Developing a Regional Regulatory Approach to Truck Platooning in the MAASTO Region: A Literature Review of the History, Progress, and Benefits of Truck Platooning

A Report from the MAASTO Working Group and Mid-America Freight Coalition

MID-AMERICA FREIGHT COALITION

MAASTO
MID AMERICA ASSOCIATION OF STATE TRANSPORTATION OFFICIALS

Authors

Ernest Perry
Mid-America Freight Coalition

Sue Ahn
Mid-America Freight Coalition

In cooperation with the MAASTO Working Group on Automation and Platooning:

Niles Annelin, Michigan Department of Transportation
Andrew Bremer, Ohio Department of Transportation
Kristin Brier, Indiana Department of Transportation
Ted Coulianos, Minnesota Department of Transportation
John Culbertson , Kansas Department of Transportation
Katie England, Indiana Department of Transportation
Louis Feagans, Indiana Department of Transportation
Mike Floberg, Kansas Department of Transportation
Chris Herrick, Kansas Department of Transportation
Jay Hietpas, Minnesota Department of Transportation
Chris Hundt, Michigan Department of Transportation
Sandra Larson, Iowa Department of Transportation
Mark Locker, Ohio Department of Transportation
John Maddox, Kansas Department of Transportation
Scott Marler, Iowa Department of Transportation
Donna Matulac, Iowa Department of Transportation
Matt McAnarney, Illinois Department of Transportation
Shane McKenzie, Kentucky Transportation Cabinet
Phil Mescher, Iowa Department of Transportation
Davonna Moore, Kansas Department of Transportation
Joel Skelley, Kansas Department of Transportation
Lynn Soporowski, Kentucky Transportation Cabinet
Sinclair Stolle, Iowa Department of Transportation
Scott Phinney, Ohio Department of Transportation

About the Mid-America Freight Coalition (MAFC)

The industries and farms of the Mid-America region can compete in the marketplace only if their products can move reliably, safely and at reasonable cost to market.

State Departments of Transportation play an important role in providing the infrastructure that facilitates movement of the growing amount of freight. The Mid-America Freight Coalition was created to support the ten states of the Mid America Association of Transportation Officials (MAASTO) region in their freight planning, freight research needs and in support of multi-state collaboration across the region.

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16. Abstract This project provides an overview of the development of truck platooning, truck automation, and the benefits related to the implementation of Truck Platooning. In an effort to establish a common or complementary set of regulations across the region, legislative actions designed to ease adoption of this technology and developed in the MAASTO states are examined. Nine areas of potential conflict between states and platooning regulations are identified across the MAASTO region. The review concludes that adoption and diffusion of truck platooning are expected to accelerate. Further, agencies and regulations may hinder the progress of the technologies as the regulatory framework is established. This project was completed in partnership with the MAASTO working group on truck parking and automation.			
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Introduction and History of Truck Platooning

The purpose of this report is to provide an understanding of truck platooning and how this technology can be adopted in a uniform manner across freight corridors in the 10-state Mid America Association of Transportation Officials (MAASTO) region. Coordinated regulations across state boundaries will better serve and meet the needs of the industry. The overall goal is to develop a Midwest Truck Platooning Regulatory Model that provides for harmonization of regulations governing truck platooning across the MAASTO region. This effort to "harmonize" is somewhat driven by the historic and current experiences of Over Size/Over Weight Regulations (OSOW) across the country. Often, there are state-by-state differences that hinder efficient movement of oversized loads. A mix of platooning regulations across the region will decrease the efficiency and slow the adoption of truck platooning.

The idea of truck platooning was introduced as early as 1939 in the "Futurama" display at the 1939 New York World's Fair. Sporadic interest and research continued. Much of the research in truck platooning references the European ARAMIS project in the early 1970s as one of the earliest direct evaluations of truck platooning, which used 25 small transit vehicles. Beginning in 1980, the Prometheus Project in Europe involved all stakeholders to create intelligent vehicles and roads. Their work was based on advanced communication, vehicle control, and AI.[1]

Research at UC Berkeley, the Partners for Advanced Transportation Technology (PATH) project, started in 1986 as a collaboration between state and local governments and pioneered several intelligent systems. The PATH project is still operational and currently runs three-truck platoons operating at 14-foot intervals.

Major modern development of vehicle automation began in the 1990s. In 1992, USDOT began the Automated Highway System program, which developed strong technical capabilities and examined societal impacts, culminating with Demo '97 in San Diego. The demo showcased automated cars, trucks, and buses in a freeway environment. In 2004, the U.S. Defense Advanced Research Projects Agency (DARPA) held a challenge asking teams to complete a course with fully automated vehicles in the Mojave Desert. In 2007, DARPA held an urban challenge as well. In 2010, Google announced it had logged 170,000 miles of driving with its fleet of self-driving cars. In Europe, the Chauffeur and Chauffeur II projects, followed by HAVE-IT and Konvoi also tested the limits of vehicle automation. During the 2000s, the Japanese government began a major program to examine truck platooning under the Energy ITS program. Also during this time, similar research was sponsored by USDOT and the California Department of Transportation.

To make truck platooning a practical reality, several countries across the globe have run, or are running, test programs. One of the projects was the Safe Road Trains for the Environment (SARTRE) project (2010-2012) that was conducted in partnership with the European Commission, Ricardo UK, and Volvo. The project's focus was to design intelligent systems for truck platooning that would have key environmental and safety benefits, as well. In a first, SARTRE involved automated control in longitudinal as well as lateral positions (lateral positions were used for the first time in platooning technology).

Peloton Technologies, a Silicon Valley outfit collaborating with Volvo and Peterbilt, has designed a truck platooning system that integrates safety, efficiency and analytics for collision mitigation and adaptive cruise control systems. The system combines vehicle-to-vehicle communications (V2V), radar-based active braking systems, and proprietary vehicle control

[1] ATA Technology and Maintenance Council Future Truck Program, *Automated Driving and Platooning Issues and Opportunities*, (September 21, 2015).

algorithms to couple trucks electronically. Beginning in 2015, Peloton has run successful demonstrations in Detroit and is looking forward to testing and evaluations in other regions.

It is clear that truck platooning is moving forward. The industry and transportation agencies are preparing for adoption of these technologies and operating approaches. While there is still a contingency of doubters within agencies and the public, their expectations may change rapidly once they become informed of the system and its benefits and see platooning trucks on the road.

Classifications of Truck Platooning and Automation

Truck Platooning suggests a certain level of vehicle automation. In 2014, the Society of Automotive Engineers (SAE) published standard J3016 which has largely been adopted by the automated vehicle community.[1] The SAE J3016 standard is summarized in Figure 1.

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Figure 1: Summary of Society of Automotive Engineers Standard SAE J3016

The ATA Technology and Maintenance Council Future Truck Program simplified the chart from the SAE:

Level 0: driver fully in charge (today's driving)

Level 1: driver may be "feet off" if using Adaptive Cruise Control or "hands off" if a Lane Keeping Assist system is engaged

Level 2: allows for both hands-off, feet-off driving – eyes must stay "on" the road

Level 3: enables hands-off, feet-off, and eyes-off. Brain on (driver is able to resume control fairly quickly

Levels 4 and 5: human driver has no responsibilities

What is Truck Platooning?

Platooning is the practice of electronically "coupling" multiple trucks in order to significantly shorten gaps between vehicles. This practice makes it possible to reduce emissions, save energy, enhance safety, and significantly increase the efficiency of dedicated truck lanes. Vehicle platooning, in its broadest sense, uses radar and vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications to form and maintain a close formation between at least two in-lane vehicles, controlling the vehicles both longitudinally and laterally at highway speeds. The Peloton model currently does not rely on V2I communication. In general, platooning implies at least an SAE Level 2 automation. However, tandem-truck platooning relies on a system referred to as Driver Assisted Truck Platooning (DATP), which is classified as Level 1 automation. DATP is a transportation system in which connected follower vehicles operate in conjunction with the lead vehicle. The lead vehicle driver operates laterally and longitudinally. That is, the driver of the lead vehicle drives normally, controlling the steering, acceleration, and deceleration. For each follower truck, the driver will continue to provide lateral control, while the connected vehicle technology will automate the speed, or longitudinal control. The driver maintains the ability to take over the speed and braking at any time, and the driver is expected to continually monitor the driving situation to be ready to assume full control as needed. DATP is a system in which two trucks are exchanging data, with one truck closely following the other. The technology basis is radar (for longitudinal sensing), DSRC IEE802.11p V2V communications (for exchanging vehicle performance parameters between vehicles), positioning (sufficient to discriminate in-lane communications from out-of-lane communications), actuation (for vehicle longitudinal control), and human-machine interfaces (with distinct modes for leading or following).

Benefit Areas: Why Truck Platooning?

The automation of passenger vehicles has advanced rapidly with various systems such as autonomous cars, collision avoidance, and parking assist. Trucking, especially long-haul trucking, trucks with set routes, and freight corridors, provide optimum opportunity to capture the benefits of truck platooning. In fact, the major reasons platooning seems ripe for the trucking industry are the potential for increased safety, increases in fuel efficiencies and vehicle throughput, the related cost savings, and environmental benefits.

Energy Conservation and Fuel Efficiencies

In 2016, petroleum accounted for 37 percent of domestic energy consumption, and of that, 71 percent was consumed by the transportation industry (Figure 2). Between petroleum and other sources, transportation accounted for 29 percent of total U.S. energy consumption.

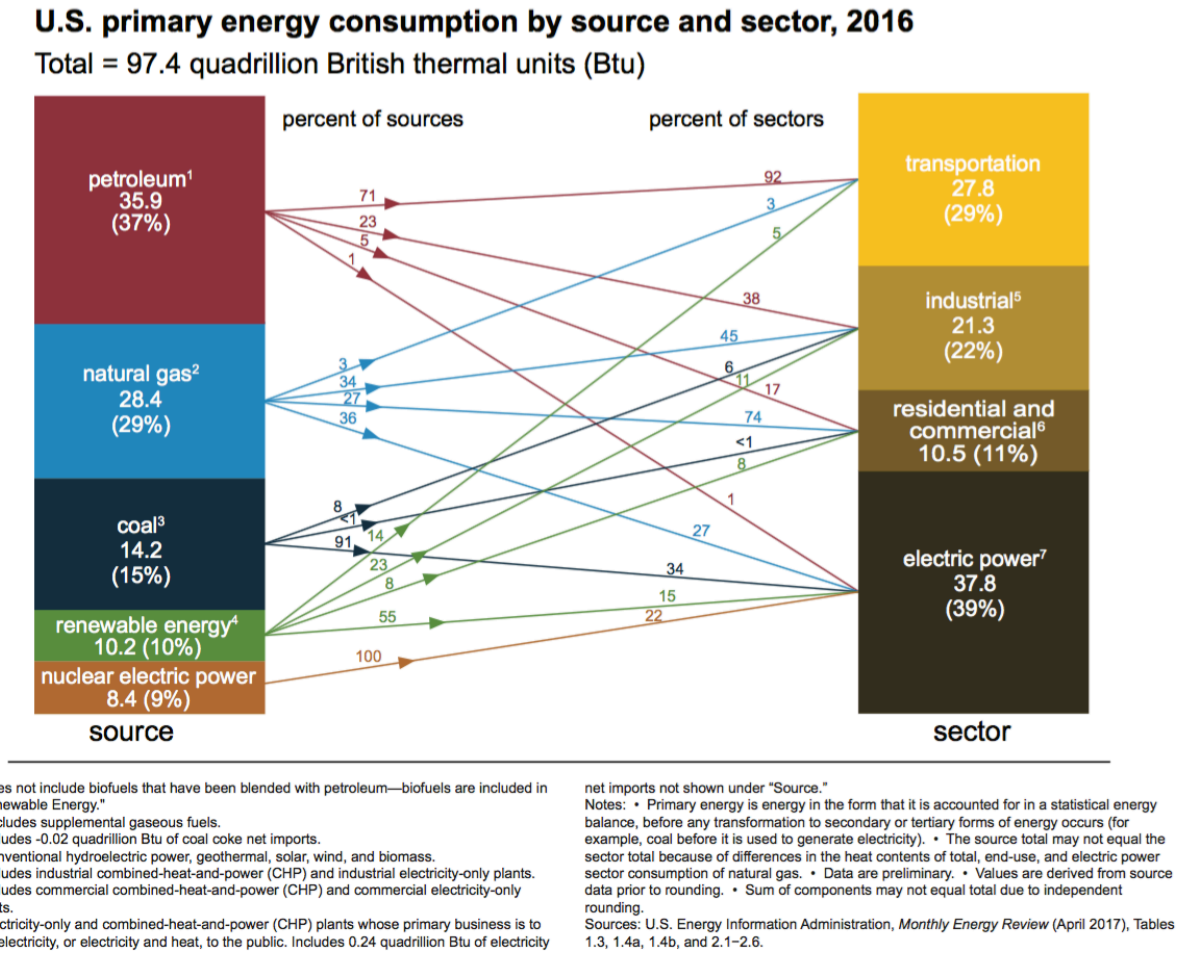


Figure 2: U.S. Primary Energy Consumption by Source and Sector

Within the transportation sector, two types of fuel account for the majority of consumption. First, gasoline, typically used by passenger cars, accounted for 55 percent of all sources used. Second, diesel fuel, typically used by heavy trucks, accounted for 21 percent of all sources used.

Long-haul trucking alone represents more than 10 percent of U.S. oil use. Fuel represents an average of 38 percent of fleet operating expenses. Trucks are only 4 percent of the vehicles on the road but consume 20 percent of transportation fuel.[1]

In 2012, the $641.1 billion U.S. trucking industry accounted for nearly 81 percent of the nation's freight bill and delivered 69 percent of all domestic freight tonnage. This freight was hauled by nearly 24 million commercial trucks and over 3 million drivers. Nearly 7 million people were employed in jobs that were trucking related.[2] Overall freight volumes are expected to increase by 20 percent from 2015 to 2024, while the trucking industry's share of freight tonnage is expected to increase even more. Infrastructure capacity improvements are projected at less than 5 percent during the same time period. As such, the nation's transportation system will be hard-pressed to meet the needs of an expanding economy.[3]

By reducing wind resistance, platooning presents a potentially significant financial incentive. Additionally, platooning offers benefits in the areas of safety, potential congestion mitigation and reduced environmental impacts. The acceptance of this technology by the public and industry will rely on greater awareness of these potential benefits and lack of negative impacts.

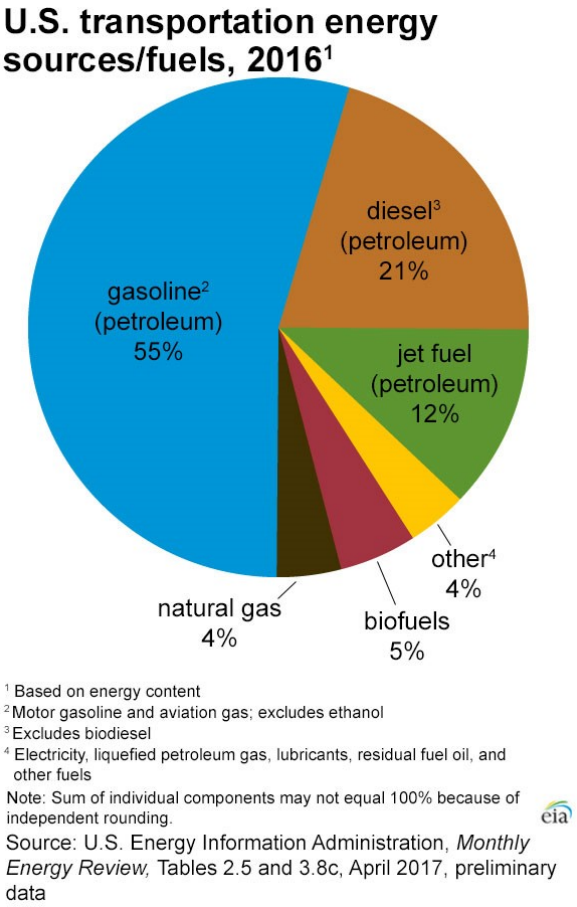


Figure 3: U.S. Transportation Energy Sources/Fuels

Safety

The safety of platooning is based on the various detection components that comprise the system. Working together, the lead and following truck also share information to facilitate platooning. Commercially available collision avoidance systems are already available for heavy trucks. These systems can reduce the frequency and severity of front and rear-end collisions. Forward Collision Avoidance and Mitigation (FCAM) systems are commercially available, radar-based, crash avoidance systems. FCAM systems include forward collision warning, adaptive cruise control, and collision imminent braking. In conjunction with the FHWA, Con-way performed a 30-month study with 12,600 tractors. By installing FCAM systems, Con-way saw a 71 percent reduction in rear-end collisions and a 63 percent reduction in unsafe following behavior. In conjunction with the USDOT, Volvo performed a three-year study with 100 trucks. The study found that 80 percent of drivers preferred to drive with collision avoidance system. Drivers also saw a 37 percent reduction in "conflicts" (i.e. hard braking, situations that could result in a collision, etc.).

[2] Auburn University, *Heavy Truck Cooperative Adaptive Cruise Control: Evaluation, Testing, and Stakeholder Engagement for Near Term Deployment: Phase One Final Report*, (April 2015).
[3] Ibid.

Truck platooning and the use of V2V communication provide an opportunity for the following truck to react to problems in conjunction with the leading truck much faster than a driver would be able to perceive and then react to problems.[4] In 2014, there were 3,903 people killed and 111,000 people injured in crashes involving large trucks. Seventy-three percent of people killed in these accidents were occupants of the other vehicles, 10 percent were non-occupants (pedestrians, cyclists, etc.), and 17 percent were occupants of large trucks.[5] Truck platooning has the potential to drastically reduce front- and rear-end collisions due to the increased time for braking that is possible with automated longitudinal control. In 2014, 83 percent of fatal large truck crashes were the result of front or rear end impacts.[6] Truck platooning has the potential to reduce these occurrences.

One major cause for concern with truck platoons is a passenger car "cut-in." DATP includes radar-based Adaptive Cruise Control (ACC) and collision mitigation systems (CMS), which aggressively brake in an impending crash situation. ACC/CMS systems assist the truck driver in braking as quickly and forcefully as possible to prevent a collision with a cut-in vehicle. Additionally, DATP may reduce the potential for cut-ins by reducing the space between trucks in a platoon.[2]

Vehicle operators are always at risk of a crash and its associated costs. V2V safety applications, such as truck platooning, could significantly reduce accidents. In 2015, there were 35,092 people killed in motor vehicle crashes in the United States, and an additional 2.44 million were injured.[7] Many factors and environmental conditions can cause crashes, but human errors are a critical cause of more than 90 percent of them.[8] While the safety benefits of truck platooning—and indeed any level of automation—are not guaranteed, the potential to reduce the number and severity of accidents is significant.

Congestion

Congestion occurs both regularly and sporadically due to a variety of factors from daily traffic patterns to accidents, construction, and weather. The societal costs of congestion are enormous. In 2015, travel delays due to traffic congestion caused drivers to waste more than 3 billion gallons of fuel and kept travelers stuck in their cars for nearly 7 billion extra hours. The total cost to the United States was $960 per commuter, or $160 billion total.[1] Congestion relief as a function of automated vehicles is difficult to quantify due to the impact autonomous vehicles may have on the propensity to commute. Currently, the opportunity cost of driving—the time a driver spends behind the wheel—leads some to take public transportation, or forgo driving altogether. Automated passenger vehicles could potentially lead to an increase in vehicles. However, connected vehicles and automated vehicles could reduce accidents and notify drivers of congestion, thus allowing them to choose a different route.

[4] Tsugawa, S., Jeschke, S., & Shladover, S. E., "A Review of Truck Platooning Projects for Energy Savings," *IEEE Transactions on Intelligent Vehicles*, 1(1), (2016): 68-77. doi:10.1109/tiv.2016.2577499.
[5] National Center for Statistics and Analysis, "Large Trucks," *Traffic Safety Facts, 2014 Data*, Washington, DC: National Highway Traffic Safety Administration, (May 2016). Report No. DOT HS 812 279.
[6] Ibid.
[7] National Center for Statistics and Analysis, "2015 motor vehicle crashes: Overview," *Traffic Safety Facts Research Note*, Washington, DC: National Highway Traffic Safety Administration, (August 2016). Report No. DOT HS 812 318.
[8] Ibid.

Studies

During the 2000s, the Japanese government conducted a major study to examine automated truck platooning under the Energy ITS program. The study found that, with a three-truck platoon operating empty at 80 km/h with a 10-meter gap, fuel economy testing showed a 4 percent improvement for the lead truck, 19 percent for the second truck, and 17 percent for the third truck. This resulted in an average reduction in fuel use of 13 percent across the platoon.[4] When the gap is reduced to 4.7 meters, the average fuel savings increase to 18 percent. The study also looked at the effects of platooning on loaded vehicles driving at 80 km/h and found that the average fuel savings would be 8 percent at a 10-meter gap and 15 percent at a 4-meter gap.[4]

Lammert et. al, in "Effect of Platooning on Fuel Consumption of Class 8 Vehicles Over a Range of Speeds, Following Distances, and Mass," found that significant fuel savings are possible when two trucks are platooned together. The study examined a range of speeds, following distances and gross-vehicle-weights (GVW). In this study, the vehicles operated on the Continental Tire Uvalde Proving Grounds track, which is a three-lane wide, 8.5-mile oval with one-mile radius turns and a 1.1-mile straightaway between the turns. This track was chosen because it isn't a zero grade, but rather has several small elevation changes of approximately 15 feet, resulting in gentle grade changes. This study used two EPA SmartWay certified trailers, complete with side skirts, in an attempt to more closely mimic current fleets, thereby providing more useful and accurate data to the transportation industry (Table 1).

Table 1: Percent Fuel Saved

Test Conditions	Lead Truck	Trailing Truck	"Team"
55 mph, 65k, 30ft	4.33%	8.38%	6.38%
55 mph, 65k, 50 ft	2.22%	9.72%	6.01%
65 mph, 65k, 20 ft	5.28%	2.81%	4.04%
65 mph, 65k, 30 ft	4.06%	7.53%	5.80%
65 mph, 65k, 40 ft	2.69%	9.10%	5.91%
65 mph, 65k, 50 ft	3.14%	9.17%	6.15%
65 mph, 65k, 75 ft	1.69%	9.39%	5.53%
70 mph, 65k, 30 ft	4.42%	4.62%	4.52%
70 mph, 65k, 50 ft	2.23%	8.36%	5.31%
VAR, 65k, 50 ft	2.70%	4.22%	3.45%
65 mph, 80k, 50ft	0.55%	6.67%	3.68%

Several different data points were examined during this study. The speed varied from 55 to 75 mph. Following distances varied from 20 feet to 75 feet. GVW varied at either 65,000 pounds or 80,000 pounds. Lammert et al. found that the lead vehicle in a two-truck platoon could realize a

2.7-to-5.3 percent fuel savings while at a GVW of 65,000 pounds. The fuel savings decreases as following distance is increased. The trailing vehicle could realize a 2.8-to-9.7 percent fuel savings at a GVW of 65,000 pounds. The best combined fuel savings of 6.38 percent occurred at a GVW of 65,000 pounds, a speed of 55 mph, and a following distance of 30 feet.[9]

The University of California Partners for Advanced Transportation Technology (PATH) program developed three generations of proof-of-concept prototype truck longitudinal control systems within the past 15-to-20 years. For the first generation of truck platooning studies, PATH equipped two trucks with platooning technology. For the second generation and third generation of studies, PATH equipped three trucks with platooning technology. As such, this review is only focused on the first generation.[4]

For the first-generation concept, the two experimental trucks were equipped with 802.11b data modems at a 20 ms update interval for the V2V communication. The platoon was tested on an airfield with 2.2 km of straight road, which allowed for steady-state cruising for 20 to 30 seconds. The trucks were tested at following distances of 10, 8, 6, 4, and 3 meters. Fuel consumption was measured during steady-state driving at 55 mph in the platooning configuration and then compared with results of the trucks driving separately. The front truck realized fuel savings in the range of 5-to-10 percent, while the following truck saw fuel savings between 10 and 15 percent.[10]

For the second-generation concept, PATH added a third identical truck. The wireless communication apparatus was also upgraded to an 802.11p DSRC system specifically designed for mobile applications. This test was performed on an 8 km section of two-lane roadway at varying speeds with accelerations and decelerations, positive and negative grades, and different platoon maneuvers. The test was conducted with following distances of 10, 8, 6, and 4 meters. While fuel savings were realized with a three-truck platoon, the results need to be interpreted with caution. At a speed of 85 km/h with a gap of 6 m, the first truck saved 4.3 percent, the second truck saved 10 percent, and the third truck saved 13-to-14.5 percent. However, the platoon experienced communication difficulties because of the location of the antennas. The middle truck blocked wireless transmissions between the first and third truck when they were completely aligned with each other. To facilitate electronic coupling, the second truck had to drive with a lateral offset of about 30 cm to ensure line of sight for all antennas. In addition, the second-generation test was conducted during higher than average wind speeds, as well as at an altitude of 100 m, where the air density is only around 80 percent of the density at sea level.[11]

PATH's third generation truck control system was a three-truck CACC system rather than a close-formation platoon. As such, this particular aspect of the PATH project is not applicable to this review.

[9] Lammert, M., Duran, A, Diez, J., Burton, K. et al., "Effect of Platooning on Fuel Consumption of Class 8 Vehicles Over a Range of Speeds, Following Distances, and Mass," *SAE Int. J. Commer. Veh*. 7(2):2014, doi: 10.4271/2014-01-2438.
[10] Ibid.
[11] Ibid.

Environmental

The effectiveness of truck platooning with 40 percent of heavy trucks on the expressway platooning, provides an estimated CO_2 reduction along expressways of 2.1 percent when the following gap is 10 meters and 4.8 percent when the gap is 4 meters.[4] These gains are typically related to the decreased fuel consumption with platooning efficiencies.

Similarly, Volatile Organic Compounds, Nitrogen Oxide, and Particle Matter, (VOC, NOX and PM) levels are also reduced as shown in the table below.

Table 2: Environmental Benefits from Truck Platooning

	Greenhouse Gas (GHG)	VOC	NOX	PM
Beginning Gallons of Diesel	100	100	100	100
Amount with 100 Gallons	2,238.00 lbs.	268.20 grams	5,167.81 grams	121.20 grams
*Gallons Diesel with 6.7% Reduction	93.30	93.30	93.30	93.30
Amount After 6.7% Reduction	2088.05 lbs.	250.23 grams	4821.56 grams	113.08 grams
Savings	**149.95 lbs.**	**17.97 grams**	**346 grams**	**8.12 grams**

*Savings calculated based fuel reduction estimates provided by Peloton

In addition to the safety benefits, emission reductions are decreased. Fuel efficiency and reduced truck emissions are in-line with industry and societal goals.

Truck Platooning Legislative Issues Across the MAASTO States

Most states do not have laws or regulations that specifically prohibit truck platooning. Instead, most states have adopted rules that govern the distance required between vehicles (See Appendix A: State-by-State Truck Platooning Laws). These regulations were, for the most part, adopted absent truck platooning technology. V2V communication greatly reduces stopping time and therefore reduces the necessary distance between two vehicles. These regulations present a challenge in pursuing adoption of truck platooning technology.

Regionally, state legislatures have differed in their approach to autonomous vehicle regulations. In 2017, 33 states have introduced legislation compared to 20 states in 2016. Twenty-one states have actually passed legislation related to autonomous vehicles, though not all legislation

pertains to truck platooning. The following describes the status of new regulations in the MAASTO states.

Illinois

As of the spring of 2018, Illinois did not have any laws addressing the testing, deployment or platooning of Connected Autonomous Vehicles (CAVs). However, in 2017, there were three bills in the Illinois General Assembly that related to CAVs. The first bill, HB791, went into effect June 1, 2018. The bill states that any local unit of government is prevented from prohibiting autonomous vehicles on their roadways. The other two bills are identical bills being proposed in the house (HB2747), by Representative Michael Zalewski, and senate (SB1432) by Senator Martin Sandoval. These bills are similar to the AV legislation passed in the Michigan legislature at the end of 2016. These bills would allow "motor vehicle manufacturers" to test AVs anywhere in Illinois if they meet the eligibility requirements laid out in the bill. It also allows qualifying manufacturers to deploy an "on-demand vehicle network." However, unlike the Michigan legislation, these bills do not address platooning.

In regards to surveying existing regulatory barriers, there are numerous areas of the Illinois Vehicle Code that may need to be addressed. Among the areas of concern are issues with the licensing of drivers and the registration and titling of vehicles. Additionally, concerns exist with Illinois Vehicle Code definitions such as "operator" and "driver." Lastly, Illinois has formed an interagency working group and one of the first issues that will be discussed is the variety of legal and policy roadblocks that could potentially slow the testing and eventual deployment of autonomous vehicles.

Indiana

As of June 2018, Indiana had no specific laws or regulations addressing automated vehicles or truck platooning. Pursuant to § 9-21-8-15 of the Indiana Code, heavy trucks must maintain a minimum following distance of 300 feet.

Iowa

Through the first half of 2018, Iowa had no specific laws or regulations addressing automated vehicles. Politicians have expressed interest and support regarding the potential of automated vehicles to benefit Iowans, especially in terms of improved safety and mobility. A statutory barrier hindering adoption of truck platooning may exist in Iowa Code § 321.308, which states that heavy trucks must maintain a minimum following distance of 300 feet.

The Iowa DOT published an Automated Vehicle Technologies Project vision document in March 2017, but the document does not predict timelines for any legislation pertaining to automated vehicles, let alone truck platooning.

Kansas

In the spring of 2018, there was a bill in support of truck platooning introduced. The bill did not make it out of the Transportation Committee.

Kentucky

A bill was signed into law in March 2018 that allows commercial motor vehicle (CMV) platooning. The bill requires a platoon plan, limits the platoon to two CMVs, and exempts the following CMV from the statute governing minimum following distance.

Here are links to the original bill and amendments:

- http://www.lrc.ky.gov/recorddocuments/bill/18RS/SB116/orig_bill.pdf
- http://www.lrc.ky.gov/recorddocuments/bill/18RS/SB116/SFA1.pdf

Michigan

A four-bill package was signed into law on September 19, 2016 that allows unrestricted automated-vehicle use on Michigan roads, not just for testing. More specifically, the bills create four overlapping authorization regimes: general legalization; testing by manufacturers, schools, or state agencies; driverless taxis operated by manufacturers within boundaries; and platooning. Platooned vehicles are also exempt from the statute governing minimum following distance for heavy trucks.

Minnesota

Although Minnesota does not have specific truck platooning language as of the spring of 2018, its statutes waive the minimum following distance if the lane is specifically designed for use by motor trucks. This means truck platooning could occur if MnDOT, or the agency responsible for the roadway, would provide a moving lane closure or full closure of the roadway.

To further the advancement of testing and implementation of vehicles in Minnesota, the state also has an Autonomous and Connected Vehicle Jurisdictional Committee. This committee is made up of state agencies, including the Department of Transportation, Department of Public Safety (State Patrol, vehicle registration and licensing, and safety), and Minnesota Council for the Disabled, Department of Commerce, and the Metropolitan Council. This group is charged with reviewing and updating Minnesota's regulatory environment to allow for the safe testing and implementation of autonomous vehicles. The committee's report is expected in December 2018.

Missouri

Missouri has not enacted any legislation or regulations pertaining to automated vehicles. Pursuant to Missouri Statute § 304.044, heavy trucks must maintain a minimum following distance of 300 feet. Legislation was rejected by the governor in July 2016 due to safety concerns.

Ohio

As of January 2018, Ohio's code allows for automated vehicle testing on public roadways as long as a driver is behind the wheel ready to take control of the vehicle. Fully autonomous testing remains to be addressed with changes in state law.

With respect to truck platooning, the Ohio Revised Code does not specifically allow or prohibit truck platooning. Ohio's governor's office has conducted multi-agency working groups to

investigate state and federal code for the operation of truck platooning and its associated technology.

The Ohio House of Representatives, in the spring of 2018, was conducting hearings to hear testimony from industry partners to learn more about autonomous and connected vehicles, the technology involved, and their applications (such as truck platooning).

Wisconsin

Wisconsin and WisDOT launched an internal, multi-division working group in 2017 to identify, monitor, and address issues related to CAV adoption. The University of Wisconsin–Madison secured federal designation as one of 10 “proving grounds” for autonomous vehicles.

Governor Scott Walker signed an executive order in May 2017 creating the Governor’s Steering Committee on Autonomous and Connected Vehicle Testing and Deployment. The committee is tasked with advising the governor “on how best to advance the testing and operation of autonomous and connected vehicles in the State of Wisconsin.” The order specifies the members of the committee, including six legislators from the state. The duties of the committee include identifying all agencies in the state with jurisdiction over testing and deployment of the vehicles, coordinating with the agencies to address concerns related to issues such as “vehicle registration, licensing, insurance, traffic regulations, equipment standards, and vehicle owner or operator responsibilities and liabilities under current law,” and reviewing current state laws and regulations that may impede testing and deployment, along with other tasks. The state Department of Transportation is required to submit a final report to the governor by June 30, 2018.

National Legislative Status

Nationally, between 2012 and the middle of 2018, 29 states had passed legislation pertaining to automated vehicle legislation, though not all of them contained language specifically related to platooning. In September 2017, the National Highway and Transportation Safety Administration (NHTSA) released new federal guidance for Automated Driving Systems (ADS).

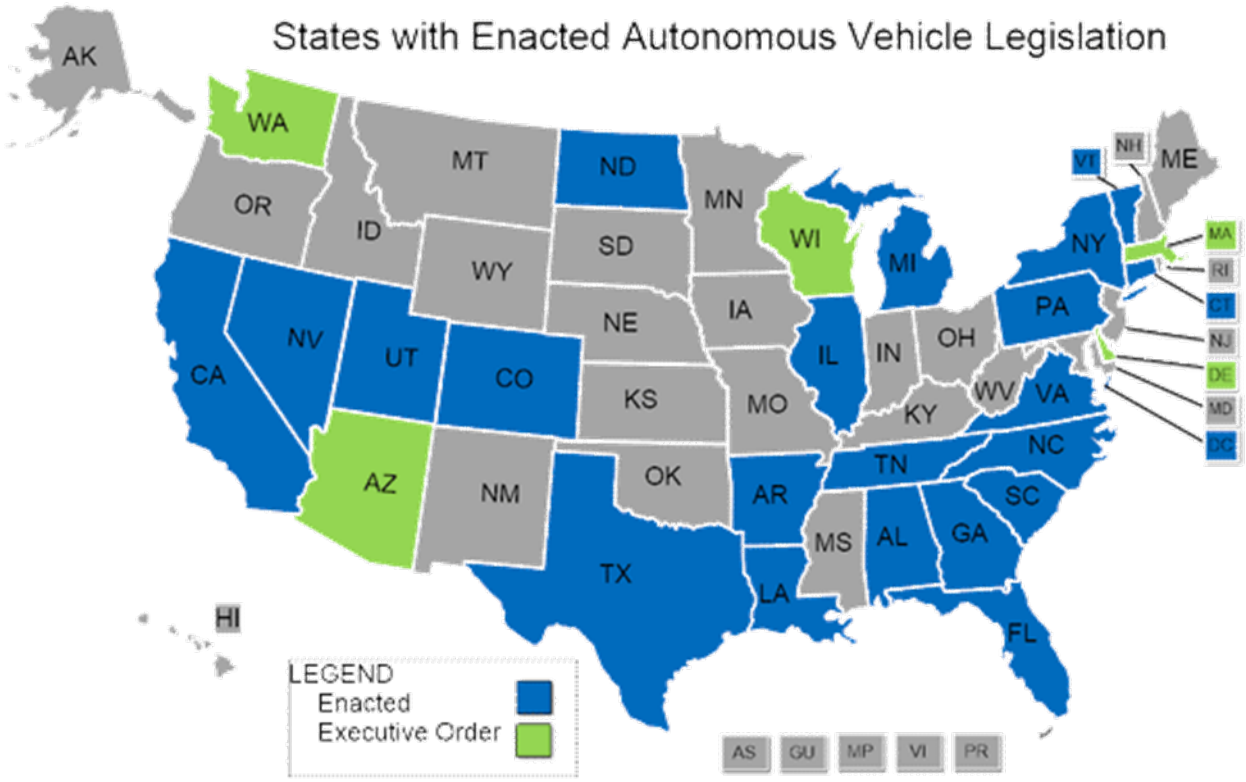


Figure 4: Map of States with Enacted Autonomous Vehicle Legislation

The NHSTA released new federal guidance for ADS in September 2017. The guidelines build on the NHSTA's 2016 guidance. Both guidance publications focus on Highly Automated Vehicles (HAVs), which are typically classified as levels 3-to-5 on the SAE scale (Figure 1). As such, this guidance doesn't specifically relate to truck platooning. However, the increased legislative activity surrounding automated vehicles signals a growing acknowledgment of the industry's direction with overall vehicle automation and truck platooning.

The updated guidance was issued shortly after the September 6th, 2017 passage of the SELF Drive Act (H.R. 3388). The bill includes four main sections:

1. Expansion of federal preemption
2. Updates to federal motor vehicle safety standards (FMVSS)
3. Exemptions from FMVSS
4. Federal automated vehicles advisory council

The bill has passed the House, but the Senate counterpart was in committee at the time this report was written. The Senate bill, S.1885, or the AV START Act was introduced in late September 2017.

State-by-state platooning regulations and changes are documented in Appendix A: State-by-State Truck Platooning Laws.

A Route Toward a Midwest Regulatory Model of Truck Platooning

Developing reasonable and clear regulations that are consistent across states lines and jurisdictions will support the development of truck platooning. With consistent regulations, the private sector can make a more informed choice about the appropriateness and efficiency of adopting truck platooning. The MAASTO states are preparing for the technology and operational changes of platooning by working together to identify, then ensure the passage of legislation that supports consistent platooning regulations. There are numerous areas of differing regulations across the states. Different following distances for the second truck in a platoon is one example of inconsistency across the states. There is also a significant lack of regulation for some of the issues. These are platooning issues that DOTs and legislatures have not seen before, such as insurance needs for platooning and the number of drivers required per vehicle and their responsibilities.

Changes in legislation, or attempts at legislative changes, that clarify and support platooning reflect the regulatory areas that arise around truck platooning. As of March 2018, thirteen states have amended their state laws to specifically permit truck platooning in some capacity. The states are: Alabama, Arkansas, California, Florida, Georgia, Indiana, Michigan, Nevada, North Carolina, South Carolina, Tennessee, Texas, and Utah. The key features from the laws thus far approved are categorized and described below:

1. Definition: What is truck platooning? Where can it be done? Visits with Peloton, state trucking associations, and industry and agency leaders bring to light the apprehension some have over platooning. Therefore, most U.S. operations and plans include only two trucks in the platoon.

   One state (TN) defines “operator” for the purposes of truck platooning to be the person in control of the lead vehicle.

2. Following too closely: An exemption from the state’s following too closely law for truck platooning is a feature of the legislation enacted in all thirteen states.

3. Requirements to submit a plan for truck platooning: Four (AR, IN, MI, TN) of the states that permit platooning require that platoon operators first submit a plan to appropriate state officials. Appropriate state officials include the state DOT (or transportation commission) in all four states and the state safety agency in two (MI, TN) of the four states. State officials have a prescribed period of time in which to reject the plan (30 or 45 days) or it is considered to be approved.

4. State DOT approval: One state (NC) requires the DOT to approve a truck platoon by traffic ordinance. This appears to have the same effect as requiring a plan.

5. Study or pilot program: Platooning is only permitted as part of a study or pilot program in two states (CA, FL).

6. Electronic displays inside vehicles: One state (FL) expressly permits the use of electronic displays visible to vehicle operators inside of trucks equipped with platooning technology.

7. Follow all applicable laws: One state (NV) requires that trucks using platooning technology must be capable of being operated in compliance with vehicle and traffic law unless granted an exemption from the state.

8. Flexibility for carrying vehicle registration: One state (TN) allows the vehicle registrations for all platooned trucks to reside in the lead vehicle rather than requiring it to reside in each vehicle in the platoon.

9. Requirement for a licensed driver: While some level of vehicle automation is required to maintain a platoon of vehicles, it appears that most state laws envision (but may not specifically require) a driver to be in control of some of the vehicle operations. Four states (CA, IN, MI, TN) specifically require that a properly licensed driver be present behind the wheel of each vehicle in a platoon. As noted in the definition paragraph above, in two states (AR, FL) the definition of truck platooning requires that some features of operating a vehicle such as steering controls and systems monitoring remain with a human operator.

The platooning implementation matrix below prioritizes the needed legislation to allow for the adoption of platooning. First-priority actions support the actual deployment of the technology. Second-priority actions are those without an immediate demand to support implementation and operations.

Table 3: Matrix of State Actions to Support Truck Platooning

Activities and Regulations Necessary to Support Adoption of Truck Platooning		Harmonization Levels (State-s, Region-r, National-n) and Optimum Solution
First Priority Legislation		
Define platooning and route locations	Address number of trucks in platoon, operator, types of electronics needed, approved routes, outreach with transportation sector and public to provide information.	s/r/n Two trucks in platoon. Industry and USDOT standards for electronics. State DOT approved routes. Include outreach and demonstrations for public and decision makers.
Following too closely	Platooning gains efficiency through drafting. Limits to distance between platooning trucks must be corrected.	s/r/n 40-foot gap (suggested by Peloton).
Electronic displays in vehicles	The displays, their access and potential for distracted driving should be considered.	s/r/n/ Industry standards and USDOT standards.
Requirement for licensed driver	Considering the public perception during adoption, both persons in the vehicles should be licensed.	s/r/n All drivers of lead and following truck are licensed. Ensure uniformity across states.
Second-Priority Legislation		
Submit a plan for truck platooning to DOT	Ensures proper routing, allows observation of activity, and data collection for analysis.	s/r/n Plan required for state and multi-state trips. State DOT defines corridors, for multi-state corridors and trips over 2 miles. Regional standards on planning trip and reporting.
State DOT approval	Ensures compliance and safety of route.	s/r/n Approval required. Multi-state trips are communicated to all relevant states. DOT coordination for multi-state trips.
Follow all applicable laws	Requires exemption for regulations and allows operation of a platoon.	s/r/n Must follow all regulations (except where changed to allow platooning) regarding following distance, truck electronics, etc.
Flexibility for carrying vehicle registration	All registration for trucks in platoon can reside in lead vehicle. Reduces paperwork, officer time when evaluating platoon on open road.	s/r/n Coordinate with state police to support their preferences. Make uniform across state, region, and nation.
Study or pilot program	To allow early adoption and observation of operations and safety.	s/r/n Use demonstrations. Follow adoption/diffusion process to encourage implementation. Coordinate across states to ensure uniformity in materials and regulations.

While transportation agencies may agree on standards for some areas, it might not be the DOT making the decision on changes to support platooning. In many cases, legislative action is required. Given the decision-making process involved, MAASTO states should continue their regional work to prioritize and define goals across each of these legislative areas. Having all of the MAASTO states agreeing on standards and needed changes will assist the DOT in supporting and enacting the needed changes through legislation.

Potential Corridors for Truck Platooning in the Midwest

Corridor Considerations

There are a number of considerations that affect the eligibility of truck platooning routes. Interstates and four-lane, divided highways are preferred due to controlled access, uniformity, and regional and national connectivity. Of all platooning, 70 percent has been on these types of roadways, so far. Corridors between known freight generators have high potential with current levels of truck traffic providing a good indicator of need. The number of ramps, access points, and the difficulty of terrain must also be considered.

As platooning technology and acceptance matures, other state or local routes may also be appropriate, but these will require a safety and operations review to ensure feasibility.

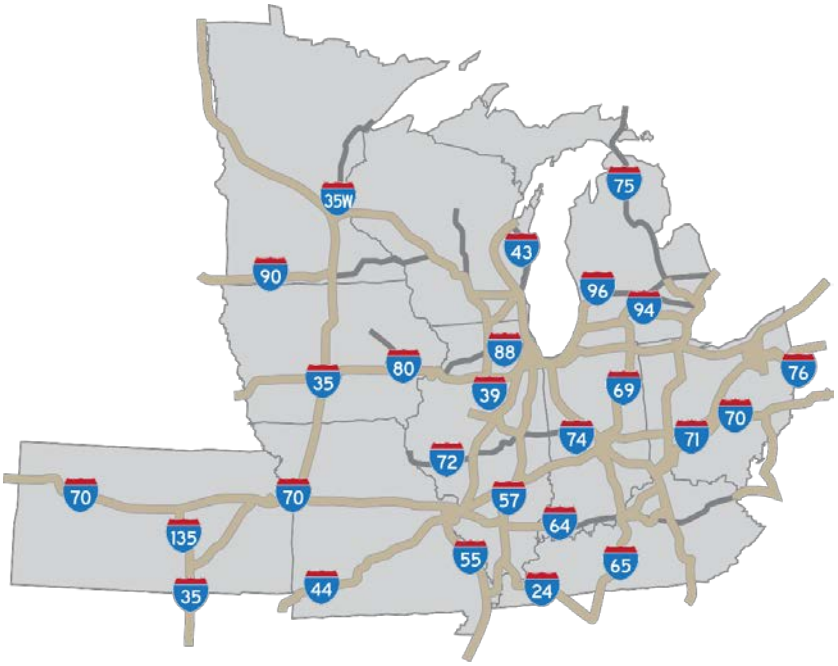


Figure 5: Potential Corridors for Truck Platooning in the Midwest

Midwest Interstates

An analysis for MAP-21 on total tonnage moved shows that the interstate highways in the MAFC region are major freight corridors. This is especially evident when the routes are viewed on the basis of kilotons moved per mile.

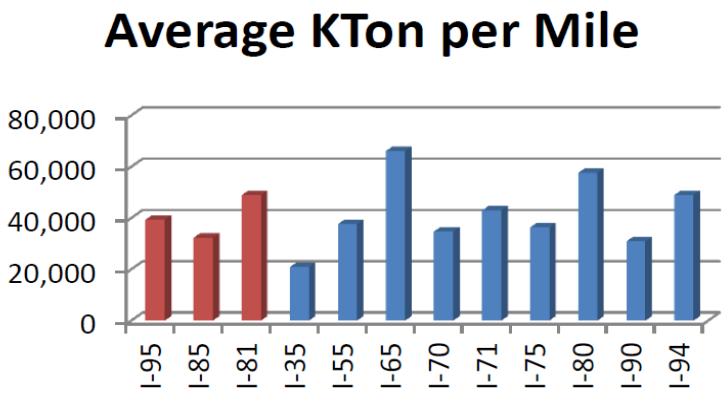


Figure 6: Kilotons Moved per Mile Along Midwest Interstates

Conclusion

It is clear that further education of the transportation and legislative decision makers, along with the general public, is required to provide an understanding of the potential safety, environmental and efficiency benefits that truck platooning can offer. Vendors, such as Peloton, as well as several state trucking associations are cautious about how the public perceives platooning and thus lean toward more conservative operations and legislation.

The rail industry has expressed concern that platooning gives trucking an unfair advantage and basically turns them into “road trains” and that truck platooning will evolve to large platoons that could threaten the rail market share. There should be no immediate concern for rail as most changes focus on making trucking safer and more fuel efficient. However, the system will still require two licensed drivers, two tractors, and two trailers. It is unlikely the 6%-plus benefit in reduced fuel costs will be market changing.

Concerns about uncontrolled trucks on the highway leave too much to the imagination. Platooning proponents cite increased safety and the current level of driver acceptance of existing advance collision warning systems. The presence of a driver in each vehicle is also seen as mitigating risk. Some in the trucking industry are also concerned that driverless trucks will result in employment loss in the trucking industry. In this case, each truck still requires a driver with the added benefit that the new technology involved could be an attraction for younger drivers, making truck driving a more desirable job for more people.

Based on industry activity, testing, and reduced costs, it appears platooning will be adopted. To the extent that the MAASTO states can develop a consistent set of regulations and expectations, the region could benefit from high rates of adoption that a corridor could attract to the region. The adoption of platooning can be expected to increase fuel efficiency and decrease emissions. It can also be expected to create a safer environment for trucks and the surrounding vehicles with vehicle detection and advanced collision warnings. Overall, truck platooning can increase the efficiency and safety of the nationwide freight system, while decreasing trucking’s impacts to the environment.

Appendix A: State-by-State Truck Platooning Laws

State Truck Platooning Laws

As of March 2018, thirteen states have amended their state laws to specifically permit truck platooning in some capacity. The states are: Alabama, Arkansas, California, Florida, Georgia, Indiana, Michigan, Nevada, North Carolina, South Carolina, Tennessee, Texas, and Utah. The key features from the laws thus far approved are categorized and described below:

1. Definition: Twelve of the thirteen states included either a definition of the truck platooning concept (AL, IN, MI, NV, TN, UT), a definition of the technology used in truck platooning (TX), or a combination of the two (AR, FL, GA, NC, SC). In some cases (AR, FL) the definition requires that some features of operating a vehicle such as steering controls and systems monitoring remain with a human operator.

   One state (TN) defines "operator" for the purposes of truck platoon to be the person in control of the lead vehicle.

2. Following too closely: An exemption from the state's following too closely law for truck platooning is a feature of the legislation enacted in all thirteen states.

3. Requirements to submit a plan for truck platooning: Four (AR, IN, MI, TN) of the states that permit platooning require that platoon operators first submit a plan to appropriate state officials. Appropriate state officials include the state DOT (or transportation commission) in all four states and the state safety agency in two (MI, TN) of the four states. State officials have a prescribed period of time in which to reject the plan (30 or 45 days) or it is considered to be approved.

4. State DOT approval: One state (NC) requires the DOT to approve a truck platoon by traffic ordinance. This appears to have the same effect as requiring a plan.

5. Study or pilot program: Platooning is only permitted as part of a study or pilot program in two states (CA, FL).

6. Electronic displays inside vehicles: One state (FL) expressly permits the use of electronic displays visible to vehicle operators inside of trucks equipped with platooning technology.

7. Follow all applicable laws: One state (NV) requires that trucks using platooning technology must be capable of being operated in compliance with vehicle and traffic law unless granted an exemption from the state.

8. Flexibility for carrying vehicle registration: One state (TN) allows the vehicle registrations for all platooned trucks to reside in the lead vehicle rather than requiring it to reside in each vehicle in the platoon.

9. Requirement for a licensed driver: While some level of vehicle automation is required to maintain a platoon of vehicles, it appears that most state laws envision (but may not specifically require) a driver to be in control of some of the vehicle operations. Four states (CA, IN, MI, TN) specifically require that a properly licensed driver be present behind the wheel of each vehicle in a platoon. As noted in the definition paragraph above, in two states (AR, FL) the definition of truck platooning requires that some features of operating a vehicle such as steering controls and systems monitoring remain with a human operator.

In addition to the features noted above, seven of the states with platooning laws also enacted laws that deal more broadly with autonomous vehicles or technology. It is possible that language in these AV laws could serve to expand the authorizations for platooning. These AV laws were not closely inspected as part of the analysis of state platooning laws.

Below is the applicable language copied from the legislation that was enacted in each of the thirteen states that have formally approved truck platooning in some form. Also included at the end of the document is a short summary of how policy guidance issued by the National Highway Traffic Safety Administration affects truck platooning.

Alabama (2018) – SB 125

Definition: Truck Platoon

A group of individual commercial trucks traveling in a unified manner at electronically coordinated speeds at following distances that are closer than would be reasonable and prudent without the electronic coordination.

Following too closely:

The trailing trucks in a truck platoon are exempt from the provisions of this section if the truck platoon is engaged in electronic brake coordination and any other requirement imposed by the Department of Transportation by rule. The intent of this subsection is to allow both commercial platooning deployment and activities to provide research for truck platooning technology and to exempt the trailing trucks from receiving a citation for following too closely as defined in this section.

(Note: The section of law this legislation amends prohibits following too closely, a portion of which reads: “The driver of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the speed of such vehicles and the traffic upon and the condition of the highway.”)

Arkansas (2017) - HB 1754

Definition: Driver-assistive truck platooning system

As used in this section, "driver-assistive truck platooning system" means technology that integrates sensor array, wireless communication, vehicle controls, and specialized software to synchronize acceleration and braking between two (2) or more vehicles while leaving each vehicle's steering control and systems monitoring and intervention in the control of its human operator.

Following too closely:

Vehicles equipped with driver-assistive truck platooning systems may follow other vehicles closer than allowed under subsection (a) and subdivision (b)(1) of this section.

(Note: subsection (a) reads: “The driver of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the speed of vehicles and the traffic upon and the condition of the highway,” and subsection (b)(1) reads: “The driver of any motor truck or any motor vehicle drawing another vehicle when traveling upon a roadway outside of a business or residence district shall not follow within two hundred feet (200´) of another motor vehicle.”)

Requirement to submit a plan:

A person may operate a driver-assistive truck platooning system on a street or highway of this state if the person files a plan for general platoon operations with the State Highway Commission.

A person may operate a driver-assistive truck platooning system on a street or highway of this state:

(1) Upon approval of the plan required under subsection (a) of this section by the commission; or

(2) 45 days after the submission of the plan required under subsection (a) of this section, if the plan has not been rejected by the commission.

California (Revised in 2017) – AB 669 SECTION

Study of truck platooning, following too closely:

The department, in coordination with the Department of the California Highway Patrol, may conduct testing of technologies that enable drivers to safely operate motor vehicles with less than 100 feet between each vehicle or combination of vehicles.

Notwithstanding Section 21705 of the Vehicle Code or any other provision of law, motor vehicles participating in testing of those technologies pursuant to subdivision (a) may be operated with less than 100 feet between each vehicle or combination of those vehicles.

The department may only use motor vehicles and streets and highways in testing conducted pursuant to subdivision (a) that the Department of the California Highway Patrol authorizes for those uses.

Requirement for a licensed driver:

A person may not operate a motor vehicle participating in testing conducted pursuant to subdivision (a) unless the person holds a valid driver's license of the appropriate class for the participating vehicle.

The department shall report its findings from the testing conducted pursuant to subdivision (a) to the Legislature on or before July 1, 2017, and shall submit an updated report to the Legislature on or before July 1, 2019. The reports required by this subdivision shall be submitted in compliance with Section 9795.

This section shall remain in effect only until January 1, 2020, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2020, deletes or extends that date

Florida (2016) - HB 7061

Definition: Driver-assistive truck platooning technology

DRIVER-ASSISTIVE TRUCK PLATOONING TECHNOLOGY—Vehicle automation and safety technology that integrates sensor array, wireless vehicle-to-vehicle communications, active safety systems, and specialized software to link safety systems and synchronize acceleration and braking between two vehicles while leaving each vehicle's steering control and systems command in the control of the vehicle's driver in compliance with the National Highway Traffic Safety Administration rules regarding vehicle-to-vehicle communications.

Study of truck platooning, following too closely, and electronic displays:

The Department of Transportation, in consultation with the Department of Highway Safety and Motor Vehicles, shall study the use and safe operation of driver-assistive truck platooning technology, as defined in s. 316.003, Florida Statutes, for the purpose of developing a pilot project to test vehicles that are equipped to operate using driver-assistive truck platooning technology.

(1) Upon conclusion of the study, the Department of Transportation, in consultation with the Department of Highway Safety and Motor Vehicles, may conduct a pilot project to test the use and safe operation of vehicles equipped with driver-assistive truck platooning technology.

(2) Notwithstanding ss. 316.0895 (following too closely) and 316.303 (electronic displays), Florida Statutes, the Department of Transportation may conduct the pilot project in such a manner and at such locations as determined by the Department of Transportation based on the study.

(3) Before the start of the pilot project, manufacturers of driver-assistive truck platooning technology being tested in the pilot project must submit to the Department of Highway Safety and Motor Vehicles an instrument of insurance, surety bond, or proof of self-insurance acceptable to the department in the amount of $5 million.

(4) Upon conclusion of the pilot project, the Department of Transportation, in consultation with the Department of Highway Safety and Motor Vehicles, shall submit the results of the study and any findings or recommendations from the pilot project to the Governor, the President of the Senate, and the Speaker of the House of Representatives.

Electronic displays inside vehicles:

This section does not prohibit the use of an electronic display used in conjunction with a vehicle navigation system; an electronic display used by an operator of a vehicle equipped with autonomous technology, as defined in s. 316.003; or an electronic display used by an operator of a vehicle equipped and operating with driver-assistive truck platooning technology, as defined in s. 316.003.

Georgia (2017) – HB 472

Definition and following too closely:

This Code section shall not apply to the operator of any non-leading vehicle traveling in a coordinated platoon. For purposes of this subsection, the term 'coordinated platoon' means a group of motor vehicles traveling in the same lane utilizing vehicle-to-vehicle communication technology to automatically coordinate the movement of such vehicles.

(Note: The section of law this legislation amends prohibits following too closely, a portion of which reads: “The driver of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the speed of such vehicles and the traffic upon and the condition of the highway.”)

Indiana (2018) – HB 1290

Definition: Vehicle platoon

Vehicle platoon means a group of motor vehicles that are traveling in a unified manner under electronic coordination at speeds and following distances that are faster and closer than would be reasonable and prudent without electronic coordination.

Following too closely:

This section does not apply to a person who drives a motor vehicle in a vehicle platoon with respect to another motor vehicle in the same vehicle platoon.

(Note: The section of law this legislation amends prohibits following too closely, a portion of which reads: “The driver of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the speed of such vehicles and the traffic upon and the condition of the highway.” The exemption language is also found in the section that deals specifically with trucks and prohibits them from following more closely than 300 feet of one another.)

Requirement for a licensed driver and other criteria:

A person may operate a motor vehicle as part of a vehicle platoon on the streets and highways of Indiana if:

1. the person is authorized under Indiana law to operate a motor vehicle on the streets or highways of Indiana;
2. the motor vehicle is authorized under Indiana law to be operated on the streets or highways of Indiana;
3. the motor vehicle is properly equipped with necessary systems for participation in a vehicle platoon; and
4. the leader of the vehicle platoon is authorized under this chapter to lead the vehicle platoon.

Requirement to submit a plan:

A person may lead a vehicle platoon in Indiana if:

1. the person or the organization with which the person is associated has filed a plan for general vehicle platoon operations with the commissioner;
2. the commissioner has not rejected the plan for general vehicle platoon operations in Indiana; and
3. the person leads the vehicle platoon in accordance with the plan for general vehicle platoon operations in Indiana.

If the commissioner receives a plan for general vehicle platoon operations in Indiana, the commissioner may approve the plan, do nothing, or reject the plan. The commissioner may reject the plan only on or before the thirtieth day after the date on which the commissioner receives the plan.

Michigan (2016) - SB 995

Definition: Platoon

“Platoon” means a group of individual motor vehicles that are traveling in a unified manner at electronically coordinated speeds.

Following too closely:

Subsections (2) and (3) do not apply to a vehicle in a platoon. When traveling upon a highway, the operator of a truck or truck tractor that is in a platoon shall allow reasonable access for other vehicles to afford those vehicles safe movement among lanes to exit or enter the highway.

(Note: subsection (2) reads: “Except as provided in subsection (4), a person shall not operate a motor vehicle with a gross weight, loaded or unloaded, in excess of 5,000 pounds outside the corporate limits of a city or village, within 500 feet of a like vehicle described in this subsection, moving in the same direction, except when overtaking and passing the vehicle,” and subsection (3) reads: “Except as provided in subsection (4), a distance of not less than 500 feet shall be maintained between 2 or more driven vehicles being delivered from 1 place to another.”)

Requirement to submit a plan and requirement for a licensed driver:

A person may operate a platoon on a street or highway of this state if the person files a plan for general platoon operations with the Department of State Police and the State Transportation Department before starting platoon operations. If the plan is not rejected by either the Department of State Police or the State Transportation Department with 30 days of receipt of the plan, the person shall be allowed to operate the platoon.

All of the following apply to a platoon:

a) Vehicles in a platoon shall not be considered a combination of vehicles for purposes of this act

b) The lead vehicle in a platoon shall not be considered to draw the other vehicles.

c) If the platoon includes a commercial motor vehicle, an appropriately endorsed driver who holds a valid commercial driver license shall be present behind the wheel of each commercial motor vehicle in the platoon.

Minnesota

The driver of any motor vehicle drawing another vehicle, or the driver of any motor truck or bus, when traveling upon a roadway outside of a business or residence district, shall not follow within 500 feet of another vehicle. The provisions of this paragraph shall not be construed to prevent overtaking and passing nor shall the same apply upon any lane specially designated for use by motor trucks.

Nevada (2017) – AB 69

Definition: Driver-assistive platooning technology

“Driver-assistive platooning technology” means technology which enables two or more trucks or other motor vehicles to travel on a highway at electronically coordinated speeds in a unified manner at a following distance that is closer than would be reasonable and prudent without the use of the technology. The term does not include an automated driving system.

Follow all applicable laws unless exempted by the DOT:

A truck or other motor vehicle may use driver-assistive platooning technology on a highway within this State only if the truck or other motor vehicle and the driver-assistive platooning technology are capable of being operated in compliance with the applicable motor vehicle laws and traffic laws of this State, unless the truck or other motor vehicle has been granted an exemption by the Department.

Following too closely:

This section does not apply to a vehicle which is using driver-assistive platooning technology, as defined in section 2 of this act.

(Note: This section refers to the state’s following too closely law, which reads: “(1.) The driver of a vehicle shall not follow another vehicle more closely than is reasonable and prudent, having

due regard for the speed of such vehicles and the traffic upon and the condition of the highway. (2.) The driver of any truck or combination of vehicles 80 inches or more in overall width, which is following a truck, or combination of vehicles 80 inches or more in overall width, shall, whenever conditions permit, leave a space of 500 feet so that an overtaking vehicle may enter and occupy such space without danger, but this shall not prevent a truck or combination of vehicles from overtaking and passing any vehicle or combination of vehicles. This subsection does not apply to any vehicle or combination of vehicles while moving on a highway on which there are two or more lanes available for traffic moving in the same direction. (3.) Motor vehicles being driven upon any highway outside of a business district in a caravan or motorcade, whether or not towing other vehicles, shall be operated to allow sufficient space between each such vehicle or combination of vehicles so as to enable any other vehicle or combination of vehicles to enter and occupy such space without danger.")

North Carolina (2017) - HB 716

Following too closely, definition, and state DOT permission:

Subsections (a) and (b) of this section shall not apply to the driver of any non-leading commercial motor vehicle traveling in a platoon on any roadway where the Department of Transportation has by traffic ordinance authorized travel by platoon. For purposes of this subsection, the term "platoon" means a group of individual commercial motor vehicles traveling at close following distances in a unified manner through the use of an electronically interconnected braking system.

(Note: This section refers to the state's following too closely law, which reads: "(a) The driver of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the speed of such vehicles and the traffic upon and the condition of the highway (b) The driver of any motor vehicle traveling upon a highway outside of a business or residential district and following another motor vehicle shall, whenever conditions permit, leave sufficient space so that an overtaking vehicle may enter and occupy such space without danger, except that this shall not prevent a motor vehicle from overtaking and passing another motor vehicle. This provision shall not apply to funeral processions.")

South Carolina (2017) - HB 3289

Following too closely:

This section does not apply to the operator of any nonleading commercial motor vehicle subject to Federal Motor Carrier Safety Regulations and traveling in a series of commercial vehicles using cooperative adaptive cruise control or any other automated driving technology.

(Note: this section refers to the state's following too closely law, which reads: "(A) The operator of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the speed of such vehicles and the traffic upon and the condition of the highway. (B) The operator of any truck or motor vehicle drawing another vehicle when traveling upon a roadway outside of a business or residence district and which is following another truck or motor vehicle drawing another vehicle shall, whenever conditions permit, leave sufficient space so that an overtaking vehicle may enter and occupy such space without danger, except that this shall not prevent a truck or motor vehicle drawing another vehicle from overtaking and passing any vehicle or combination of vehicles. (C) Motor vehicles being operated upon any roadway outside of a business or residence district in a caravan or motorcade whether or not towing other vehicles shall be so operated as to allow sufficient space between each such vehicle or combination of vehicles so as to enable any other vehicle to enter and occupy such space without danger. This provision shall not apply to funeral processions.")

Tennessee (2017) - Bill: SB 676

Flexibility for carrying registration:

For purposes of any vehicle operating as part of a platoon, as defined by § 55-8- 101, the requirements of subsection (a) are satisfied if the certificate of registration is at all times carried in the first or lead vehicle in the platoon.

(Note: this section refers to a state law that requires certificate of registration to be carried in all vehicles, which reads: “(a) Every certificate of registration shall at all times be carried in the vehicle to which it refers or shall be carried by the person driving, or in control of the vehicle, who shall display the certificate upon demand of any officer or employee of the department. The owner may, in order to ensure its safekeeping, provide a duplicate or facsimile of the certificate of registration to be kept in the vehicle for display by any person who may legally operate the vehicle under the owner's registration. (b) The provision of subsection (a) requiring that a certificate of registration be carried in the vehicle to which it refers, or by the person driving the vehicle, shall not apply when the certificate of registration is used for the purpose of making application for renewal of registration or upon a transfer of the vehicle.”)

Definition: Platoon and Operator

"Platoon" means a group of individual motor vehicles that are traveling in a unified manner at electronically coordinated speeds.

"Operator" means:

(A) For purposes of a conventionally operated vehicle, every person who is in actual physical control of a motor vehicle whether or not licensed as an operator or chauffeur under the laws of this state; and

(B) For purposes of a vehicle operating in a platoon, as defined by § 55- 8-101, the person in control of the lead vehicle of the platoon;

Following too closely:

Except for a motor vehicle in a platoon, no motor truck of more than one and one-half ton rated capacity shall approach any other motor truck of like or greater capacity proceeding in the same direction on any of the highways of this state without the corporate limits of any municipality at a distance nearer than three hundred feet (300'), except in overtaking and passing such other trucks, or unless one (1) or both of these trucks have come to a stop or except in rendering assistance to a disabled or partly disabled truck.

Requirement to submit a plan, requirement for licensed drivers:

(a) A person may operate a platoon on the streets and highways of this state after the person provides notification to the department of transportation and the department of safety. The notification provided pursuant to this subsection (a) must include a plan for general platoon operations.

(b) If the notification and the plan submitted pursuant to subsection (a) are not rejected by either the department of transportation or the department of safety within thirty (30) days after receipt of the notification and the plan, the person may operate a platoon on the streets and highways of this state

(c) For purposes of a platoon operating pursuant to this section:

(1) Vehicles in the platoon are not a caravan or motorcade;

(2) The lead vehicle in the platoon is not drawing any subsequent vehicle in the platoon;

(3) If the platoon includes a commercial motor vehicle, an appropriately endorsed driver who holds a valid commercial driver license must be present behind the wheel of each commercial motor vehicle in the platoon.

Texas (2017) - Bill: HB 1791

Following too closely and definition:

An operator of a vehicle equipped with a connected braking system that is following another vehicle equipped with that system may be assisted by the system to maintain an assured clear distance or sufficient space as required by this section. In this subsection, "connected braking system" means a system by which the braking of one vehicle is electronically coordinated with the braking system of a following vehicle.

(Note: The section referred to reads: “FOLLOWING DISTANCE. (a) An operator shall, if following another vehicle, maintain an assured clear distance between the two vehicles so that, considering the speed of the vehicles, traffic, and the conditions of the highway, the operator can safely stop without colliding with the preceding vehicle or veering into another vehicle, object, or person on or near the highway. (b) An operator of a truck or of a motor vehicle drawing another vehicle who is on a roadway outside a business or residential district and who is following another truck or motor vehicle drawing another vehicle shall, if conditions permit, leave sufficient space between the vehicles so that a vehicle passing the operator can safely enter and occupy the space. This subsection does not prohibit a truck or a motor vehicle drawing another vehicle from passing another vehicle. (c) An operator on a roadway outside a business or residential district driving in a caravan of other vehicles or a motorcade shall allow sufficient space between the operator and the vehicle preceding the operator so that another vehicle can safely enter and occupy the space. This subsection does not apply to a funeral procession.”)

Utah (2015) - HB 373

Definition: Connected platooning system

As used in this section, "connected platooning system" means a system that uses vehicle-to-vehicle communication to electronically coordinate the speed and braking of a lead vehicle with the speed and braking of one or more following vehicles.

Following too closely:

Subsection (2)(b) does not apply to:

(b) the operator of a vehicle that is:

I. part of a connected platooning system; and

II. not the lead vehicle.

(Note: subsection (2)(b) reads: “(2) The operator of a vehicle: (b) shall follow at a distance so that at least two seconds elapse before reaching the location of the vehicle directly in front of the operator's vehicle.”)

National Highway Traffic Safety Administration

Automated Driving Systems (ADS) 2.0 Guidance – Relation to truck platooning

The Voluntary Guidance, which was updated in September 2017, applies to the design aspects of motor vehicles and motor vehicle equipment under NHTSA's jurisdiction, including low-speed vehicles, motorcycles, passenger vehicles, medium-duty vehicles, and heavy-duty CMVs such as large trucks and buses. However, Interstate motor carrier operations and CMV drivers fall under the jurisdiction of FMCSA and are not within the scope of this Voluntary Guidance. Currently, per the Federal Motor Carrier Safety Regulations (FMCSRs), a trained commercial driver must be behind the wheel at all times, regardless of any automated driving technologies available on the CMV, unless a petition for a waiver or exemption has been granted.

The purpose of this Voluntary Guidance is to help designers of ADSs analyze, identify, and resolve safety considerations prior to deployment using their own, industry, and other best practices. It outlines 12 safety elements, which the Agency believes represent the consensus across the industry, that are generally considered to be the most salient design aspects to consider and address when developing, testing, and deploying ADSs on public roadways.

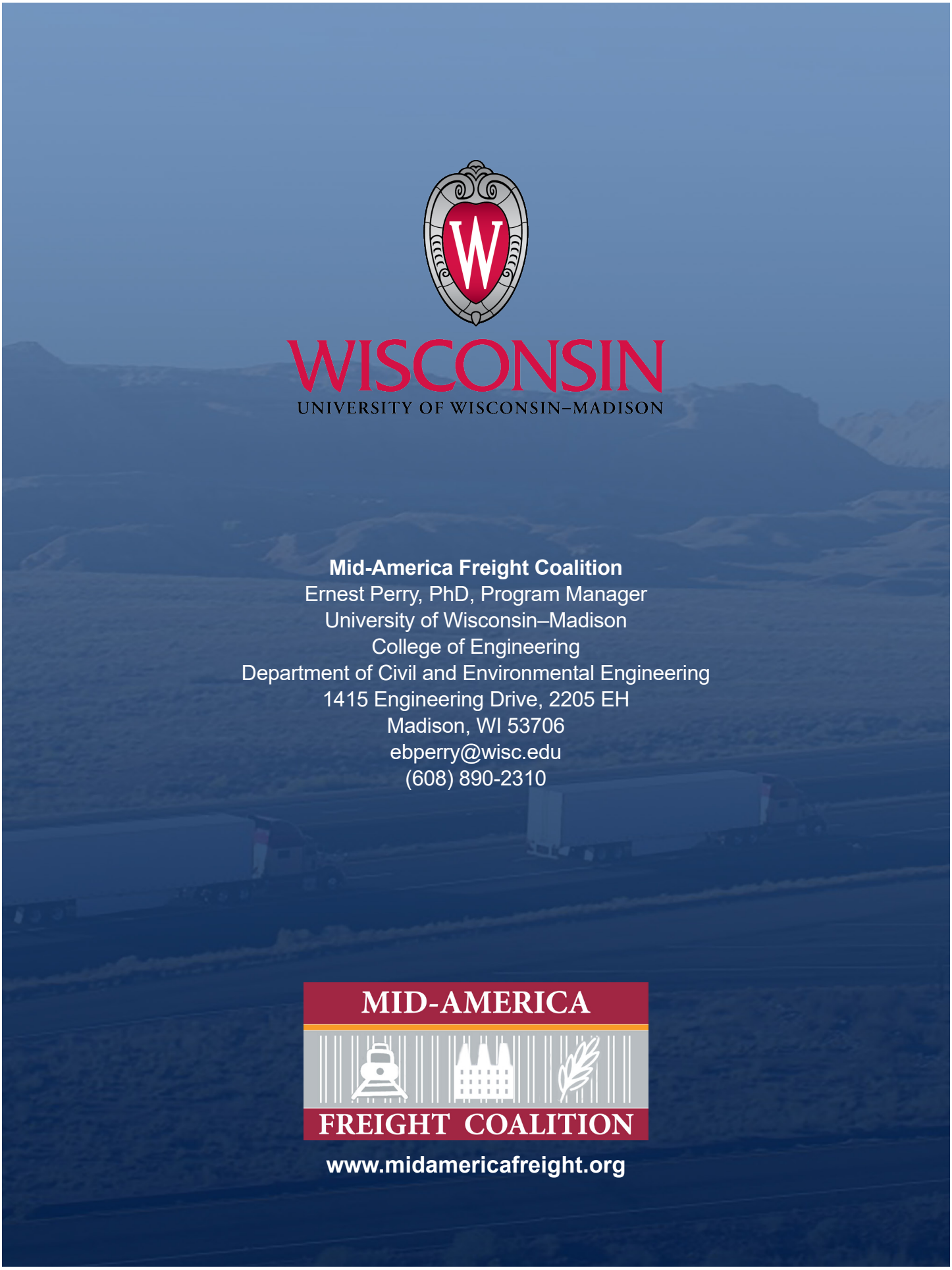
1. System Safety
2. Operational Design Domain
3. Object and Event Detection and Response
4. Fallback (Minimal Risk Condition)
5. Validation Methods
6. Human Machine Interface
7. Vehicle Cybersecurity
8. Crashworthiness
9. Post-Crash ADS Behavior
10. Data Recording
11. Consumer Education and Training
12. Federal, State, and Local Laws

Best Practices for Legislatures - In reviewing draft State legislation, the Agency has identified common components and has highlighted significant elements regarding ADSs that States should consider including in legislation. As such, NHTSA recommends the following safety-related best practices when crafting legislation for ADSs:

1. Provide a "technology-neutral" environment
2. Provide licensing and registration procedures
3. Provide reporting and communications methods for Public Safety Officials
4. Review traffic laws and regulations that may serve as barriers to operation of ADSs

NHSTA also clearly defines the roles of the Federal Agency and the State Agencies, described in the chart below.

NHTSA's Responsibilities	States' Responsibilities
• Setting Federal Motor Vehicle Safety Standards (FMVSSs) for new motor vehicles and motor vehicle equipment (with which manufacturers must certify compliance before they sell their vehicles) • Enforcing compliance with FMVSSs • Investigating and managing the recall and remedy of noncompliances and safety-related motor vehicle defects nationwide • Communicating with and educating the public about motor vehicle safety issues	• Licensing human drivers and registering motor vehicles in their jurisdictions • Enacting and enforcing traffic laws and regulations • Conducting safety inspections, where States choose to do so • Regulating motor vehicle insurance and liability



WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

Mid-America Freight Coalition
Ernest Perry, PhD, Program Manager
University of Wisconsin–Madison
College of Engineering
Department of Civil and Environmental Engineering
1415 Engineering Drive, 2205 EH
Madison, WI 53706
ebperry@wisc.edu
(608) 890-2310

MID-AMERICA
FREIGHT COALITION

www.midamericafreight.org