DRISI
CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION
TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

TPF-5(494) Winter Chain-On Delay Travel Times

Develop and test a Bluetooth-based algorithm to estimate chain-up delays near Fawndale and improve I-5 traveler information.

Rural

May 2026

Project Title:
Winter Chain-On Travel Time Delay

Task Number: 4148

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WHAT IS THE NEED?

Increases in severe winter conditions along the I-5 corridor have resulted in more aggressive chain control restrictions and, in some cases, closure of the interstate corridor wide. Districts utilize a series of strategic chain control checkpoints to determine a vehicle's ability to drive through an impacted area. Often, these chain control checkpoints create a large amount of non-recurring congestion and enormous vehicle queues. During winter operations, D2's Fawndale chain control checkpoint generates queues of up to 20 miles, creating hours of delay for commercial vehicles and motorists. This reduced efficiency has a significant safety, economic, and operational impact to the State of California. Many California Department of Transportation (Caltrans) districts have implemented travel time messages to improve efficiency in urban areas experiencing recurring congestion. District 3 implemented winter travel times with limited success. With increases in commercial vehicles supporting an ever-growing supply chain, we need to better understand queue delay times and be able to inform the public of delay times at chain control checkpoints during inclement weather.

WHAT ARE WE DOING?

We are proposing to procure, install, and operate Bluetooth detection devices near District 2's Fawndale chain control point. Using the collected Bluetooth detection data, District 2 RWIS data and National Weather Service data, we will utilize data fusion techniques to develop a winter travel delay algorithm for this chain control point. Once developed, we will ground truth and make fine-tuned adjustments to the algorithm and system during the project. We intend to develop this algorithm / system so it will be usable at other chain control checkpoints statewide. We will also document

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the design, installation, integration, operation, and maintenance processes of this system.

WHAT IS OUR GOAL?

To provide accurate, timely, and reliable chain control checkpoint delay times to motorists during weather events. Providing this information to the traveling public is crucial for the Department to improve winter travel efficiency as both supply chain issues and climate change-induced events continue to increase. A key goal is to develop a working algorithm and system to deploy at multiple chain control points. Another key goal is to inform commercial vehicle operators and motorists that significant delays are ahead, allowing them to make adjustments to their travel plans before arriving at the chain control point. Ultimately, Caltrans will gain a deeper understanding of current and impending congestion issues, which will inform future planning activities.

WHAT IS THE BENEFIT?

Climate change is not going away, and supply chain issues will continue to impact our roadways. As severe winter storms continue to cripple the state highway system, having the ability to communicate accurate winter travel delay times will be crucial to maintain the safety, operational efficiency, and goods movement of our roads. Accurate winter travel delay times communicated to motorists at strategic decision points allow motorists the ability to take an alternate route, re-adjust travel plans, or avoid traveling, resulting in less vehicles on the road and less green-house gases emitted into the atmosphere during the queuing process. Finally, reducing the economic impact on the commercial vehicle industry due to chain up delays would benefit one of the largest users of our system.

WHAT IS THE PROGRESS TO DATE?

Project calls and meetings took place as needed. A presentation was given during a moderated session at Institute of Transportation Engineers (ITE) / National Rural Intelligent Transportation Systems (NRITS). Originally, we were scheduled to present a poster, and a poster was completed in anticipation of this. A presentation was created for the moderated session that took place in August in Orlando.

A student was hired to work on the project during summer. This student helped with data analysis and preparation of the poster (subsequently, presentation) for the 2025 ITE / NRITS Conference. This student continues during the academic year, working on a Data Science Capstone Project on data analysis.

Another student is working on a Computer Science Senior Project, helping to test and document code used on the project. Two more students are working on a Computer Science Senior Project, testing data collection, particularly from Bluetooth Low-Energy devices in vehicles traveling at highways speeds.

Additional students are working on a related senior project testing data collection for Bluetooth Low-Energy (BTLE) along Interstate 15 north of Butte, Montana.

Access to Caltrans Bluetooth Sensor data continued to be tested and data was downloaded for analysis. Retrieval scripts were monitored for access to Caltrans Chain Requirements, Content Management System (CMS) messages, CCTV, and Road Weather Information System (RWIS). National Weather Service (NWS) National Digital Forecast Database (NDFD) weather forecast and Here.com speed data retrieval scripts continued to collect data. Data Archival routines were monitored. The Here.com subscription model changed in August, and updates were made to retrieval processes to account for this, as well as procurement.

Further analysis was performed with data from all Caltrans Bluetooth sensors and other data. Fitness for use and data cleaning and preprocessing continued. Data quality was evaluated. In conjunction with chain-up and bad weather events, data was analyzed. Focus was placed on known chain-up events and determination of benchmark travel times during chain up events. Extensive analysis was conducted on a November 2024 chain-up incident. This formed the basis for the poster / presentation for ITE / NRITS 2025 and served as a tool for the project team to better understand various aspects of a typical chain up event. All site data was incorporated into the analysis. New data from the 2024-25 bad weather season was analyzed.

Preliminary investigation activities were performed for the Preliminary Algorithm Development task. Students had previously developed a preliminary backup detection algorithm as part of a prior

Capstone project, and development of a new preliminary algorithm is currently underway. Work was also initiated on the Preliminary Algorithm Testing task and will continue into the next quarter.