Connected Vehicle Deployment Technical Assistance

Equipment Loan and Help Desk Program Technical Primer

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16. Abstract The USDOT's Connected and Automated Vehicle Support Services provide infrastructure owner operators (IOOs), equipment manufacturers, and device vendors with technical assistance and equipment loans during connected and automated vehicle (CAV) deployments. By providing knowledge and equipment, the services advance CAV deployments without any cost for users. Support services are provided to all levels of users, including IOOs interested in testing CAV technologies as they consider deployment, vendors interested in bench testing time and space at the Turner-Fairbank Highway Research Center (TFHRC), and organizations in the later stages of CAV deployment, such as the Connected Vehicle (CV) Pilot Sites.			
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Introduction

The Connected and Automated Vehicle (CAV) Support Services provide infrastructure owner operators (IOOs), equipment manufacturers, and device vendors with technical assistance and equipment loans during CAV deployments without any cost to users. The program is based out of the Saxton Transportation Operations Laboratory (STOL) in Northern Virginia and provides support to all levels of users, including IOOs interested in testing CAV technologies as they consider deployment, vendors interested in bench testing time and space at the Turner-Fairbank Highway Research Center, and organizations in the later stages of CAV deployment, such as the Connected Vehicle (CV) Pilot Sites.

Equipment Loan Program

The CAV Support Services offers an Equipment Loan Program that provides deployers with the opportunity to borrow and test CV equipment from vendors to ensure these devices will work with their existing infrastructure. Deployers can borrow equipment in 30-day increments with the ability to extend the loan if there is no other request for the equipment. Equipment can be borrowed, shipped to deployers, and returned to the program free of charge. Agencies can expect to receive equipment from the program within a month. The following types of CV equipment are available for loan:

Roadside Units (RSUs)
A dedicated short-range communications (DSRC) transceiver that is mounted along a road or pedestrian passageway that broadcasts data to OBUs or receives data from OBUs in its communications zone.

Source: USDOT

On Board Units (OBUs)
A device that located on or integrated within vehicles to collect the vehicle's and/or provide an interface through which ITS services can be provided, e.g. tolls, navigation, and travel information. An OBU continuously transmits vehicle data in the form of Basic Safety Messages (BSMs) to other vehicles, RSUs, infrastructure, and devices.

Source: USDOT

Packet Sniffers
Hardware designed to monitor network traffic by examining data packets flowing through the air over radio frequencies. This device can be used to evaluate and verify the message content RSUs and OBUs are broadcasting.

Source: USDOT

Signal Phase and Timing (SPaT) and MAP Message Test Devices
Hardware designed to provide real-time visualization and logging of traffic signal phase and timing information to vehicles approaching signalized intersections.

Source: USDOT

Spectrum Analyzer
An electronic equipment that is used to measure the magnitude (amplitude or strength) of a given input signal set against the full frequency range of the instrument. It is primarily used to measure the strength of the spectrum of known and unknown signals.

Source: USDOT

DSRC Antennas
Hardware (equipped on vehicles) that enables vehicle-to-infrastructure (V2I) and vehicle-to-infrastructure communication using DSRC.

Source: USDOT

In addition to CV equipment, specialized equipment is also available for loan. The Equipment Loan Program also provides support and equipment for testing activities at the STOL testbed.

Help Desk

Deployers can utilize the CAV Support Service's help desk for technical assistance during CAV testing and deployments. The help desk is also a resource for deployers who are looking to conduct testing and demonstrations at the STOL testbed. Assistance and support are provided through email and phone exchanges and initiated by submitting a ticket or sending an email to CAVSupportServices@dot.gov. The help desk can assist with the following services:

Table 1. Description of Help Desk Support Services

Support Services	Description
Device Configuration Support	• Output review – assistance with submission of case and review of logs • J2735 messages – assistance with interpretations of standard, content, and structure
Map/Traveler Information Message (TIM) Tool Application Support	• First-level support for questions or issues related to Map/TIM generation tools
Device Testing Support	• Dedicated short-range communications (DSRC) wireless sniffer access • Global Positioning Satellite (GPS) location support • Internet Protocol Version 6 (IPv6) assistance
Infrastructure Implementation Support	• IPv6 network design recommendations • Physical installation guidance
Security Support	• Network security guidance • Security Credential Management System (SCMS) questions and updates.
V2X Hub	• Support for V2X Hub User Group • V2X Hub installation and setup. (Previous version, V2I Hub on OSADP: https://www.itsforge.net/index.php/community/explore-applications#/40/148.)
Other	• Standards guidance and implementation • System components and high-level architecture • Troubleshooting devices

Source: USDOT

How to Submit a Ticket

To request more information regarding the Equipment Loan Program & Help Desk, deployers can email CAVSupportServices@dot.gov. For deployers who are interested in leveraging this resource, all requests can be submitted through the ticket system. Responses to questions or requests can be expected within one business day.

1. Navigate to https://CVCS.Samanage.com

2. Create an account (only registered domains allowed, e.g. @dot.gov. If an agency's domain is not registered, call the number or email CAVSupportServices@dot.gov)

3. Submit a ticket, just like an IT help desk.

Use Case Examples

Many CV deployers have leveraged the CAV Support Services as a resource for their CV project including Wyoming DOT (WYDOT), City of Denver, and the CV Pilot sites. The following case studies provide three examples of different deployers across the United States who have worked closely with the program to overcome technical challenges and find solutions for their CV projects.

Wyoming DOT CV Pilot Trailer Antenna Placement and Equipment Configuration

Figure 1. Wyoming CV Pilot Tractor Trailer (Source: WYDOT)

The focus of the WYDOT Connected Vehicle (CV) Pilot is to improve safety and mobility by creating new ways to communicate road and travel information to commercial truck drivers and fleet managers along the 402 miles of Interstate 80 (I-80) in Wyoming. This requires equipping semi-trailer trucks (semis) with CV OBUs and antennas to enable communication with other equipped vehicles and the infrastructure.

During initial installation and testing in early 2018, the WYDOT team found that antenna performance was an issue when their tractor-trailers were experiencing a substantial DSRC "shadow" behind the box trailer. Since DSRC signals require line-of-sight for reception, if the antennas were not positioned appropriately, the box trailer would likely "block" the signal broadcast. This would result in degradation of the DSRC signal from the semis to other light duty vehicles within 50-150 meters behind the box trailer.

The WYDOT team worked with their vendors, other equipment suppliers, and the Equipment Loan Program to find a solution to the DSRC shadow problem. Testing was performed in summer 2018 using multiple configurations and various types of antennas, cables, elevations, and antenna mounting locations on the semi. The team took advantage of the Equipment Loan Program to test efficacy of other antennas and to support testing with CV equipment including a data packet sniffer. Having access to other CV equipment allowed WYDOT to test additional units and components in varying configurations that would have taken much longer without the Equipment Loan Program. Based on testing with the

loaner equipment, WYDOT was able to hone-in on refined equipment specifications and provide that information to their vendors.

City of Denver V2X Hub

In April 2018, the City of Denver ATCMTD project team participated in a session with experts from Federal Highway Administration (FHWA) to learn about approaches to procurement, management of agile and open-source projects, and resources available to help early adopters.

After learning about the services and support that are offered by the Equipment Loan Program and Help Desk, the team reached out to the program and began borrowing equipment to see how the devices would work with their existing technology. Denver was early enough in the process that the team did not know exactly what requirements to include in a solicitation for devices. "We started testing to see how these devices would work with our existing technologies in a living lab environment," says Emily Silverman, the Smart City program manager in Denver. "The equipment loan program was the perfect solution. Within a few days, devices were on their way, free of charge, to Denver."

Figure 2. Installation at Intersection (Source: City of Denver)

When the Denver team held a demonstration for leadership, the program shipped backup units overnight to ensure their testing and demonstration activities could be carried out successfully. Borrowing equipment from TFHRC includes the benefit of direct communication with technical support staff at TFHRC's Saxton Transportation Operations Laboratory. Denver's technical team collaborated with the support staff to get all the loaner equipment working with the city's traffic signal controllers, including older generation controllers Denver's team had assumed would not be supported.

"This achievement was a big deal for Denver," says Dave Edinger, Denver's chief information officer. "Our Smart City team operates from a set of core values, including supporting multivendor interoperability and avoiding lock-in."

The Denver team noted that they were able to borrow the equipment for several months and for a few pieces, almost one year. Overall, the team found that borrowing equipment was much faster than waiting for vendor lead times, which can take several months. The team recommends early deployers to utilize the Equipment Loan Program and Help Desk to gain experience using the equipment and to understand the different implementation approaches across vendors.

Connected Vehicle Pilots Interoperability Testing

In summer 2018, the three CV Pilot Deployment Sites (New York City, Tampa and Wyoming) convened at the Turner-Fairbank Highway Research Center (TFHRC) in McLean, Virginia to conduct a CV device Interoperability Test on the STOL testbed. In addition to testing interoperability among CV devices from the three sites, the testing also served to identify potential interoperability issues that may require

resolution prior to the sites advancing to an operational phase of the CV Pilot Deployment Program later in 2018.

Figure 3. A THEA vehicle (white car) waits as it receives an intersection movement assist warning being triggered by a New York City vehicle (black car) at the TFHRC test track. (Source: USDOT)

Planning for the testing event was jointly led by the CV Pilot sites in coordination with TFHRC and USDOT staff. TFHRC and CAV Support Services provided a testing facility, technical assistance and equipment support to the CV Pilot sites. This support included installing the same RSU models used by the sites to allow them to replicate their configurations, installing OBUs from the sites in vehicles and providing trained drivers to operate the vehicles during the interoperability test runs.

Additionally, the sites each loaded the RSUs from the Equipment Loan Program with their own software. A test of this nature involving three deployment sites, six device vendors and multiple communications media had never been done before.

Resources

1. https://www.pcb.its.dot.gov/CAVSupportServices.aspx

2. https://www.its.dot.gov/pilots/wyoming_antenna.htm

3. https://www.fhwa.dot.gov/publications/publicroads/19spring/05.cfm

4. https://www.its.dot.gov/pilots/crosssite_cvp.htm

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