MAY 2021

Project Title: Connected and Automated Vehicle (CAV) Application Development

Task Number: 3614

Start Date: January 1, 2019

Completion Date: December 31, 2024

Task Manager: Melissa Clark Transportation Engineer (Electrical) melissa.clark@dot.ca.gov

WHAT IS THE NEED?

A connected vehicles environment holds the potential to support a fundamental advance in surface transportation. While the vehicle component and infrastructure component of the transportation system have traditionally been only loosely coupled (through static signing, vehicle presence detectors, etc.), connected vehicle technologies will allow the components to “work” actively together – creating a fully connected vehicles and infrastructure environment. This provides the potential for reduction in congestion and improvement in safety and environment, resulting in improved traveler services. In order to realize this potential, a connected vehicles system and environment will require unprecedented collaboration between the private and public sectors, on a scale not required in the current loosely coupled system.

To date, the national United States Department of Transportation (USDOT) Connected Vehicle initiative has focused largely on “how” to technically accomplish the integration. A considerable amount of solid technical work at the local, state and national level has been devoted to developing communications standards (e.g., Dedicated Short Range Communications (DSRC)), developing and deploying field equipment for small-scale prototype/proof-of-concept testing, and high-level conceptual development. As this work has progressed, it has become increasingly clear that there will not be a single way to implement connected vehicle technologies. For example, the recent trend is that various wireless technologies in addition to DSRC should be considered when exploring deployment of connected vehicles applications. In addition, there has also been considerable focus in developing automated vehicles and...
providing supporting infrastructure. Those vehicles will initially, and potentially in the long-term, need a connected environment to fully realize all the safety, mobility and societal benefits.

As owners and operators of the nation’s surface transportation infrastructure, state and local transportation agencies are at the core of the connected vehicle infrastructure. While automakers and device manufacturers will dictate availability of vehicular equipment, transportation agencies will control the deployment and operation of roadside infrastructure and the incorporation of connected vehicle technologies into infrastructure applications (such as traffic signal control). To guide transportation agency involvement in connected vehicle deployments, AASHTO developed a Strategic Plan and Connected Vehicle Field Infrastructure Footprint Analysis to aid the owners and operators in the nationwide deployment of the connected vehicle infrastructure. USDOT has also produced guidance documents for deploying and supporting connected vehicle technology. While great strides have been made over the last decade, it is clear that additional research is still needed to develop, field-test, and perform technology transfer for applications that will make full use of the connected vehicle environment.

The Connected Vehicle Pooled Fund Study (CV PFS) acts as a continuation of the Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII) (TPF-5(206)). TPF-5(206) was initiated in 2009 and was active for nearly 10 years. During that time, the program has been successful in its pursuit to provide technology transfer to aid transportation agencies and OEMs in justifying and promoting the connected vehicle environment and applications through modeling, development, engineering and planning activities. As of May 2018, eleven research projects have been completed and four additional projects are currently underway. The new CV PFS will continue the work of TPF-5(206) after that project ends.

WHAT ARE WE DOING?

In this project the focus is on:

- Research, development, and evaluation of connected vehicle applications;
- Improved technology transfer to state and local agencies through:
  - Documenting and sharing deployment best practices and guidelines;
  - Providing input into emerging standards;
  - Identifying additional requirements within the Connected Vehicle Program to connected vehicle technology by transportation agencies and OEMs
  - Coordinating with OEMs on infrastructure and vehicle tests, application development, and standards development.

The specific program of projects to be conducted will be developed by participating states in the pooled fund study. Examples of recent projects include:

- Vehicle-to-Infrastructure Queue Advisory/Warning
- Using Third Parties to Deliver Infrastructure-to-Vehicle
- Multi-Modal Intelligent Traffic Signal System – Phase III: Deployment Readiness Enhancements

WHAT IS OUR GOAL?

To provide technology transfer to state, local, and international transportation agencies as well as vehicle Original Equipment Manufacturers (OEMs) in preparing for the deployment of connected vehicle infrastructure and to provide input to the AASHTO Connected and Automated Vehicle working group, USDOT Connected Vehicle Program, and other national initiatives.

To establish a multi-phase program to facilitate research, field demonstration, evaluation, and technology transfer of connected vehicle...
infrastructure, vehicles, and applications. To aid transportation agencies and OEMs in justifying and promoting the large scale use of connected vehicle environment and applications through modeling, development, engineering, and planning activities.

**WHAT IS THE BENEFIT?**

Connected Vehicle research can enable driver, pedestrians, transit riders, and even cyclist to reach a destination quickly, safely, and in a cost-efficient manner. Research will investigate communication with the traffic signals, road infrastructure, communication methods, etc. There is potential for reduction in congestion, safety improvements, and improved traveler services.

**WHAT IS THE PROGRESS TO DATE?**

This project is multi-dimensional and a multi-phase program to facilitate the field demonstration, and deployment of Connected Transportation Systems infrastructure applications.

Currently, five projects are active and being sponsored by the pooled fund study:

1. Vehicle-to-Infrastructure Queue Advisory/Warning
2. Using Third Parties to Deliver Infrastructure-to-Vehicle
4. Creation of a Guidance Document for MAP Preparation
5. Connected Intersections Program: Program Management and Technical Support

A total of 13 projects were completed with the support from the pooled fund study. (Note that, IntelliDrive, the previous name of Connected Vehicle, appears in the early stage projects.)

1. Connected Traffic Control System: Research Planning and Concept
2. Basic Infrastructure Message Development and Standards Support
5. 5.9 GHz Dedicated Short-Range Communication Vehicle-Based Road and Weather Condition Application: Phase I
6. 5.9 GHz Dedicated Short-Range Communication Vehicle-Based Road and Weather Condition Application: Phase II
8. Traffic Management Centers in a Connected Vehicle Environment
10. Certification Program for Cooperative Transportation Systems: Preparing to Develop a Standards Compliance and Interoperability Certification Program for Cooperative Transportation Systems Hardware and Software
11. IntelliDrive Traffic Signal Control Algorithms
12. Investigation of Pavement Maintenance Support Applications of IntelliDrive
13. Investigating the Potential Benefits of Broadcasted Signal Phase and Timing (SPAT) Data under IntelliDrive

The website provides more detail to the projects listed above:

http://www.cts.virginia.edu/cvpfs_research/
The contents of this document reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the California Department of Transportation, the State of California, or the Federal Highway Administration. This document does not constitute a standard, specification, or regulation. No part of this publication should be construed as an endorsement for a commercial product, manufacturer, contractor, or consultant. Any trade names or photos of commercial products appearing in this document are for clarity only.