



U.S. Department of Transportation  
Federal Highway Administration

Turner-Fairbank  
Highway Research Center

SAXTON  
LABORATORY

# Connected and Automated Vehicle (CAV) Telematics Tool: Your Data in Realtime

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# Overview

- ▶ Is an open-source, Web-based platform provided by USDOT.
- ▶ Supports cooperative driving automation (CDA) research.
- ▶ Facilitates real-time data collection and streaming from vehicles and infrastructures.
- ▶ Provides a dashboard on which users can visualize data.



# Components



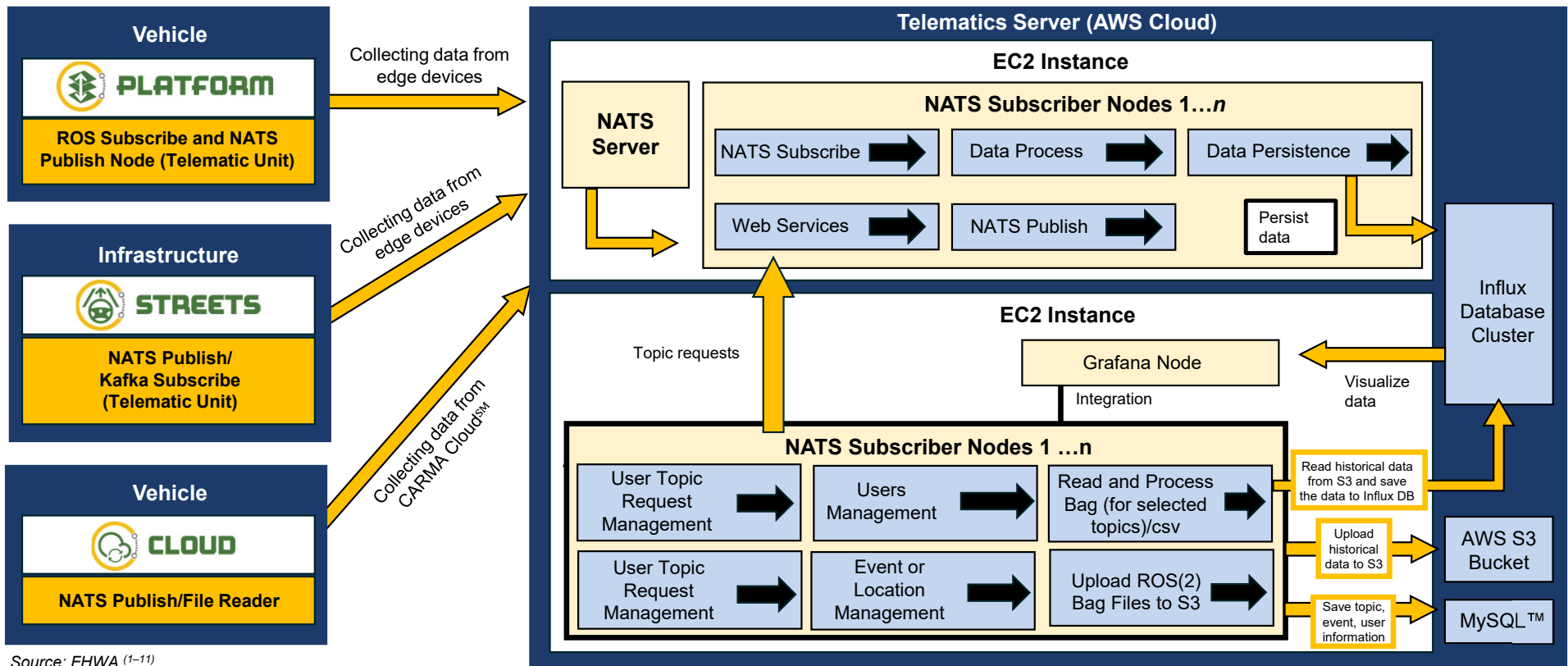
## ▶ **Hardware:**

- ▶ Edge device or a computer connected physically to the entity to collect the data.
- ▶ Cellular network provider to stream the data.

## ▶ **Software:**

- ▶ Data processing server to process the data.
- ▶ Time-series database to store collected data.
- ▶ User-interface to visualize and analyze data.

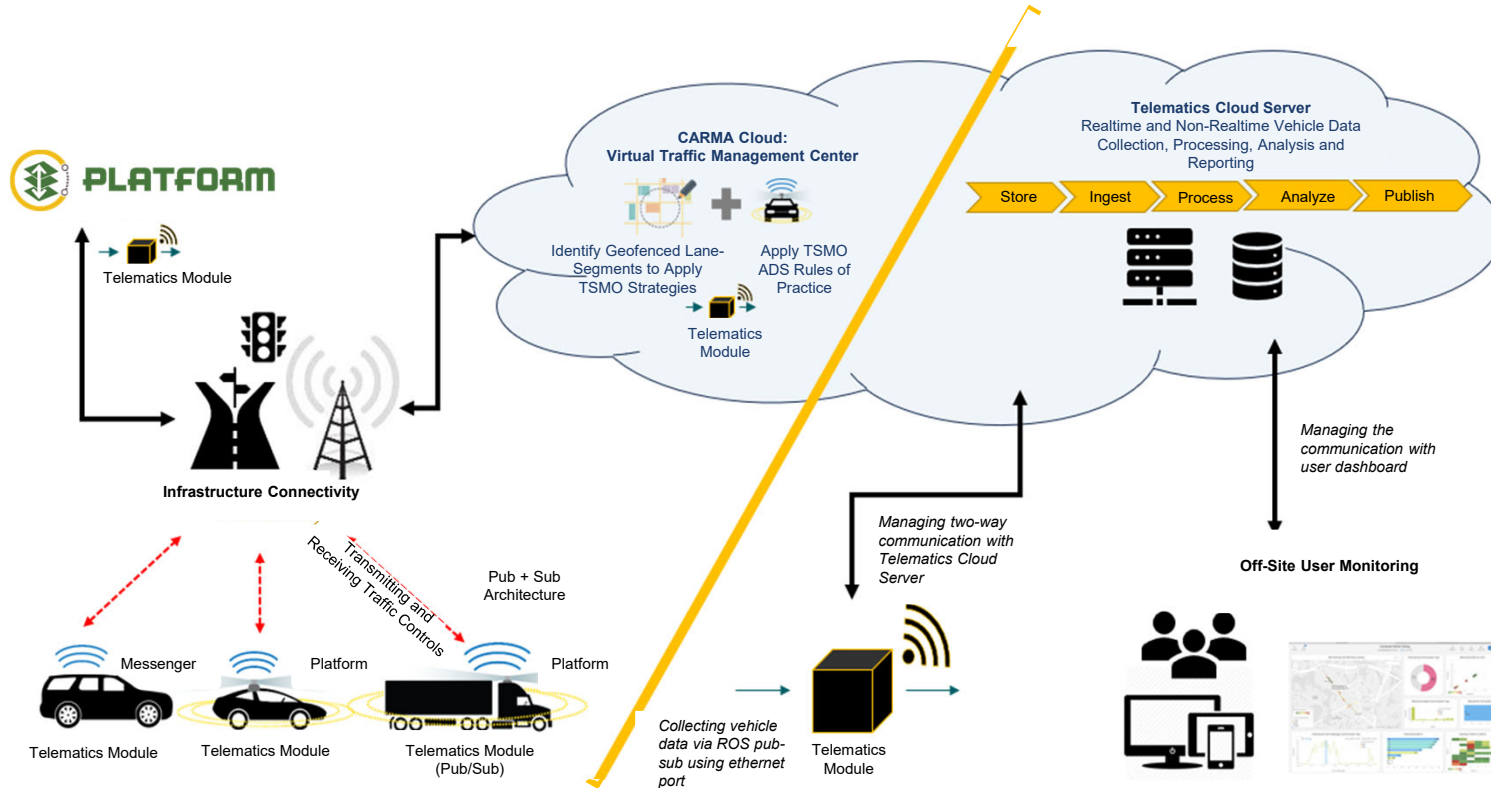
# CAV Telematics Tool Architecture



Source: FHWA.(1-11)

AWS = Amazon Web Services™; csv = comma separated values; EC2 = Elastic Compute Cloud; n = number of nodes; ROS = Robot Operating System; S3 = Simple Storage Service.

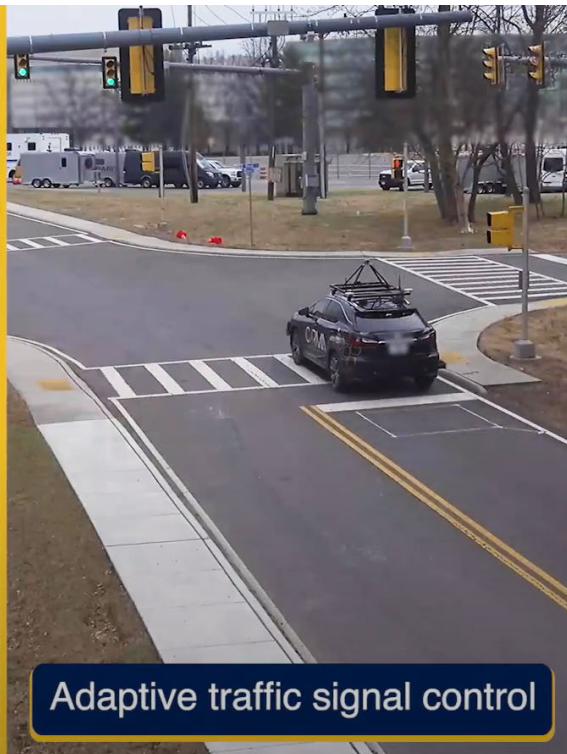
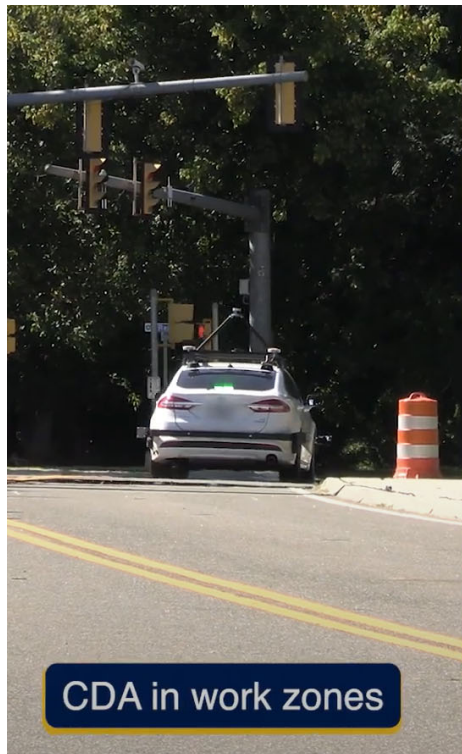
# High-Level Interaction Diagram



TSMO = transportation systems management and operations.

Source: FHWA.(1,2,6,9,12)

# Supports Any Use Case Involving Vehicles



Source: FHWA.

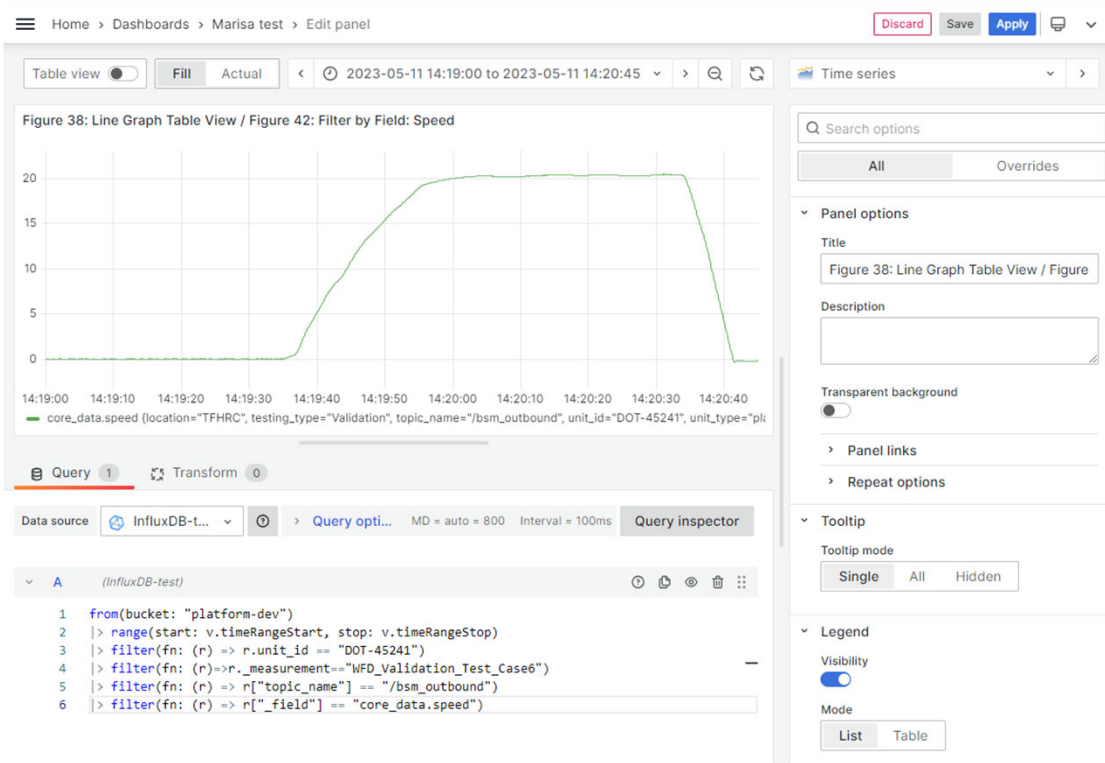
# Key Features



- ▶ This tool facilitates realtime data collection and streaming. The tool can track many different types of data, including:
  - ▷ Current speed of vehicle.
  - ▷ Acceleration.
  - ▷ Distance from end of lane.
  - ▷ Vehicle lane status.
  - ▷ Basic safety messages.
  - ▷ Traffic signal phases.
  
- ▶ CAV Telematics Tool Tutorial:  
[https://www.youtube.com/watch?v=miU74slm0zk.](https://www.youtube.com/watch?v=miU74slm0zk)



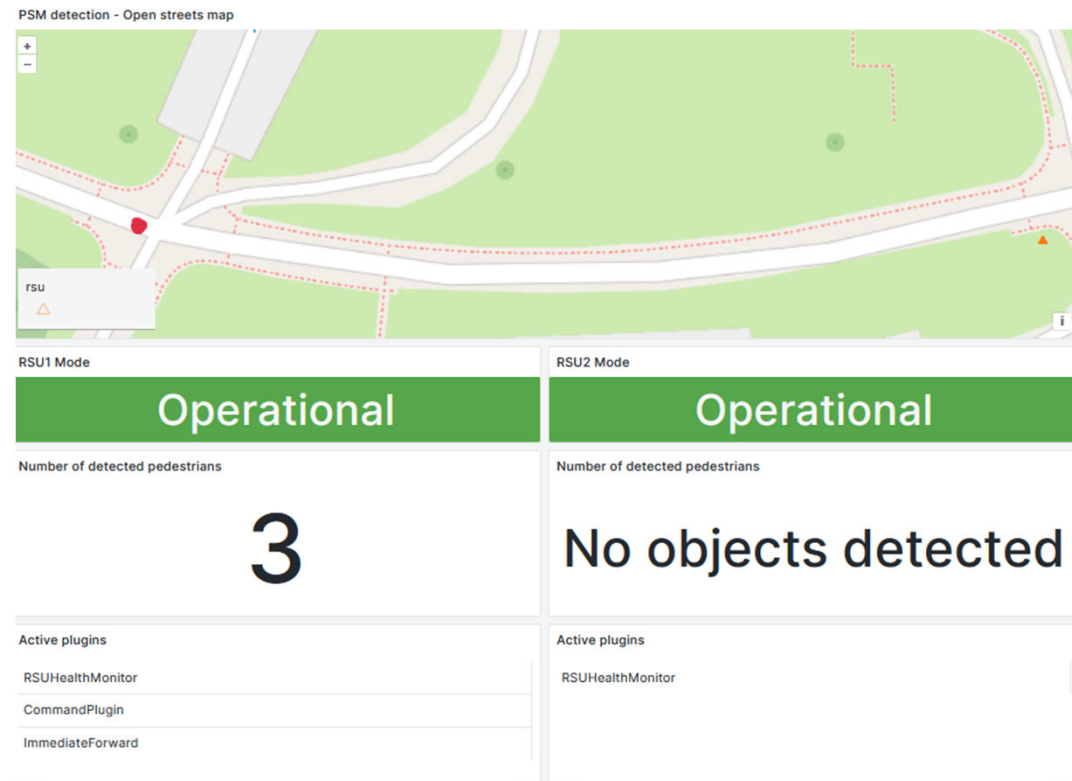
# Visualizing Speed



# Vehicle-to-Everything (V2X) Hub<sup>SM</sup> Integration



- ▶ The telematics tool connects with V2X Hub to stream data directly from infrastructure.<sup>(14)</sup>
- ▶ The tool can be used to monitor roadside unit (RSU) health and message broadcasts.<sup>(1,15)</sup>

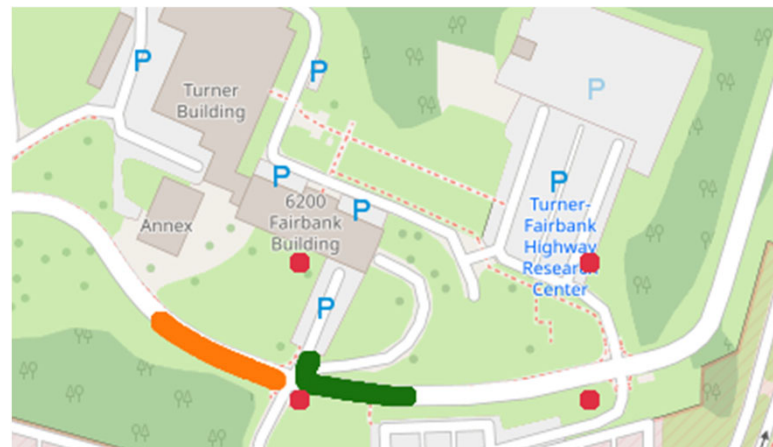


Source: FHWA.<sup>(1)</sup>

# Historical Data Processing



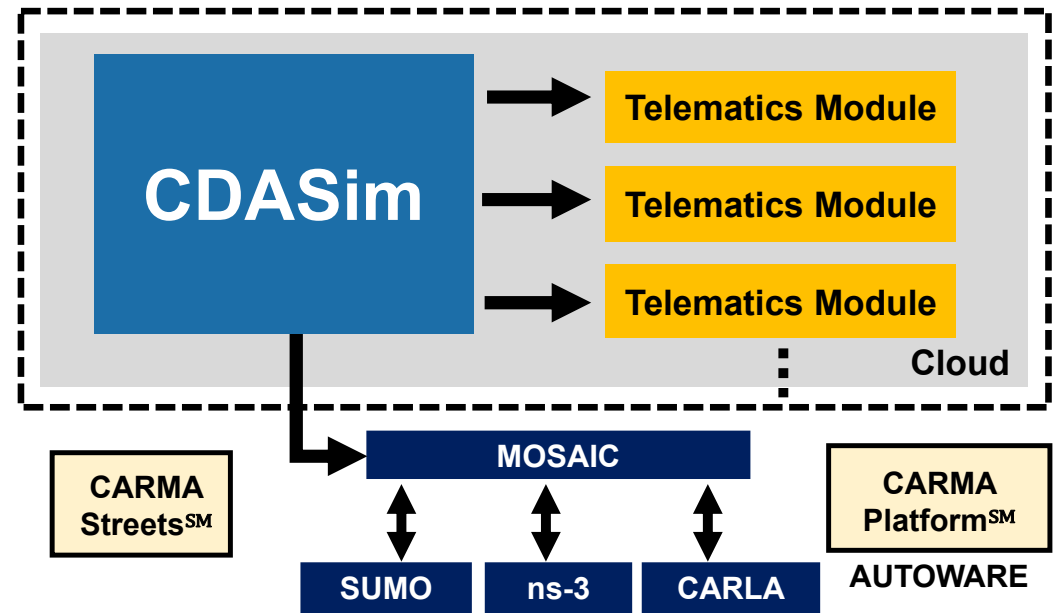
- ▶ This tool can be used to visualize historically recorded data by facilitating the uploading and processing of collected logs.<sup>(16)</sup>
- ▶ Logs can be uploaded through the Web-user interface and data from them plotted on the dashboard for event analysis.



# Streaming Simulation Data



- ▶ Connects to simulation environment to stream vehicle and infrastructure data from simulated entities.
- ▶ Integrates with CDASim environment.<sup>(17)</sup>
- ▶ Supports CARLA<sup>®</sup> and SUMO<sup>™</sup> simulation environments as a co-simulation by using the *MOSAIC*<sup>™</sup> framework to facilitate coordination and data exchange.<sup>(17-21)</sup>
- ▶ Simulates cooperative automated driving system communications using ns-3.<sup>(21)</sup>



Source: FHWA.<sup>(1,2,3,17-22)</sup>

# Local Deployment



- ▶ The tool offers an optional local deployment of the setup, so users can stream data without an internet connection.
- ▶ Deployment allows for use of tool in portable infrastructure units, such as CAVe-in-a-box.<sup>(23)</sup>
- ▶ The open-source code base enables users to deploy all services on their own hardware.

# CAV Research



- ▶ Effective CDA research, deployments, operations, training, and education will require vehicle and infrastructure data to be collected, consolidated, and made accessible for processing and analysis.
- ▶ The CAV telematics tool has been used in current CDA research for observing and analyzing timing of traffic signal states and data from an automated vehicle as the vehicle clears an intersection.



# Benefits

- ▶ Users can view real-time data flow from different sources on a map or a graph:
  - ▷ CARMA Platform.<sup>(2)</sup>
  - ▷ CARMA Cloud.<sup>(6)</sup>
  - ▷ CARMA Streets.<sup>(3)</sup>
  - ▷ V2X Hub.<sup>(14)</sup>
  
- ▶ Users can record and save the historical data of the system.
  
- ▶ V2X Hub users can see current operational status of connected RSUs.<sup>(14,15)</sup>

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# Questions?

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