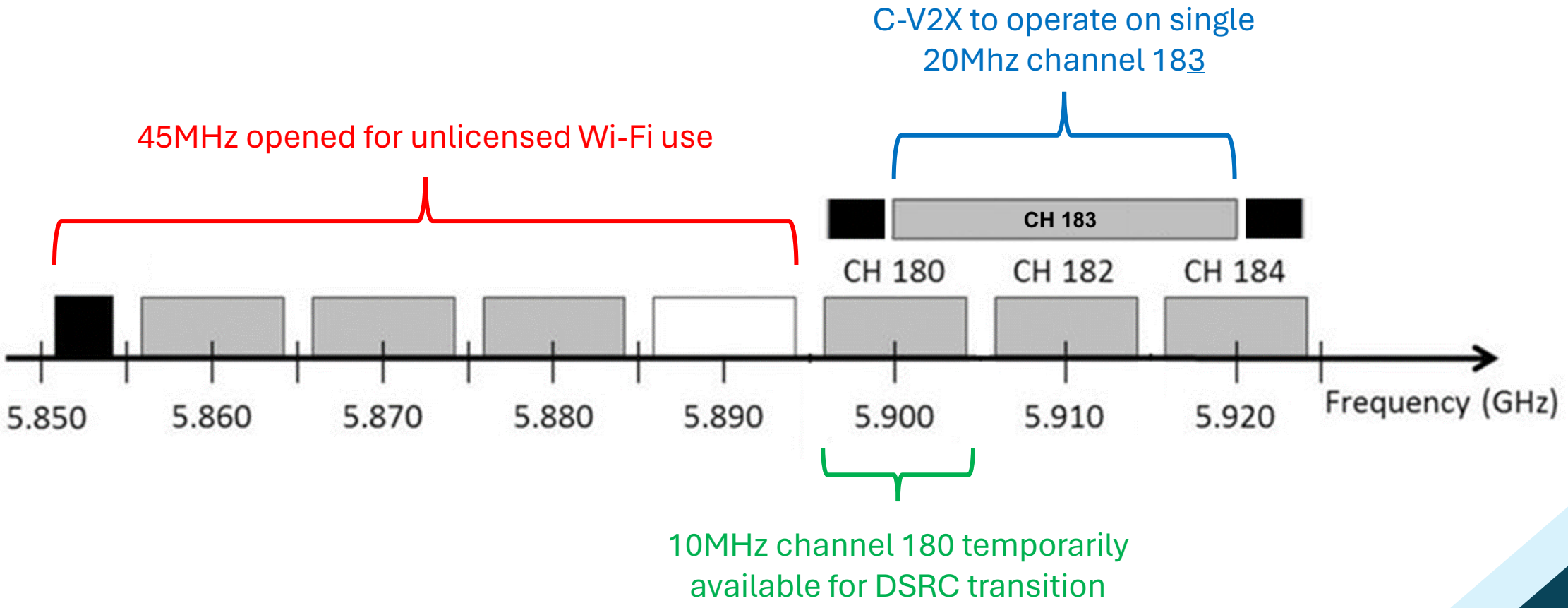
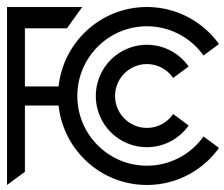


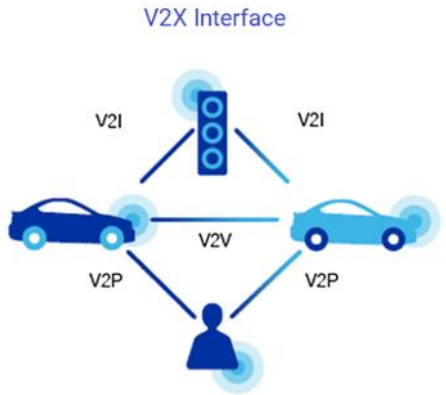
Image Source: DOI:10.1088/1757-899X/477/1/012052, CC 3.0

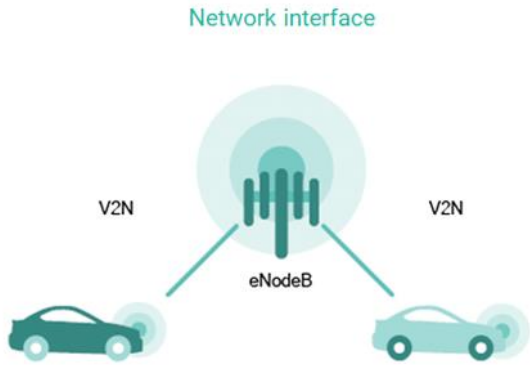
READINESS FOR
C-V2X DEPLOYMENT
INTEGRAL
BLUE
COMMUNICATIONS ENGINEERING & SYSTEMS INTEGRATION

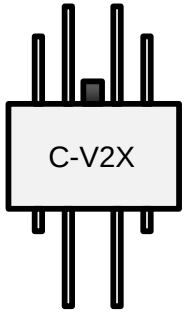
C-V2X Readiness

FCC Readiness	Application Readiness	Infrastructure Readiness
Need waivers/experimental licenses for C-V2X	Identify applications that work best over direct V2X	Communication requirements
Need to register new RSUs	Identify applications that work best over network comms	Remote accessibility and maintainability
RSU FCC certification	Identify applications that could be deployed using both	Edge processing
Tip: joint waivers; temporary	Tip: “surrogate” V2V apps	Tip: CTI 4001, CTI 4501









Funding Sources

- DOT Navigator Home
- Find Grant Opportunities
  - Overview
  - Calendar of Funding Opportunities
  - DOT Discretionary Grants Dashboard
  - BIL Launchpad
- Search Technical Assistance Resources
- Grant Application Resources
- Data & Mapping Tools
- Funding and Match Requirements
- Webinars
- Bipartisan Infrastructure Law Funding
- Find Transportation Contacts Near You
- ROUTES Home

DOT Discretionary Grants Dashboard

The DOT Discretionary Grants Dashboard provides communities with an overview of discretionary grant opportunities that can help meet their transportation infrastructure needs. Designed with all communities in mind, the Dashboard identifies grant programs with rural and Tribal set-asides or match waivers available. The Dashboard also includes Federal grant programs outside of DOT that may be of particular interest to rural communities. The Dashboard is updated weekly.

Additional Resource: The DOT Navigator is a resource to help communities understand the best ways to apply for grants, and to plan for and deliver transformative infrastructure projects and services.

Download CSV

Eligible Activities: - Any -

Eligible Applicants: - Any -

Agency/Office: - Any -

Transportation Type: - Any -

Match Waiver: - Any -

Rural Set-Aside: - Any -

Tribal Set-Aside: - Any -

Status: - Any -

Keywords:

Apply

Source: https://www.transportation.gov/grants/dashboard

Funding Sources

Bipartisan Infrastructure Law Grant Programs

The following list is five-year totals for all grant programs authorized under the Bipartisan Infrastructure Law for the Department of Transportation. This does not include programs that were authorized but are subject to appropriation.

The BIL Launchpad provides customized information on available funding, interactive technical support, data on successful awards, and essential resources. With this platform, localities can accelerate their grant application process and access the necessary tools to enhance their transportation infrastructure.

To view additional information and quickly sort programs funded under the law by fields like amount, eligible recipient, or program name, visit Build.gov. Applicants for funding should consult program-specific guidance. For additional information and to apply, visit Grants.gov.

Program Name	Category	Five-year Funding Amount
Accelerated Implementation and Deployment of Advanced Digital Construction Management Systems (Set-aside)	Roads, Bridges and Major Projects	$100,000,000
Accelerated Implementation and Deployment of Pavement Technologies (Set-aside)	Roads, Bridges and Major Projects	$60,000,000
Advanced Transportation Technologies & Innovative Mobility	Roads, Bridges and Major Projects	$300,000,000

Source: https://www.transportation.gov/bipartisan-infrastructure-law/bipartisan-infrastructure-law-grant-programs

Funding Sources

Key Notices of Funding Opportunity

In order to provide stakeholders with more visibility into upcoming funding opportunities, DOT is publishing a list of anticipated dates for upcoming Notices of Funding Opportunity (NOFOs) for key programs within the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA), as well as adjacent programs that support BIL and IRA objectives. This list is not comprehensive and will be updated periodically with additional programs and revised dates as appropriate.

The USDOT Discretionary Grants Dashboard provides communities with an overview of discretionary grant opportunities that can help meet their transportation infrastructure needs.

Opening Date	NOFO	Operating Administration/Office	Closing Date (to be added for each program after the NOFO is issued)
Large Bridge NOFO: September 27, 2023	Bridge Investment Program	Federal Highway Administration	Large Bridge: August 1, 2024
Bridge Projects: December 20, 2023 Bridge Planning Grants: December 20,2023	Bridge Projects Planning and other Bridge Projects	Federal Highway Administration	Bridge Project Grants: 3/19/2024 Planning Project Grants: 10/1/2024

Source: https://www.transportation.gov/bipartisan-infrastructure-law/key-notices-funding-opportunity

Funding Sources

Program	Description
FMCSA HP-ITD*	Technology deployment program specifically for CMVs
SSFA: “Safe Streets 4 All”**	Focused on multimodal roads and street applications
ATTAIN**	Focused on advanced technologies for safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure ROI
SMART	Grants for conducting demonstration projects on smart community technologies with a second phase for scaled deployment
CMAQ Funding	Any solutions that improve congestion mitigation, including V2X

* Must align with the State’s Program Plan/Top Level Design (PP/TLD)
** Requires a 20% total project cost match

WHERE DO I START?
INTEGRAL BLUE
COMMUNICATIONS ENGINEERING & SYSTEMS INTEGRATION

Helpful Documents

CTI 4001 v01.01 – Amendment 1

Connected Transportation Interoperability (CTI)

Roadside Unit (RSU) Standard

A connected intersection-ready Standard of AASHTO, ITE, NEMA and SAE International

September 2022

This document is produced by the RSU Standardization Working Group.

Published by the following organizations:

American Association of State Highway and Transportation Officials AASHTO

ite A Community of Transportation Professionals

NEMA National Electrical Manufacturers Association

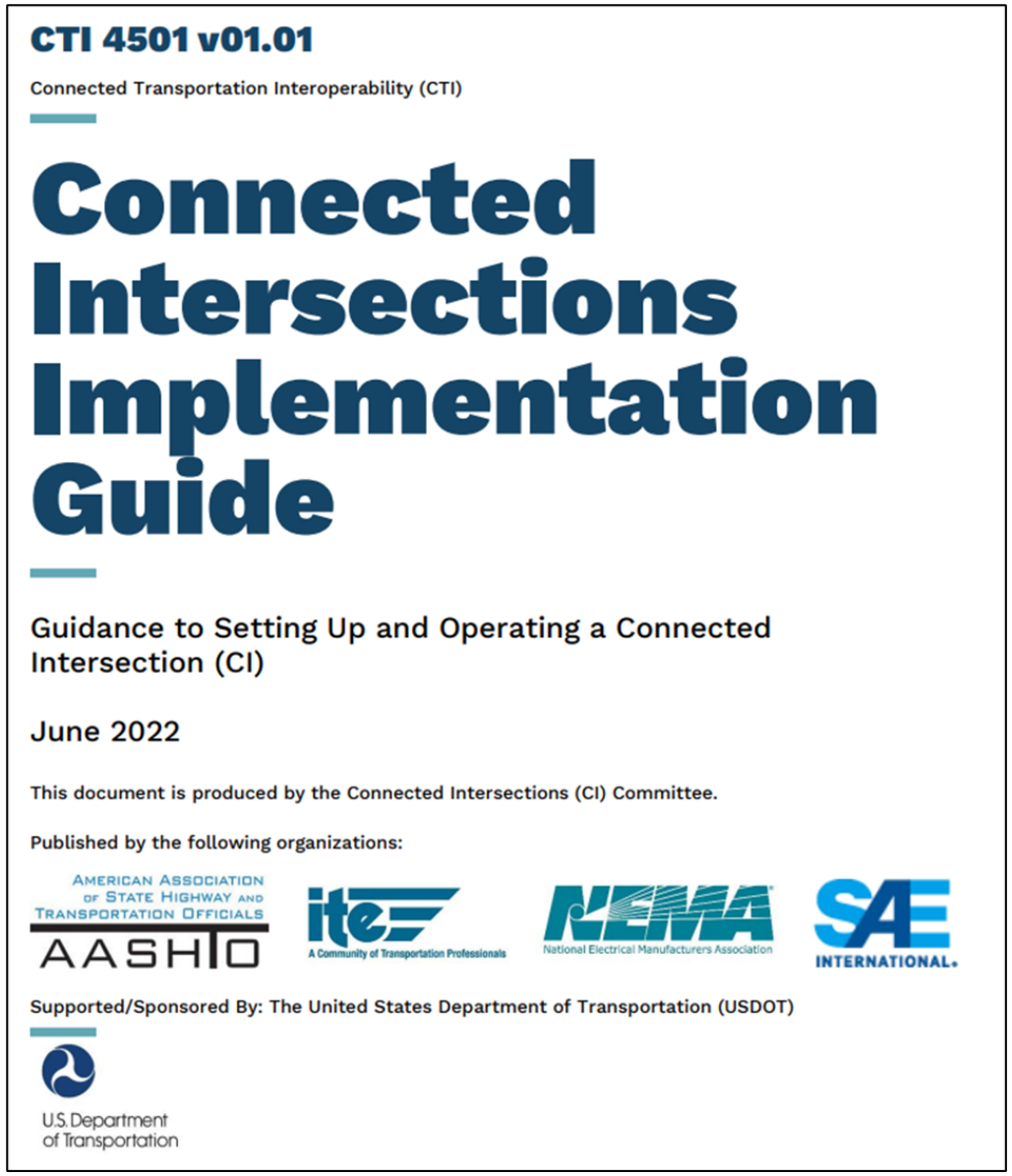
SAE INTERNATIONAL

Supported/Sponsored By: The United States Department of Transportation (USDOT)

U.S. Department of Transportation

Source: https://www.ite.org/technical-resources/standards/rsu-standardization/

Helpful Documents



CTI 4501 v01.01

Connected Transportation Interoperability (CTI)

Connected Intersections Implementation Guide

Guidance to Setting Up and Operating a Connected Intersection (CI)

June 2022

This document is produced by the Connected Intersections (CI) Committee.

Published by the following organizations:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS AASHTO

ite A Community of Transportation Professionals

NEMA National Electrical Manufacturers Association

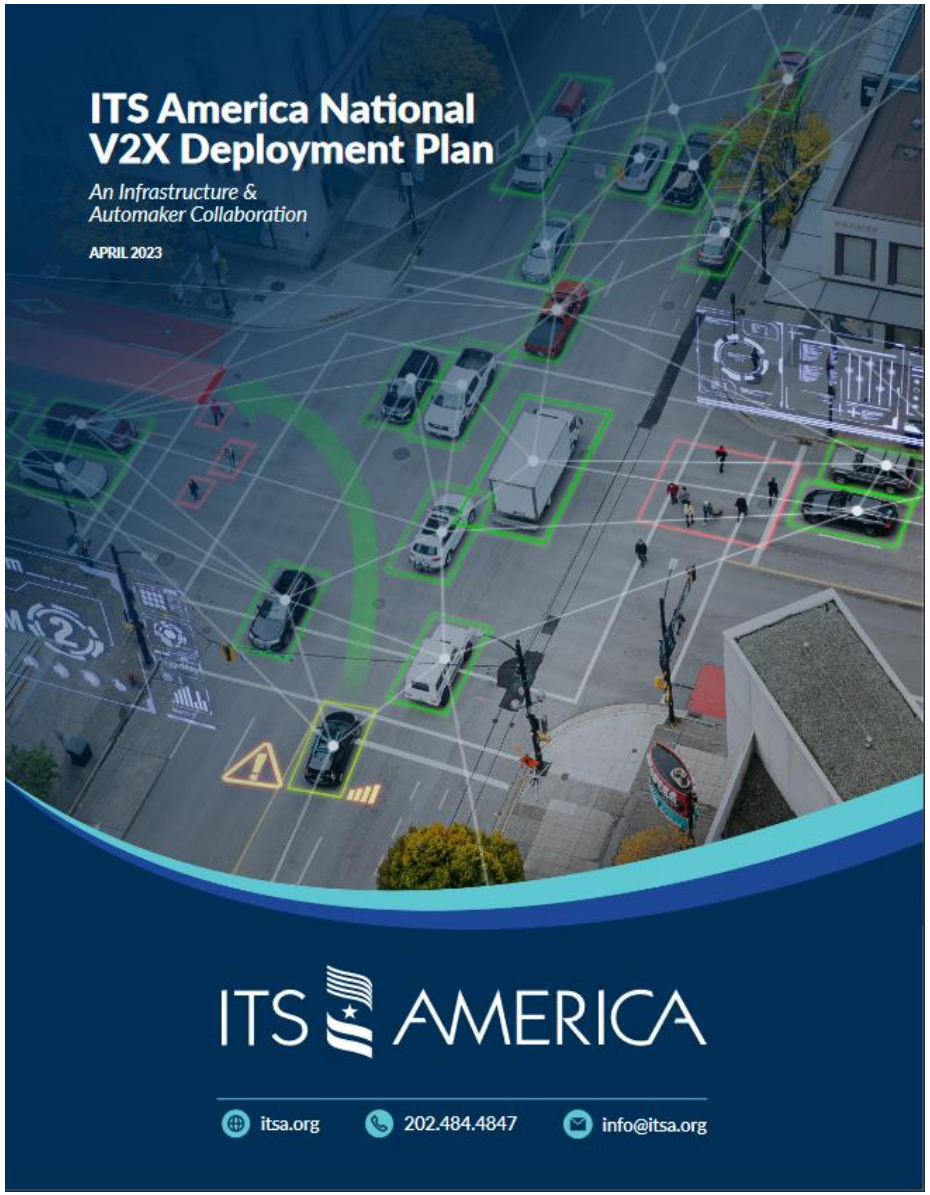
SAE INTERNATIONAL

Supported/Sponsored By: The United States Department of Transportation (USDOT)

U.S. Department of Transportation

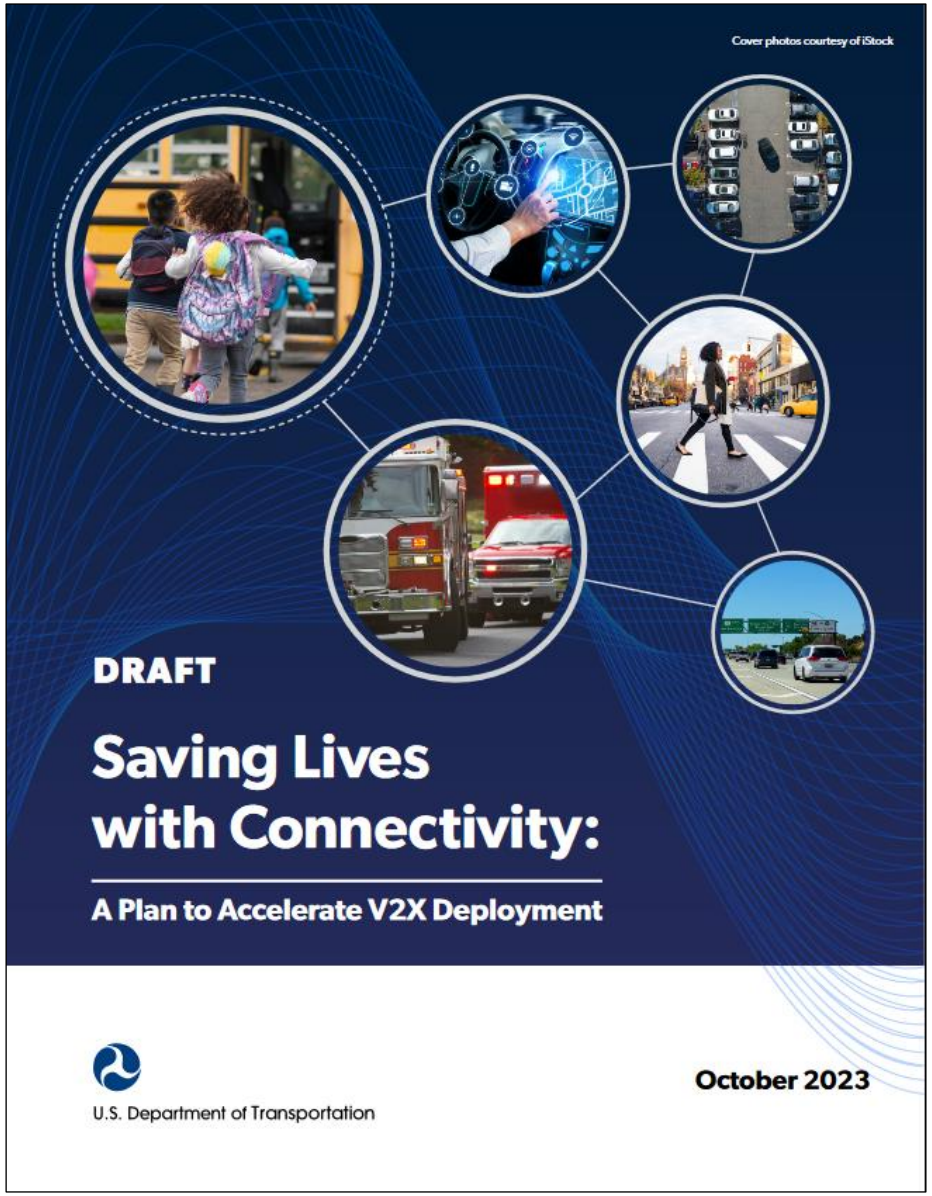
Source: https://www.ite.org/technical-resources/standards/connected-intersections/

Helpful Documents



Source: https://itsa.org/wp-content/uploads/2023/04/V2XDeploymentPlan.pdf

Helpful Documents



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