U.S. Department of Transportation
Federal Highway Administration

Office of Safety and Operations
Research and Development

An Open-Source Tool to Enable Interoperable Connectivity

The Federal Highway Administration's (FHWA) efforts to enhance interoperable connectivity seek to build on existing open-source software applications for communication among all parts of a connected deployment, including vehicles, infrastructure, pedestrians, cyclists, and emergency services. As part of this effort, FHWA developed V2X Hub℠ (represented visually by the image on the left) open source software that enables networked, wireless communication between vehicles, infrastructure, and personal communication devices and creates an interoperable environment for research and development into V2X communications.(1)

Connected and automated vehicles (CAVs) offer opportunities to improve safety for surface transportation and increase system efficiency. Federal CAV research produced findings and resources that support open-source software as a development strategy to provide access and interoperability to users with a variety of hardware and CAV use cases. V2X Hub development as an open-source software application also fosters a community of practice environment composed of users and experts who can support each other by contributing code that addresses everyday needs and by providing experienced insight. To join the CAV community of practice, please email CAVSupportServices@dot.gov.

Source: FHWA. (See references 2—8.)

Figure 1. Image. Functionalities of V2X Hub.

Functionalities of V2X Hub[2]

- **SPaT and MAP Messages:** Receives and translates National Transportation Communications for Intelligent Transportation System Protocol (NTCIP™) 1202 objects and combines those objects with preconfigured MAP messages for broadcasting the standard SAE International® J2735™ SPaT and MAP messages.[2,4]
- **RSU Interface:** Forwards SAE J2735 and SAE J3224™ messages from the V2X Hub℠ to an RSU for immediate broadcast and listens to incoming SAE J2735 and SAE J3224 messages from an RSU to the V2X Hub. The interface also uses NTCIP 1218 to monitor the health and operational status of RSUs to ensure they are functioning correctly.[2,3,5]
- **Pedestrian Safety:** Repackages information about pedestrian location from either an infrastructure-based camera or mobile device into an SAE J2735 standard Personal Safety Message (PSM) for broadcast by an RSU to nearby vehicles, integrating pedestrians without V2X radios into the CAV environment.[4]
- **CARMA Cloud℠ (Traffic Control, Work Zone):** Establishes a network connection with a server running CARMA Cloud, enabling work zone and emergency response vehicle use cases.[6]
- **CARMA Streets℠:** Feeds CARMA Streets (an infrastructure edge-computing component) with real-time data for executing transportation use cases. Currently, CARMA Streets executes Signal Optimization and Cooperative Perception use cases.[6]
- **CDASim:** Establishes a bridge between V2X Hub℠ and the CDASim cosimulation platform, enabling V2X Hub℠ to interact seamlessly with other platforms, including the CARMA Platform℠, a vehicle driving simulation, a traffic simulation, and a V2X communication simulator within the simulation environment.[6,7]
- **CAV Telematics Tool:** Feeds real-time data into the tool, enabling the creation of customized dashboards for visualizing message data. The telematics dashboards allow real-time monitoring and analysis of CDA use case testing, including vehicle and traffic data.[8]
- **Preemption:** Enables traffic signal controllers to detect first responders (police, fire, and emergency medical services vehicles) using basic safety messages and to changes the traffic light using signal preemption, holding traffic until the emergency vehicle passes.[2]
- **Operational Data Environment:** Pushes data to an operational data environment server, where data are distributed to devices and transportation management applications.[2]

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For more information, please contact the CAV Support Services at CAVSupportServices@dot.gov
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