Early Opportunities to Apply Automation in California Managed Lanes

Identifying the Need

Connected and automated vehicles (CAVs) hold the potential to make significant improvements to traffic safety, travel time reliability, roadway capacity, and the environment. Achieving these benefits will require a combination of in-vehicle technologies, infrastructure support, and connected vehicle capabilities, including both vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. To understand how these CAV applications will function in real-world scenarios, testing sites need to be identified and evaluated. Managed lanes have the potential to be ideal testbeds for CAV technologies, and California has one of the largest networks of managed lanes in the country – a unique advantage when testing new connected automated vehicle (CAV) concepts. Managed lanes include high occupancy vehicle (HOV) lanes, high occupancy toll (HOT) lanes, express lanes, and general-purpose lanes for mixed traffic.

Project Description

Eight sites were selected as the most promising facilities for early experimental and deployment sites for CAVs. A set of criteria was developed, and the locations were visited and assessed. The I-15 express lanes in San Diego and the I-10 express lanes in Los Angeles were designated as the best potential fit as managed lane sites for future CAV testing.

The major CAV applications being studied by USDOT for near-term deployment in managed lanes were also evaluated and five applications were chosen to be considered for testing in the two proposed California sites. Finally, conceptual test and deployment plans for the five CAV applications, various testing scenarios, and an analysis of the likely timeline for testing and pilot deployment and related vehicle and infrastructure requirements of those applications were created. Approximately two years of preparation will be required before testing or initial deployment can occur.

What is the Goal?

The purpose of this research is to identify specific opportunities to leverage California's managed lane network as early experimental and pilot deployment sites for CAVs and to analyze the major CAV applications and their impact on mixed traffic for testing on the designated sites.

Progress to Date

The project is complete. The I-15 site was identified and recommended because it fits all the site selection criteria. It offers an exclusive and controllable traffic environment for the CAV tests; most of the facility is physically segregated from the general-purpose lanes; and the interaction between the traffic stream of the express lane and the general traffic is limited to the ingress/egress areas.

The operation agencies (SANDAG and Caltrans) are active in promoting the testing of CAVs at the facilities, have streamlined the test permitting process, and are willing to open the right-of-way for installing additional road-side infrastructure - an essential component of the CAV tests. They also offer the opportunity to close some entrances and/or exits during tests, giving the testing team the ability to actively control the test traffic conditions, thus allowing the subject vehicles to be evaluated in different levels of traffic complexity. The facility also has an extensive coverage of the traffic monitoring system which can be used to collect real-time data during the tests. In addition, I-15 has already been named an official CAV proving ground by USDOT.

Out of the 11 CAV applications that were considered for early testing and deployment, five were chosen as the most potentially beneficial: highway CACC, V2I speed harmonization, freeway merge coordination, automated bus rapid transit, and automated barrier mover vehicle. Previous simulation studies or small-scale field tests indicate that the first four applications have potential to greatly shift traffic flow patterns within the existing highway facilities.

Projected Benefits to California

The expected benefits of deploying the five CAV applications at the proposed sites include increased capacity, reduced congestion, and smoother traffic flow in managed lanes with some related improvements to safety, reduced energy consumption, and emissions.

The highway CACC application is expected to improve the capacity of the managed lane by allowing vehicles to safely travel at very short gaps under high-speed conditions. This can greatly improve the roadway capacity, traffic flow stability, and efficiency.

The V2I speed harmonization application will send advisory speeds to vehicles upstream, letting vehicles reduce their speed before entering the bottleneck area, ultimately leading to decreased traffic breakdown and improved safety. This significantly reduces the traffic fluctuations leading to less vehicle acceleration/deceleration and shockwaves. It also reduces front and back collisions, energy consumption, and emissions.

The highway merge coordination application will streamline the freeway merging process by identifying and creating gaps in traffic before entering the merging area, allowing for smoother traffic flow. The automated bus rapid transit application could be tested and implemented in several stages by first operating in mixed traffic. Testing results will demonstrate the readiness of implementing the bus in a more complicated traffic environment.

And finally, the automated barrier mover vehicle application may speed up lane reconfiguration if the process can be automated, providing a faster response time to traffic incidents and improvements to efficiency. All of these contributing factors would result in significant improvement of traffic mobility, safety, and vehicle fuel economy without massive investment on infrastructure expansion.

Final Report

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Images

Fig 1. Ingress/Egress Section of I-15 Express Lane Facility.

Fig 2. Moveable Barriers and Direct Access Ramps on I-15 for Public Transit.

Fig 3. Permanent Barriers along I-15 Express Lane.

Figure 4. Changeable Message Signs on I-15 Express Lane.

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