DRISI
Caltrans Division of Research, Innovation and System Information

Research Notes

Connected Vehicle - Pooled Fund Study- TPF-5(389)

A research program to support the research, development, and deployment of connected vehicles

Advanced Research

MAY 2022

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.

Caltrans

DRISI provides solutions and knowledge that improves California's transportation system

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.

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, there are two projects approved and being sponsored by the pooled fund study expected to begin in 2022:

1. Connected Intersections (CI) Message Monitoring
2. Model Connected Vehicle (CV) Data Architecture

There are two active and on-going projects:

1. Connected Intersections Program https://engineering.virginia.edu/cv-pfs-projects-and-research#accordion620710

2. Creation of a Guidance Document for MAP Preparation Phase II https://engineering.virginia.edu/cv-pfs-projects-and-research#accordion620711

A total of 17 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. Vehicle-to-Infrastructure Queue Advisory/ Warning
2. Multi-Modal Intelligent Traffic Signal System – Phase III: Deployment Readiness Enhancements
3. Creation of a Guidance Document for MAP Preparation
4. Using Third Parties to Deliver Infrastructure-to-Vehicle
5. Connected Traffic Control System: Research Planning and Concept
6. Basic Infrastructure Message Development and Standards Support
7. Multi-Modal Intelligent Traffic Signal System – Phase I: Development of Concept of Operations, System Requirements, System Design and a Test Plan
8. Multi-Modal Intelligent Traffic Signal System – Phase II: System Development, Deployment and Field Test
9. 5.9 GHz Dedicated Short-Range Communication Vehicle-Based Road and Weather Condition Application: Phase I
10. 5.9 GHz Dedicated Short-Range Communication Vehicle-Based Road and Weather Condition Application: Phase II
11. Best Practices for Surveying/Mapping Roadways and Intersections for Connected Vehicle Applications
12. Traffic Management Centers in a Connected Vehicle Environment
13. Aftermarket On-Board Equipment for Cooperative Transportation Systems: Enabling Accelerated Installation of Aftermarket On-Board Equipment for Cooperative Transportation Systems
14. Certification Program for Cooperative Transportation Systems: Preparing to Develop a Standards Compliance and Interoperability Certification Program for Cooperative Transportation Systems Hardware and Software
15. IntelliDrive Traffic Signal Control Algorithms
16. Investigation of Pavement Maintenance Support Applications of IntelliDrive
17. Investigating the Potential Benefits of Broadcasted Signal Phase and Timing (SPAT) Data under IntelliDrive

The website provides more detail to the projects listed above.
https://engineering.virginia.edu/cv-pfs

LEARN MORE

Check out the reports in the links provided:
https://www.pooledfund.org/Details/Study/642

Connected Vehicle Pooled Fund Study Website
https://engineering.virginia.edu/cv-pfs

IMAGES

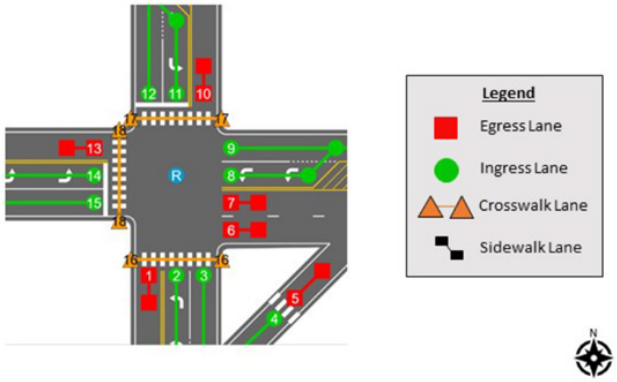

Image 1: Illustration of example lane ID numbering approach from the "Guidance Document for MAP Preparation"

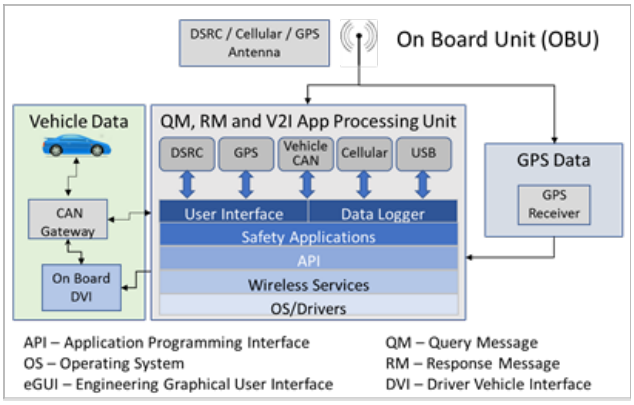

Image 2: Event-Driven Configurable Messaging (EDCM)-Enabled Vehicle System (Source: CAMP)

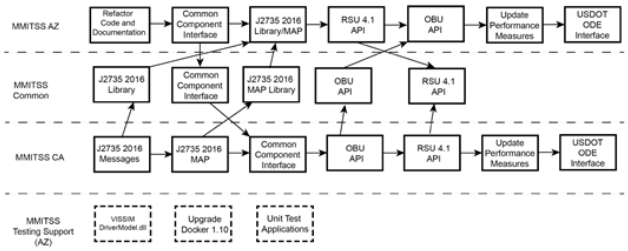

Image 3: MMITSS Development Plan