The CARMA ecosystem engages various stakeholder groups to accelerate advancements and encourage collaboration in CDA research, development, and testing.

**CARMA COLLABORATIVE**

The CARMA COLLABORATIVE is growing a community of CARMA users, prospective users, and other stakeholders working to advance CDA through shared expertise and collaboration. The CARMA Collaborative conducts outreach activities to enhance stakeholder awareness and participation, and facilities strategic partnerships to promote the use of CARMA in CDA research. These outreach activities include virtual and in-person events, webinars, conferences, meetings, and communications materials (e.g., social media, multimedia, publications). Through these efforts, the CARMA collaborative aims to develop a community of organizations focused on CDA that are using CARMA.

**CARMA SUPPORT SERVICES**

CARMA SUPPORT SERVICES provide stakeholders with knowledge and technical support on the CARMA product/tool suite to accelerate CDA research. Staff from the Saxton Transportation Operations Laboratory provide the tools and expertise to CARMA implementers. Support services hopes to accelerate CARMA innovation by providing excellent customer service to users.

For more information, visit [https://highways.dot.gov/research/operations/CARMA](https://highways.dot.gov/research/operations/CARMA) or contact the CDA Program at CARMA@dot.gov.
The CARMA research tracks leverage emerging automated driving technology and vehicle-to-everything (V2X) technology to enable increased safety, operational efficiency, and sustainability in moving people and goods.

Through collaboration and open-source software (OSS) development, CARMA enables researchers and engineers to research, develop, test, and evaluate CDA features on infrastructure and vehicles equipped with driving automation features. This research will establish the foundation for the adoption of CDA across transportation infrastructure and vehicle make and model.

Under the CARMA ecosystem is a network of products, research tracks, evaluation tools, and engagement strategies that all use CDA to improve transportation safety and performance.

**CARMA Ecosystem**

To advance CDA R&D, the U.S. Department of Transportation developed CARMA, a technology-enabling initiative under the FHWA CDA program. CARMA focuses on improving the transportation system by leveraging emerging automated driving technology and vehicle-to-everything (V2X) technology to enable increased safety, operational efficiency, and sustainability in moving people and goods.

The CARMA ecosystem has proven to be an innovative set of OSS tools with strong stakeholder support. The ecosystem is poised to move into a new phase of R&D focused on benefit analysis and application testing, building toward large-scale test track and/or on-road pilot testing.

**FREIGHT**

**CDA FREIGHT RESEARCH TRACK** is a joint effort between FHWA, the Federal Motor Carrier Safety Administration (FMCSA), the U.S. Maritime Administration, and the Intelligent Transportation Systems Joint Program Office (ITS/JPO). The effort explores the application of CDA to commercial vehicles, such as buses and trucks, and port operations, with the ultimate goal of accelerating the adoption of CDA technologies in freight vehicles and demonstrating the potential of automated truck movement in ports and warehouses.

**TRAFFIC**

**CDA TRAFFIC RESEARCH TRACK** aims to demonstrate how the introduction of CDA can improve road safety and traffic conditions in partnership with ITS/JPO, the Federal Transit Administration, and FMCSA. The basic travel use case developed on the CARMA Platform tests TSMO strategies to enhance infrastructure and reduce recurring traffic congestion.

**RELIABILITY**

**CDA RELIABILITY RESEARCH TRACK** examines CDA applications to one-time traffic congestion (i.e., hazardous weather, traffic incidents, and work zones) in partnership with ITS/JPO and FMCSA. This track focuses on scenarios for road and weather management, traffic incident management, and work zones. In these scenarios, the vehicle will detect the cause of traffic congestion and adjust its speed and route accordingly, which ultimately will reduce traffic congestion.

**CLOUD**

**CARMA CLOUD™** is a set of cloud-based, OSS services enabling communication and cooperation between cloud services, vehicles, infrastructure, and road users. It will allow the application of TSMO CDA strategies through rules for road users to help manage the flow of traffic.

**PLATFORM**

**CARMA PLATFORM™** is a vehicle-based platform that uses the information from CARMA Cloud to enable automated vehicles to interact and cooperate with road elements, including vehicles, infrastructure, and other vulnerable road users with mobile devices.

**STREETS**

**CARMA STREETS** is an infrastructure-based application for automated vehicles to share information and planned trajectories with one another and infrastructure to enable cooperative actions that improve transportation operations and safety.

**MESSAGER**

**CARMA MESSAGER** is a vehicle-based application for manual, or nonautomated vehicles and it enables communication with other participants to engage in CDA. This new capability will support research with first responders and encourage transit participation in CDA.

**ANALYTICS**

**CARMA ANALYTICS** helps with the transfer, storage and fusion, and analytics of cooperative automated vehicles and traditional transportation data.