



VEHICLE-TO-EVERYTHING (V2X) HUB: Open-Source Connected Vehicle (CV) Software



Source: FHWA.

INTRODUCTION

The V2X Hub project seeks to build on existing open-source software (OSS) applications for communication among all parts of a connected deployment, including vehicles, infrastructure, pedestrians, cyclists, and emergency services, to create an interoperable software environment for V2X research and deployment.

The V2X Hub is a multimodal OSS that enables networked, wireless communications among vehicles, infrastructure, and personal communications devices.

Connected and automated vehicles (CAVs) offer opportunities to improve safety for surface transportation and to improve system efficiency. Federal CAV research has produced substantial findings and resources that support OSS as a software development strategy to allow access and interoperability to users with a variety of different hardware and CAV use scenarios. V2X Hub's development as an OSS application also allows for a community of practice comprising users and experts who can support each other by contributing code to address common needs and providing experienced insight.

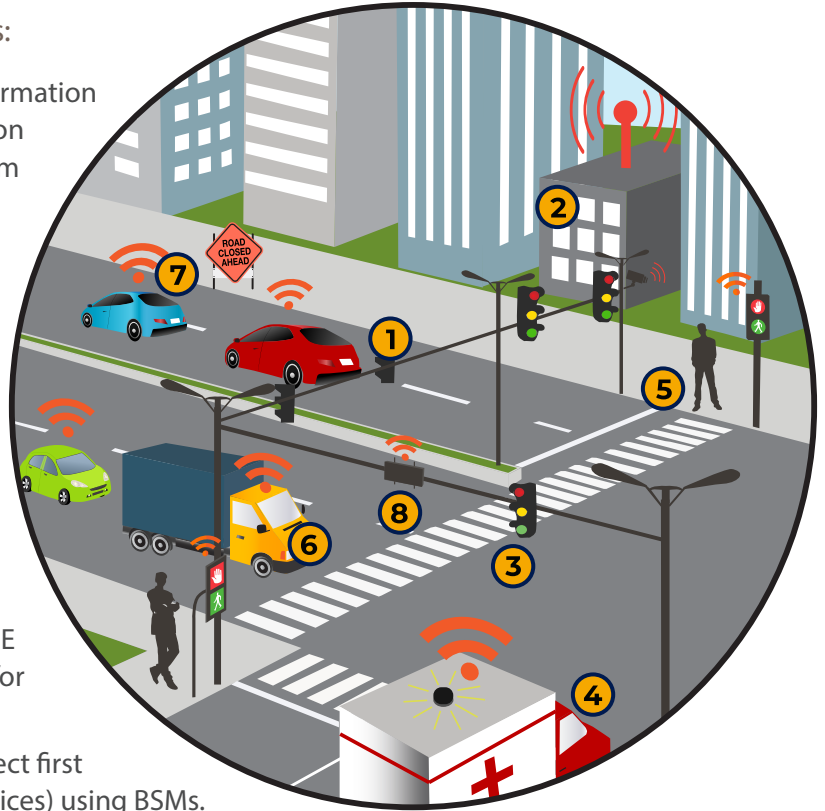


Source: FHWA.

PLUGINS

The V2X Hub integrates the following functionalities:

- 1 **Signal Phase and Timing (SPaT):** Receives SPaT information from traffic signal controller as National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) standard 1202 v2¹ objects and combines those objects with preconfigured MAP messages. This information is broadcast using the Society of Automotive Engineers (SAE) J2735² SPaT messages for road users.
- 2 **Basic Safety Message (BSM) and SPaT Logger:** Collects BSMs and SPaT information sent to and from infrastructure and road users and logs the data for evaluation at a traffic management center (TMC).
- 3 **Immediate Forward:** Forwards SAE J2735 messages from the V2X Hub to a roadside unit (RSU) for immediate broadcast. Also, immediately forwards SAE J2735 messages received by an RSU to the V2X Hub for logging or use by other plugins.
- 4 **Preemption:** Enables traffic signal controllers to detect first responders (police, fire, and emergency medical services) using BSMs. Preemption also changes the light using signal priority and holds traffic until the emergency vehicle passes.
- 5 **Pedestrian Safety:** Takes information about pedestrian location from a mobile device and repackages an SAE J2735 standard personal safety message (PSM) for broadcast by an RSU to nearby vehicles. This plugin enables integrating pedestrians without dedicated short-range communications (DSRC) radios into the CAV environment.
- 6 **Performance Measures:** Gives traffic engineers access to a variety of metrics for evaluating intersection performance, such as queue length and average delay.
- 7 **Work Zones:** Broadcasts SAE J2735 standard traveler information messages (TIMs) with information such as work zone locations. The plugin is designed to broadcast preloaded TIMs on a preprogrammed schedule, with the option to broadcast TIMs on demand using information sent from a TMC.
- 8 **V2X Message Validation:** Verifies and validates messages (e.g., SPaT, MAP, PSM, and TIM) generated from different vendor devices conformed to specifications (U.S. Department of Transportation RSU 4.1³) and standards (SAE J2735 and NTCIP 1202 v2) to support early deployers of CAV technology.



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Modifications: FHWA.

RESOURCES

Find us on GitHub: <https://github.com/usdot-fhwa-OPS/V2X-Hub>

For SAE J2735 Standard Information: https://www.sae.org/standards/content/j2735_201603/

For support, contact CAV support services: CAVSupportServices@dot.gov

¹ AASHTO, ITE, and NEMA. 2005. *National Transportation Communications for ITS Protocol: Object Definitions for Actuated Signal Controller (ASC) Units – version 02*. NTCIP 1202:2005. <https://www.ntcip.org/wp-content/uploads/2018/11/NTCIP1202v0219f.pdf>, last accessed December 1, 2021.

² SAE International. 2020. *V2X Communications Message Set Dictionary*. SAE J2735. Warrendale, PA: SAE International.

³ USDOT. 2016. *DSRC Roadside Unit (RSU) Specifications Document v4.1*. Washington, DC: U.S. Department of Transportation. https://cflsmartroads.com/projects/CV_Testing/USDOT%20RSU%20Specification%204%201_Final_R1.pdf, last accessed December 1, 2021.

