



86th Legislature, Interim Charge 3, Request for Information

House Committee on Transportation

September 18, 2020

Interim Charge 3.

Study the technology and safety aspects of autonomous and semi-autonomous vehicles, including predictive capabilities and the potential for dedicated freeway and surface lanes for public transportation, autonomous vehicles, and semi-autonomous vehicles. Make recommendations for optimizing state policy to prepare for varying vehicle technologies to ensure safety and traffic reliability on Texas roadways.

Introduction

The Texas Legislature has authorized the Texas Department of Transportation (TxDOT) to examine and evaluate innovative transportation technologies to reduce costs, reduce traffic congestion, promote safety, and increase economic productivity. In an era of limited financial resources and evolving technological advances, TxDOT and its transportation and technology partners understand the importance of embracing the opportunities inherent in applying technology and innovations in transportation operations to help address transportation challenges.

TxDOT's involvement in Connected and Autonomous Vehicles (CAV) includes, but is not limited to the following:

- Monitoring for technological innovations that can be implemented on the state system;
- Monitoring private entity initiatives and activities in the state;
- Incorporating CAV technology into planning, operational, and organizational strategies for TxDOT, including both passenger vehicle and freight related strategies;
- Sharing innovations, knowledge, and best practices with local government agencies, private partners, national transportation organizations, Federal Highway Administration (FHWA), and other state DOTs;
- Leading the state-wide Connected and Autonomous Vehicle Task Force;
- Exploring scenario planning to aid in mapping out an unpredictable future;
- Pursuing federal grant funding opportunities associated with CAVs; and
- Advancing the capabilities of our traffic management systems to enhance the safety and potential benefits of CAV technologies, including working to improve our business and traffic network infrastructure.

Connected and Autonomous Vehicles Overview

While connectivity and autonomy are being developed on parallel paths that will likely merge in the future, at this time development of connected vehicles and automated vehicles remains largely discrete.

Autonomous and Semi-Autonomous Vehicles

Autonomous Vehicles (AV) are the end point of a progressive series of automation of critical driving functions. Already in many semi-autonomous vehicles on the road today, drivers are benefitting from Advanced Driver Assistance Systems (ADAS), which are technologies to help with certain driving tasks, such as staying within a lane or emergency braking. Incorporation of these systems in vehicles are recognized as lower "levels" of autonomy. The potential for ADAS largely impacts safety although studies are mixed as to what eventual magnitude of effect they will have.

When enough ADAS grow in sophistication and combination, vehicles will begin to be classified among the higher levels of autonomy and will eventually achieve full autonomy. To date, TxDOT is not aware of any commercially available vehicle classified within the highest levels of autonomy. As such the ultimate impacts of fully autonomous vehicles remain largely unknown due to the significant number of variables associated with their use, such as any effects on safety and roadway efficiency or how the autonomy will ultimately merge with connected vehicle technology. However, TxDOT expects that these changes, which will phase in over multiple decades, will be significant.

Connected Vehicles

Connected Vehicles (CV) rely on underlying technology further classified as Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), and, collectively, Vehicle to Everything (V2X) communications. By sending and receiving short communications, connected vehicles receive key information about surrounding vehicles, infrastructure, and other connected devices that can be relayed to their drivers or processed by the vehicle to aid safe operations. Vehicle to Everything communication enables connected vehicle applications, many of which were outlined by USDOT's Intelligent Transportation Systems Joint Program Office (ITS JPO). Many of these applications affect safety, and National Highway Transportation Safety Administration studies indicate that through these applications, 81 percent of all unimpaired light vehicle crashes (76 percent of all light-vehicle crashes) could be avoided or otherwise mitigated.¹ A review of these applications, compiled in the figure below, reveals the many driving areas that could be made safer or more efficient through connected vehicle technology.

CONNECTED VEHICLE APPLICATIONS

V2I Safety	Environment	Mobility
Red Light Violation Warning Curve Speed Warning Stop Sign Gap Assist Spot Weather Impact Warning Reduced Speed/Work Zone Warning Pedestrian in Signalized Crosswalk Warning (Transit)	Eco-Approach and Departure at Signalized Intersections Eco-Traffic Signal Timing Eco-Traffic Signal Priority Connected Eco-Driving Wireless Inductive/Resonance Charging	Advanced Traveler Information System Intelligent Traffic Signal System (I-SIG) Signal Priority (transit, freight) Mobile Accessible Pedestrian Signal System (PED-SIG) Emergency Vehicle Preemption (PREEMPT)
V2V Safety	Eco-Lanes Management Eco-Speed Harmonization Eco-Cooperative Adaptive Cruise Control Eco-Traveler Information Eco-Ramp Metering Low Emissions Zone Management AFV Charging / Fueling Information Eco-Smart Parking Dynamic Eco-Routing (light vehicle, transit, freight) Eco-ICM Decision Support System	Dynamic Speed Harmonization (SPD-HARM) Queue Warning (Q-WARN) Cooperative Adaptive Cruise Control (CACC) Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG) Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE) Emergency Communications and Evacuation (EVAC) Connection Protection (T-CONNECT) Dynamic Transit Operations (T-DISP) Dynamic Ridesharing (D-RIDE) Freight-Specific Dynamic Travel Planning and Performance Drayage Optimization
Agency Data	Road Weather	Smart Roadside
Probe-based Pavement Maintenance Probe-enabled Traffic Monitoring Vehicle Classification-based Traffic Studies CV-enabled Turning Movement & Intersection Analysis CV-enabled Origin-Destination Studies Work Zone Traveler Information	Motorist Advisories and Warnings (MAW) Enhanced MDSS Vehicle Data Translator (VDT) Weather Response Traffic Information (WxTINFO)	Wireless Inspection Smart Truck Parking

¹ Harding, J., G. Powell, R. Yoon, J. Fikentscher, C. Doyle, D. Sade, M. Lukuc, J. Simons, and J. Wang. Vehicle-to-Vehicle Communications: Readiness of V2V Technology for Application. Publication DOT HS 812 014. National Highway Traffic Safety Administration, Washington, DC, 2014. <https://www.nhtsa.gov/staticfiles/rulemaking/pdf/V2V/Readiness-of-V2V-Technology-for-Application-812014.pdf>

Connected and Autonomous Vehicle Task Force

The Texas Connected and Autonomous Vehicle Task Force was established in January 2019 as a central point for connected and autonomous vehicle advancement in Texas. TxDOT is the lead agency on the Connected and Autonomous Vehicle Task Force. The Connected and Autonomous Vehicle Task Force is designed to be a one-stop resource for information and coordination on all ongoing connected and autonomous vehicle projects, investments, and initiatives in Texas. In addition to documenting public and private entity efforts and facilitating partnerships, the task force hosts industry forums and reports lessons learned to facilitate progress and encourage greater collaboration.

Over the last six months, the Connected and Autonomous Vehicle Task Force has been actively moving forward to address the deployment of connected and autonomous vehicles in Texas. During that time, TxDOT has worked to achieve several goals:

- Formulate, organize, and launch five subcommittees;
- Conduct three rounds of subcommittee meetings by the end of August 2020;
- Finalize and execute an inter-agency contract with the Texas A&M Transportation Institute (TTI) to help manage the Connected and Autonomous Vehicle Task Force, develop a Connected and Autonomous Vehicle Task Force website, draft white papers, and develop an annual report;
- Host a virtual full Connected and Autonomous Vehicle Task Force meeting in July that was attended by over 135 individuals;
- Increase Task Force membership to stakeholders across the country; and
- Establish a presence nationally which has led to media publications referring to Texas as “an official hotbed of AV activity.”

Connected and Autonomous Vehicles Task Force Subcommittees

Since March 2020, TxDOT has worked with the Governor’s Office to identify a number of key areas that the Connected and Autonomous Vehicle Task Force will address in the coming years. For the first year, those areas were prioritized to create a list of the top five topics, each to be focused on by a unique subcommittee. These subcommittee topics are:

- Data, Connectivity, Cyber Security, and Privacy;
- Education, Communication, and User Needs;
- Safety, Liability, and Responsibility;
- Licensing and Registration; and
- Freight and Delivery.

Working with the Connected and Autonomous Vehicle Task Force voting membership, chairs, and co-chairs were selected to help lead these subcommittees. Each subcommittee is comprised of between 25 to 35 stakeholders bring a unique perspective to the respective topics.

Subcommittees began meeting in June 2020 and have met regularly each month since. With the help of TTI, each subcommittee is working to develop a white paper that will be part of the annual report. During the first round of meetings, the subcommittees identified the highest priority topics and, through a vote, chose their first white paper subject area. White papers will be drafted over the next few months and presented to each subcommittee by the end of October 2020.

Connected and Autonomous Vehicles Task Force Website

Immediately after executing the inter-agency contract with TTI, website development began. The TTI web team has been working with TxDOT to meet hosting requirements and worked with the Connected and Autonomous Vehicle Task Force, and TxDOT to begin developing website concepts. These concepts are designed to create a website that meets the needs for all interested Texans and industry stakeholders and will also be a true representation of the current state and future of CAV in Texas. The website team is planning to have the site go live in early October 2020.

Texas on a National Scale

As all of this has been moving forward, the Connected and Autonomous Vehicle Task Force has established a presence on a national scale. This includes membership in several organizations and groups of states. Some of the major efforts TxDOT has been involved with include:

- The Automated Vehicle Transparency and Engagement for Safe Testing Initiative (AV TEST) Initiative, directed by National Highway Transportation Safety Administration (NHTSA) to collect locations of all autonomous vehicle testing nationally;
- American Association of State Highway and Transportation Officials (AASHTO) State Autonomous Vehicle Task Forces Community of Practice;
- Intelligent Transportation Society of America (ITS America) and the Federal Highway Administration sponsored Cooperative Automated Transportation (CAT) Coalition;
- Partnership for Automated Vehicle Education (PAVE) State Advisory Council; and
- Ohio Department of Transportation-led Autonomous Vehicle Pooled Fund Study.

These efforts have helped establish connections with partners at other state departments of transportation and the federal level to better prepare for connected and autonomous vehicles in Texas. We share lessons learned that are vital at the state and local levels and help connect our Texas cities and regions with interested stakeholders who are moving into Texas at incredible speeds.

Developing Strategies and Planning

TxDOT has established several internal cross-division working groups to prepare the agency for an array of new advanced technologies being developed across the ever-changing transportation landscape. Specific focus areas include, but are not limited to, emerging transportation technologies generally, cooperative and automated transportation (which includes connected and autonomous vehicles), freight technology and operations and the connectivity needed to support all of these.

Emerging Transportation Technologies

TxDOT recognizes that although many new technologies are coming, there are certain underlying principles that must be applied to each. Specifically, within TxDOT, each new technology will require data management, robust planning exercises, project and program development, and business processes support. Having identified these particular principles as common across all new transportation technology, TxDOT has a starting point to address everything from unmanned aerial systems to blockchain security to innovative lane configurations.

Cooperative Automated Transportation

In addition to the statewide CAV Task Force, TxDOT has established an internal working group to explore and expand on the points listed above. Through the efforts of this workgroup, TxDOT seeks to ensure that not only is the transportation system Connected and Automated, but also Cooperative. Cooperative means that all facets of the transportation system work together to maximize safety and efficiency. This working group proposes agency policies, strategies, pilot programs, and deployments for emerging connected vehicles and autonomous vehicle technologies. Additionally, it supports TxDOT's Research and Technology Implementation Division, which recently launched a research project with the University of Texas San Antonio to: (1) propose updates to Texas, and in particular TxDOT, roadway design standards, given the emerging landscape of autonomous vehicles; and (2) research and model changes in standards of lane widths, parking requirements (including new types of parking infrastructure), lane designations, and other roadway design elements to determine the most efficient outcomes.

Texas Freight Network Technology and Operations

Recognizing the important role of freight in the transportation system, and the potential for connected and autonomous vehicle and other new technology to disrupt this industry as well, TxDOT staff is also identifying specific freight-related challenges and opportunities. These efforts will guide technology and operations related investments on the Texas Multimodal Freight Network and include a review of current and future freight transportation challenges and opportunities, freight technology and operations strategy assessments, and user needs gathered through focused public and private sector stakeholder engagement.

Connected Network Strategy

TxDOT has also established an internal workgroup to provide recommendations about an expanded fiber optic sharing program with private sector entities along TxDOT rights of way. The workgroup seeks to help strengthen TxDOT traffic and business network infrastructure to support Vehicle to Everything (V2X) applications and provide improved traffic management opportunities while providing right of way access to telecoms, broadband, and cellular providers that will greatly enhance access to those systems for the public.

Connected Infrastructure Developments

TxDOT is currently developing the Texas Connected Freight Corridors project, one of several significant federal grant projects in the state associated with connected vehicle technologies. The Texas Connected Freight Corridors will create a sustainable connected vehicle deployment in Texas using I-35, I-10, I-30, and I-45. It will showcase connected vehicle applications applicable to TxDOT and its partners throughout the Texas Triangle,

which is the series of highways between the state's four largest metro regions. The Texas A&M Transportation Institute, the University of Texas at Austin Center for Transportation Research, and the Southwest Research Institute are leading the development of an operations plan, a safety management plan, and a performance measurement and evaluation plan. TxDOT anticipates this project to be the defining backbone of wider connected infrastructure deployments across the state. It will help TxDOT establish statewide precedence for V2X as it relates to: (1) data standards; (2) data sharing practices; and (3) cybersecurity and privacy.

Additionally, TxDOT has projects in the Houston area related to emergency vehicle preemption, which allows emergency vehicles to disrupt a normal signal cycle to proceed through intersection more quickly and under safer conditions, through V2X and along I-35 related to work zone safety and continues to track connected vehicle deployments by local governments across the state. These projects, among others, will help develop best practices and inform policy recommendations beyond the Texas Connected Freight Corridors.

Conclusion

Connected and Automated technologies are generally seen as an ongoing and inevitable evolution within the transportation industry, and TxDOT sees great potential to improve roadway safety and efficiency. TxDOT continues to track and contribute to the development of these technologies from early stage research to deployment to monitoring and scaling. At the same time, TxDOT continues to update the legislature through the Connected and Autonomous Vehicles Task Force, and TxDOT staff remains fully available to provide supporting data and analysis on relevant topics.