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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

November 2025

Project Title:
Winter Chain-On Travel Time Delay

Task Number: 4148

Start Date: June 1, 2023

Completion Date: August 31, 2025

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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 management activities continued throughout the period, including coordination with the Western States Rural Transportation Consortium Steering Committee and planning for the upcoming moderated presentation at the 2025 ITE / NRITS Conference in Orlando. Student involvement remained central, with Capstone students contributing to data analysis, development of a preliminary backup detection algorithm, and the creation of a poster presented at Montana Tech's TechXpo. A new student was hired for summer work to support ongoing data analysis and preparation of presentation materials. Data retrieval and archival processes for Bluetooth sensor data, chain control status, CMS messages, CCTV, RWIS, weather forecasts, and speed data were actively maintained. A significant analytical focus was placed on known chain-up events, particularly the November 2024 event, which informed the current findings and presentation materials.

Next steps include continuing project management efforts, supporting the student working over the summer, and requesting a no-cost time extension. Data collection tasks will continue, including monitoring retrieval scripts and adjusting Here.com data processes to match the upcoming subscription model change. Preparations will be made for the 2025–26 bad weather season. Data analysis will deepen through continued cleaning, fitness-for-use checks, and comparative evaluation of Bluetooth and Here.com data, with emphasis on late 2024 and early 2025 chain-up events. Further development of the preliminary algorithm will use the November 2024 event for initial training and subsequent events for testing. Preparations for preliminary algorithm testing will commence, with a full algorithm evaluation and summary planned for a subsequent phase.