



CALTRANS DIVISION OF RESEARCH,
INNOVATION AND SYSTEM INFORMATION

Research Results

Advanced
Research

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Project Title:

Technical Support for Connected Vehicle Pilot Deployment “One California Deployment Support”

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Technical Support for Connected Vehicle Pilot Deployment “One California Deployment Support”

Vehicle Infrastructure Integration (VII).

WHAT WAS THE NEED?

The California Department of Transportation (Caltrans), three of California's largest metropolitan regions, and the University of California developed a partnership named One California with an intention to implement and demonstrate Connected Vehicle (CV) technology that can benefit the traveler, the environment, and the economy of California. Over the last decade or so, the United State Department of Transportation (USDOT) sponsored research to develop nearly 100 CV applications that had at their core, the ability to exchange data wirelessly between vehicles (Vehicle-to-Vehicle or V2V) and between vehicle and road infrastructure (Vehicle-to-Infrastructure or V2I). These nearly 100 applications spanned six specific categories including V2V Safety, V2I Safety, Agency Data, Environment, Road Weather, Mobility, and Smart Roadside.

This One California team was led by Caltrans and supported by three regional transportation partners, including: The Metropolitan Transportation Commission of the San Francisco Bay Area (MTC), The Los Angeles County's Metropolitan Transportation Authority (LA Metro), and The San Diego Association of Governments (SANDAG). The academic partners were UC Berkeley PATH and UC Riverside Center for Environmental Research and Technology (CE-CERT).

WHAT WAS OUR GOAL?

The goals of this project were in two focus areas. The first was to develop, implement and field test a set of critical CV applications in the California CV Test Bed to establish technological foundations for California CV deployment. The second was to support the development of CV in California.



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

WHAT DID WE DO?

One California sought to spur innovation, promote economic vitality, and protect precious natural resources through early adoption of CV systems and applications. Specifically, the One California team aimed to improve traveler safety, mobility, and the productivity of goods movement while improving California's environment through the implementation, demonstration, and evaluation of a variety of previously developed CV applications, at various locations within California.

The research that was covered in the Final Report contained the work conducted during this project. The rest of the Final Report consisted of the following content:

- Roadside Unit Upgrade and Test Bed Expansion
 - Described the efforts to upgrade the Roadside Unit (RSU) at eleven (11) existing test-bed intersections to be compliant with the 2016-version of IEEE 1609 family of standards and expand the test bed with five (5) additional intersections.
- Development of CV Applications
 - Described the CV applications developed under this project.
- Prepare California CV Test Bed for Field Testing
 - Described the efforts conducted to prepare the California CV Test Bed to be ready for the system test.
- Field Operation Test and System Performance Evaluation
 - Presented field operation test procedure and evaluation results

WHAT WAS THE OUTCOME?

The work throughout this project showcased that

- CV-based signal priority helped to reduce 7.3% on number of stops at red signal, 7.4% on trip time, and 12.5% on stopped time at red signal; and
- Radio Technical Commission for Maritime (RTCM) Services corrections increased correct detection rate of lane-of-travel from 86%

without correction to 100% with correction. Caltrans Traffic Signal Control Program (CTSCP) enhancements for CV applications, particularly the dynamic force-off points feature, made the CTSCP capable of applying more advanced traffic signal control and priority control schemes that adapted to the prevailing traffic conditions. However, it still needs a long time for connected vehicles to reach a high enough penetration rate so that CV data-based signal performance measures could be realistic. Research on utilizing infrastructure-based traffic detection and classification data to develop and test adaptive control schemes is needed. Alternative approaches, such as cloud-based vehicle probe data from mobile phones, need to be investigated to fill the data gap.

In current implementation of RTCM broadcasts, the base reference station is pre-selected. To deploy RTCM broadcasts in California, research is needed to develop a RTCM broadcasts system that can automatically select the best reference station based on Roadside Unit (RSU) position and automatically switch to an alternative reference station when the primary reference station has a temporary failure. In addition, network Real-Time Kinematic (RTK) can provide wider coverage area than single base RTK. Research is needed to investigate approaches to fuse single base RTK with network RTK to provide most cost-effective RTCM corrections.

WHAT IS THE BENEFIT?

The upgrade and expansion of Roadside Units (RSUs) and the test bed provide a robust infrastructure for evaluating and implementing connected vehicle technologies, enhancing transportation safety and efficiency. The development of CV applications improves traffic signal control, priority control, and overall transportation performance, optimizing the utilization of data exchange between vehicles and infrastructure.

Additionally, the preparation of the California CV



Test Bed ensures a reliable platform for conducting field tests, enabling accurate evaluation of connected vehicle systems and applications. As a result, this process stimulates ongoing improvement and advancements in transportation technology, ultimately paving the way for the development of safer and more efficient transportation systems.

LEARN MORE

TBD-Final report link.