Executive Summary of 2nd Comprehensive Report

Texas Connected and Autonomous Vehicles Task Force

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Disclaimer

The contents of this white paper reflect the views of the Texas CAV Task Force members, who are responsible for the information presented herein. The contents do not necessarily reflect the official views or policies of the State of Texas or any Texas state agencies. The white paper does not constitute a standard, specification, or regulation, nor does it endorse standards, specifications, or regulations. This white paper does not endorse practices, products, or procedures from any private-sector entity and is presented as a consensus broad opinion document for supporting and enhancing the CAV ecosystem within Texas.

Texas CAV Task Force Charter

The Texas CAV Task Force was created at the request of Texas Governor Greg Abbott in January 2019. The task force is responsible for preparing Texas for the safe and efficient rollout of CAVs on all forms of transportation infrastructure.

The primary functions are:

- Coordinating and providing information on CAV technology use and testing in Texas.
- Informing the public and leaders on current and future CAV advancements and what they mean in Texas. This process includes reporting on the current status, future concerns, and how these technologies are changing future quality of life and well-being.
- Making Texas a leader in understanding how to best prepare and wisely integrate CAV technologies in a positive, safe way, as well as promoting positive development and experiences for the state.

The CAV Task Force is composed of a voting group of no more than 25 members and represents the full spectrum of CAV stakeholders.

Terminology Note

The Texas CAV Task Force addresses the full spectrum of connected, automated, and autonomous vehicles. An *automated vehicle* refers to a vehicle that may perform a subset of driving tasks and requires a driver to perform the remainder of the driving tasks and supervise each feature's performance while engaged. The performance capabilities consist of levels 0–4 with level 0 having

no driving automation and level 5 having full automation, with automation increasing at each progressive level. A fully autonomous vehicle can perform all driving tasks on a sustained basis.

These definitions are still blurred in common discussions and language. Currently, the industry is developing automated vehicle capability while pursuing fully autonomous vehicles. The white papers generally use the term *autonomous* to refer to vehicles with fully autonomous capabilities and the term *CAV* to refer to the grouping of connected, automated, and autonomous vehicles. Please see the 2021 terminology white paper for a full listing of terms and definitions used in this developing technology ecosystem.

White Paper Executive Summaries

As a part of its initial efforts, the task force was asked to provide white papers across several topics related to connected, automated and autonomous vehicle technologies. The task force focused on five areas and limited the scope of the white papers to discussing key concepts to (a) understand the current situation, and (b) identify issues and opportunities for these key topic areas. The white papers were developed by five related subcommittees.

Connected and Automated Vehicle Data Issues and Opportunities

A White Paper from the Subcommittee on Data, Connectivity, Cybersecurity, and Privacy

The connected vehicle market is growing at a fast pace, and cars are becoming more connected than ever before. This trend is expected to continue; a Counterpoint Connected Car study predicts that more than 70 percent of the cars sold will be connected by the year 2025. The data generated by the vehicle typically includes information about the vehicle's status and driver's behavior, as well as location-based data. With the continued emergence of advanced driving assistance systems (ADAS) features, vehicles that are connected back to the original equipment manufacturers (OEMs) become more relevant as a critical data source and insight into the traffic stream. Many newer vehicles also have an electric vehicle component, from which additional data may be available. Overall, the interest in connected and autonomous vehicle data comes from OEMs, suppliers, insurers, mobility providers, infrastructure owners/operators (IOOs), fleet owners, and others.

The various applications for vehicle data include but are not limited to the following:

- Predictive maintenance,
- Fleet management,
- Roadside assistance,
- In-car payments,
- Usage-based Insurance, and
- Traffic management.

In particular, IOOs can analyze the data in a multitude of ways to gain insight into roadway conditions. For example, hard-braking events are being examined in conjunction with other roadway characteristics to highlight areas where roadway improvements may need to be prioritized. As another example, video from dashcams or forward-looking cameras can be analyzed to detect missing roadside features (i.e., the feature was there on the previous video but is not there now), vegetation encroaching on roadway signs, striping and pavement conditions, and numerous other use cases.

Both raw and processed vehicle and roadside data add value to all parties involved. The sharing of these data among the multiple interest groups provides widespread opportunity to examine and improve work zones, provide insight into crashes, examine operational conditions, and more. This data sharing can be accomplished via a data exchange—essentially a data portal where participants can both send and receive data.

Data exchanges can also play an important role in piecing together disparate data. Combining these data sources will enable users to analyze road conditions in real time and communicate important travel information to the traveling public, state/local government entities, private-sector partners,

and other stakeholders. In addition to real-time analysis, exchanges could also support analysis of long-term historic data, enabling data-driven infrastructure investments and various research initiatives. Public agencies and/or private companies will likely need to see a business case value to participate in a data exchange community. This value may increase as the number of partners grows and the types and amount of data exchanged become more substantial.

Before this is possible, issues such as the following must be addressed and clarified to the satisfaction of all participants:

- Standards,
- Privacy,
- Governance,
- Security, and
- Use cases.

Tackling these concerns will help Texas continue to be an innovation leader in this emerging sector and benefit all Texans.

This white paper is found in Appendix A of the Texas CAV Task Force 2nd Comprehensive Report.

Strategic Communication Plan for Advancing the Dialogue about Connected and Automated Vehicle Technology

A White Paper from the Subcommittee on Education, Communication, and User Needs

Connected and autonomous vehicle (CAV) technology holds much promise, but questions remain surrounding its widespread use and adoption. The issues include planning, policy making, regulatory and legal frameworks, institutional issues, operations, funding, and ultimately public trust and acceptance. The Texas CAV Task Force's Subcommittee on Education, Communication, and User Needs supports statewide efforts to inform and engage with agencies, stakeholders, industry, and the general public.

This document sets forth a strategic communication plan for the CAV Task Force. The strategic communication plan identifies four overarching goals:

- Educate,
- Generate awareness,
- Build trust, and
- Increase adoption.

The strategic communication plan is premised on best practices of communication including:

- Audience identification and segmentation,
- Market research,
- Message design, and
- Message delivery.

This plan recognizes that specific outreach and education messages and tactics, tailored to specific audiences based on their needs, serve to enhance overall education and outreach efforts. Based on guidance from the subcommittee, this plan identifies stakeholders and audiences. It presents

communication techniques and tools, messages, and message delivery mechanisms. It is strategic but also suggests various tactics. Importantly, it recognizes the need for continuous evaluation and adaptation as audiences change and grow and technology advances. Public outreach plans can guide development of materials for specific audiences and provide a comprehensive roadmap for education and outreach efforts beyond the key messages.

The education subcommittee, with its broad multidisciplinary representation, is the forward-facing entity responsible for executing an engagement plan. The subcommittee's charge and responsibility are to develop tools and resources that allow for meaningful engagement. This strategic plan will guide those efforts.

This white paper is found in Appendix B of the Texas CAV Task Force 2nd Comprehensive Report.

Latest Considerations for Highway and Controlled Environment Freight Automation in Transportation Operations

A White Paper from the Subcommittee on Freight and Delivery

Texas is a leader in the adoption of connected and autonomous vehicle (CAV) technologies, with many companies testing or implementing automated goods movement technologies. It is recognized that the freight ecosystem remains a rapidly changing environment. The Texas Department of Transportation (TxDOT) and partners need to consider the future of emerging freight CAV concepts as it pertains to highway operations. This white paper reviews the latest opportunities, best and emerging practices, and implementation options to support the continued development and support of freight CAV activities in Texas. These activities include:

- Developing a transfer hub/terminal strategic plan: developing an automated trucking transfer hub/terminal strategic plan that includes a thorough evaluation of existing and planned implementation in Texas, how this will impact the freight network, what the development impacts and needs are, and some specific outlining of roles and responsibilities, including support to local governments.
- Assessing Texas Freight Network and automated truck impacts: assessing how automated trucking will change the Texas Freight Network, what infrastructure is needed (including business route optimization, and drayage and circuit identification), what operations coordination would help, and where priority corridors or circuits are that support automated trucking.
- Developing a freight CAV ecosystem: creating an opportunity to share information between the public and private sectors in robust ways; offering ways for the private sector to input activities, and for the public sector to provide data about the freight network, freight facilities, existing freight flows, projects, and more.

While border and law enforcement remain a critical area of concern for freight CAVs, these issues are being studied under different platforms, including the work related to Senate Bill 1308.

The main consideration of this paper is on highway and controlled environment locations. However, many CAV deployments in Texas are in urban areas like Dallas and Austin, and there is potential for activity on resource roads that needs additional research and coordination. The street locations further require in-depth coordination with local governments, as well as discussion of jurisdictional decision-making and how that impacts CAV development decisions.

During the development of this white paper, numerous changes occurred in the companies in the automated truck space. While this paper may refer to a company no longer in existence at the time of publication, it is important to document the activities that have taken place. Steps by companies no longer in the space can still be meaningful to the continued future development of the ecosystem.

This white paper is found in Appendix C of the Texas CAV Task Force 2nd Comprehensive Report.

Operations and Technology Education Needs for Automated Vehicle Users and Stakeholders

A White Paper from the Subcommittee on Licensing and Registration

Vehicles with automated features and autonomous vehicle deployments are rapidly growing in number. However, the public has a general level of confusion regarding what these automated and autonomous features are truly capable of, which can lead to a false sense of security or drivers operating vehicles in a manner in which they were not intended. Education and guidance are critical needs for the public so that they can fully understand vehicle technologies and operate them safely. This white paper details a literature review and stakeholder interviews conducted to gather information on how to best inform the public and automated and autonomous vehicle stakeholders about what is needed to improve and expand the education of owners and operators of automated and autonomous vehicles. The takeaways from this process include:

- Using consistent terminology is important,
- Automated vehicle technology is intended to increase safety by assisting in some of the driving tasks, such as lane-keeping assistance, automatic emergency braking, or adaptive cruise control, which can ultimately reduce the severity of or even prevent crashes.
- Automated vehicles still require a driver in the driver's seat or a safety operator in the case of shuttles and freight.
- Autonomous vehicles are those vehicles where no driver is needed at all. Further compounding the issue, naming conventions for vehicle technology and the description of how technologies can be used lead to greater misperceptions.
- There is a great need to use consistent terminology, accurately describe the intent of vehicle technology, and promote the general understanding of automated and autonomous vehicles.

Due to this continued high level of misunderstanding and misconceptions about CAV technologies and capabilities, several key opportunities exist, including:

- Collaborating with automobile manufacturers and dealers,
- Consider mandating manufacturer-led training for service and collision technicians,
- Using chat rooms or discussion boards for sharing information between service and collision technicians
- Providing educational materials in multiple formats for different audiences (e.g., a printed document versus a video distributed on the internet),
- Embracing autonomous vehicle deployments will enhance public understanding,
- Including the correct stakeholders in discussions,
- Recognizing the potential value of vehicle safety inspections,
- Updating crash reporting to reflect automated vehicles, and

- Planning for the use of data from connected and autonomous vehicles (CAVs) to improve safety and reduce congestion.

This white paper is found in Appendix D of the Texas CAV Task Force 2nd Comprehensive Report.

Connected and Automated Vehicle Digital and Physical Infrastructure Needs

A White Paper from the Subcommittee on Safety, Liability, and Responsibility

This paper discusses connected and autonomous vehicle (CAV) digital and physical infrastructure needs, challenges, and opportunities for future development. While connected vehicles (CVs) and autonomous vehicles (AVs) currently share many of the same technologies, their operational parameters and needs may differ. The evolution of the CAV industry aims to provide a greater safety benefit than previous technologies. Advanced driver assistance system (ADAS) technologies already in use have demonstrated their potential to reduce crashes, prevent injuries, and save lives. As the surrounding digital and physical infrastructure continues to improve and better meet the needs of CAVs, human error will be increasingly erased from the driving equation. There is however, a dichotomy of thought in the direction of research and development within the CAV industry. For some, improving vehicle performance focuses on the physical infrastructure consisting of the ODD, pavements, markings, signage, sensors, and other various infrastructure components so the vehicles can read the roadway. However, the other research and development direction focuses on digital infrastructure and the CAV's ability to safely perform within a surrounding operational domain by relying on precise digital communication.

Overall, both approaches have issues that need to be addressed to realize the goals. Some of the numerous challenges include interaction with law enforcement, work zones, extreme weather events, differing maintenance needs, standardization of physical infrastructure, cybersecurity, rural connectivity, and roadway conditions. These challenges all play a part in CAVs with respect to the direction of development. They may require a concerted effort on data sharing/exchange and may present possibilities for more investment through public-private partnerships for further development of the CAV industry. Within the context of this paper, the follow attributes of digital and physical infrastructure are discussed as they relate to Safety, Liability, and Responsibility.

The digital infrastructure areas are:

- Digital twinning,
- Data sharing/exchange,
- Geospatial data,
- Cybersecurity, and
- Data processing.

The physical infrastructure areas are:

- Operational design domain (ODD),
- Pavements,
- Pavement markings,
- Signage,
- Off-pavement,

- Maintenance,
- Drop-off/pickup lanes, and
- Work zones.

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Regardless of the specific functions or attributes of digital or physical infrastructure discussed in this paper, a common theme is that in the future, roadways must be covered by a comprehensive communication infrastructure of some type. Pros and cons exist for numerous technologies, but the prevailing thought is that private sector telecommunications companies will deploy, operate, and own, the roadside digital infrastructure and offer paid services to users, be they agencies, companies, or individual drivers. Even if some autonomous vehicles would not use this infrastructure and rely solely on the physical components, the mixed-use environment which will potentially continue for decades will be a user of this communications infrastructure, helping to support advanced traveler information, emergency response, and numerous other critical safety needs before the advent of fully autonomous vehicles.

This white paper is found in Appendix E of the Texas CAV Task Force 2nd Comprehensive Report.