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ON

"INNOVATION AND AMERICA'S INFRASTRUCTURE: EXAMINING THE EFFECTS OF EMERGING AUTONOMOUS TECHNOLOGIES ON AMERICA'S ROADS AND BRIDGES"

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Introduction

Advocates for Highway and Auto Safety (Advocates) is a unique coalition of public health, safety, and consumer organizations, insurers and insurance agents that promotes highway and auto safety through the adoption of federal and state laws, policies and regulations. Advocates works to prevent crashes, deaths and injuries through the advancement of safer vehicles, safer drivers and safer roads and infrastructure.

Motor Vehicle Deaths Remain Unacceptably High

According to the federal government, each year motor vehicle crashes kill tens of thousands of people and injure millions more at a cost to society of over $800 billion.[1] According to the latest statistics from the National Highway Traffic Safety Administration (NHTSA), 37,461 people were killed on our nation's roads in 2016. This is an increase of over five percent from 2015, and it[2] follows a seven percent increase from 2014 to 2015.[3]

Advocates Has Consistently Promoted Technology to Save Lives and Prevent Injuries

Advocates has always enthusiastically championed vehicle safety technology and for good reason; it is one of the most effective strategies for preventing deaths and injuries. NHTSA has estimated that since 1960, over 600,000 lives have been saved by motor vehicle safety technologies.[4] In 1991, Advocates led the coalition that supported bipartisan legislation sponsored by Senators John Danforth (R-MO) and Richard Bryan (D-NV) that included airbag technology in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991.[5] As a result, by 1997, every new car sold in the United States was equipped with a front seat airbag and the lives saved have been significant. Over the last decade airbags saved approximately 2,500 lives annually,[6] and have saved an estimated 47,625 lives since 1987, according to NHTSA.[7]

Advocates continued to build on this success by supporting additional lifesaving technologies as standard equipment in all vehicles in other legislation and regulatory proposals. These efforts include: tire pressure monitoring systems;[8] rear outboard 3-point seat belts;[9] electronic stability control;[10] rear seat belt reminder systems;[11] rear view cameras;[12] brake transmission interlocks;[13] seat belts on motorcoaches;[14] and, electronic logging devices for commercial motor vehicles (CMVs).[15] These safety advances have saved hundreds of thousands of lives and many have been accomplished because of the bipartisan leadership of the Members of the Senate. Additionally, crash avoidance systems, such as automatic emergency braking (AEB), are critical to the development of autonomous vehicles (AVs) and could be saving even more lives if the technology was required as standard equipment.[16]

Autonomous Vehicles Need Sensible Safeguards

Advocates believes that AVs have the potential to make significant and lasting reductions in the number of deaths and injuries that occur each year on our Nation's roads. However, deploying AVs before they can be safely operated on public roads and without commonsense government oversight and industry accountability is not only reckless and ill-advised, but it will also substantially reduce public confidence in this new technology.

The Safe Operation of Autonomous Vehicle Systems Has Yet to be Proved

Serious and fatal crashes involving AVs have revealed significant flaws in this still developing technology, including AVs' ability to detect and respond to roadway infrastructure, emergency vehicles, bicyclists and pedestrians. On May 7, 2016, in Williston, Florida, a Tesla Model S on "Autopilot" struck and passed beneath a semitrailer killing the driver.[17] On January 22, 2018, in Culver City, California, another Tesla Model S operating on "Autopilot" collided with a parked fire truck that was responding to the scene of a separate crash.[18] Remarkably, neither the Tesla

driver nor any first responders were injured.[19] On March 18, 2018, in Tempe, Arizona, an Uber test vehicle operating on self-driving mode struck and killed a pedestrian walking a bicycle.[20] Then, just a few days later on March 23, 2018, in Mountain View, California, a Tesla Model X operating on "Autopilot" collided with a safety barrier resulting in the death of the driver.[21] According to the National Transportation Safety Board (NTSB) preliminary report on the crash, the vehicle was being operated under "Autopilot", had moved out of the lane of travel on its own and accelerated to 70 miles-per-hour (MPH) before colliding with the barrier.[22] The collision and subsequent intense fire closed the freeway for at least five hours.[23] Most recently, on May 29, 2018, a Tesla Model S operating on "Autopilot" struck a parked police vehicle in Laguna Beach, California.[24] The NTSB has investigated or is investigating all of these crashes except the last one.

In addition to the tragic crashes that have already happened involving autonomous systems, data accumulated from the limited miles traveled also paints an alarming picture. In 2016, the latest year for which data is available, on average a person was killed in a traffic collision every 84.7 million miles traveled on U.S. roads.[25] Before the fatal crash in Arizona, Uber had reportedly logged 2 million autonomous miles as of the end of 2017 and was predicted to accrue another 1 million miles over the next 100 days.[26] Based on a simple evaluation of this data, the autonomous Uber had one fatality in three million miles; that is a fatality rate 28 times that of human drivers. This analysis highlights just how little proof there is that these systems are safe. The two voluntary safety self-assessments filed with NHTSA illustrate that manufacturers are touting the "millions of miles"[27] or "five million miles"[28] driven by their test vehicles as proof of their systems' safety. However, these numbers pale in comparison to the more than three *trillion* miles traveled by human drivers on U.S. roads each year.[29]

Similar misdirection about safety performance data has been used in response to recent crashes involving AVs. After the 2016 fatal Tesla crash in Florida, the NHTSA Office of Defects and Investigation (ODI) issued a report which included an analysis of data supplied by Tesla that showed "that the Tesla vehicles crash rate dropped by almost 40 percent after Autosteer [a feature of the Autopilot system] installation."[30] However, included in the ODI report was a critical footnote that the crash rates reported were "for all miles travelled before and after Autopilot installation and are not limited to *actual Autopilot use*" (emphasis added).[31] Despite this clear statement by NHTSA, Tesla continues to mischaracterize the ODI analysis in response to subsequent fatal crashes involving vehicles operating under the "Autopilot" system.[32] NHTSA has since clarified again that the effectiveness of the "Autopilot" system was not evaluated in its prior investigation, refuting the claims by Tesla.[33] Moreover, Tesla was removed as a party to the NTSB investigation of the second fatal crash involving one of its vehicles shortly after a March blog post once again made this same claim.[34]

These types of details matter when it comes to AVs, particularly when evaluating claims are made to support their introduction. Some members of the industry assert that waiting for AV technology to be perfect would be "the enemy of the good."[35] In some cases, they point to a report of the same title by the Rand Corporation (RAND) to bolster this argument.[36] In fact, the RAND report concluded that allowing the deployment of AVs, which have a safety performance that is just 10 percent better than that of the average human driver, would save more lives than waiting for a perfectly safe AV.[37] However, the critical underpinning of this statement, which is being widely missed in the use of this report, is that these vehicles are in fact demonstrably better, even in some minute amount, than human drivers. It is essential to note that this is a fact

which has yet to be proved. The industry and regulators have yet to agree on the proper metrics for evaluating the safety performance of an AV, let alone requirements for operation which would assure that these vehicles are ten percent, one percent, or even a tenth of a percent better than the average human driver.

Federal Vehicle Safety Standards Have Both Immediate and Long Term Benefits

Advocates has always supported the introduction of safety technologies once its benefits have been identified and verified. Often additional advantages arise out of the widespread implementation of the base technology. For example, Advocates evaluated an abundance of research and data demonstrating that installing a rearview camera in passenger vehicles would help to prevent backover crashes and resultant deaths and injuries, often to young children and disabled persons.[38] Advocates, together with others in the safety community especially KidsAndCars.org and the remarkable families of backover victims, then fought for a decade in total to ascertain a rearview camera requirement for all new vehicles, which recently took effect on May 1, 2018. The Insurance Institute for Highway Safety (IIHS) conducted research, published in their November 17, 2016 *Status Report*, demonstrating additional benefits of rearview cameras such as reducing property damage crashes during backing, and assistance with backing maneuvers such as parking.[39] Furthermore, if a video sensor stream was required, including additional driver assistance technologies such automatic rear braking, parking guidance, and even automated parking assistance, even more advantages could be realized.

Similarly, Advocates supported equipping vehicles with anti-lock braking systems (ABS), which helps a driver to maintain control of the vehicle when braking on slippery surfaces. ABS has also resulted in wide ranging benefits. In fact, ABS is the base technology for electronic stability control (ESC) which helps to prevent rollover and loss of control crashes and is attributed to

having saved more than 7,000 lives since 2011.[40] Automatic emergency braking (AEB), which uses on-board sensors such as radar, cameras or lasers to detect an imminent crash, warns the driver and applies the brakes or increases the braking effort if the driver does not take sufficient action. The applications which are in ABS and ESC are also an underlying technology for AVs.

A critical component of both of these safety successes is a federal standard that ensures these technologies have a specific level of performance so that consumers can have confidence in the technology as well as familiarity with a new feature of their vehicle. Federal standards also pave the way to build public acceptance and use of these technologies which magnifies the safety benefits. In sum, effective government oversight and performance standards are critical to the success of new safety technologies placed into motor vehicles.

Examples of the success of effective standards and oversight of automated systems fly over our heads every single day. According to the U.S. Bureau of Transportation Statistics, 741 million passengers traveled on domestic flights in 2017.[41] The tragic April 2018 death of a Southwest Airlines passenger was the first U.S. commercial airline fatality since 2009.[42] Over that same span of time (2010-2017), nearly 5.4 billion passengers travelled safely through our skies. The Federal Aviation Administration (FAA) estimates that airline pilots use automated systems 90 percent of the time while flying.[43] Meanwhile, on our roads from 2010 to 2017, crashes claimed the lives of approximately 275,000 road users.[44] The federal government, and the U.S. Department of Transportation (DOT) in particular, already have experience in developing standards and implementing effective oversight of autonomous systems in transportation. While adaptation for governing AVs on roads is necessary, this is not an entirely new concept. The U.S. DOT would do well to coordinate with other departments and its own agencies, and make

the best use of its past research, current regulations, and the latest technologies to set standards ensuring the safe introduction of AVs.

Federal Standards are Especially Critical Considering Public Opinion Polls Show Skepticism about AVs

Numerous public opinion polls show strong public skepticism and reticence about AVs.[45] Those doubts are warranted based on the recent crashes and the past conduct of automakers. Over the last few years, automakers have hidden from the American public and regulators safety defects which have led to numerous unacceptable and unnecessary deaths and injuries as well as the recall of tens of millions of vehicles.[46] Consumer acceptance of AV technology is critical to its success and to fully realizing the lifesaving potential of AVs. In January of 2018, Advocates commissioned an independent public opinion poll that revealed intense apprehension regarding the widespread deployment of AVs. In fact, two-thirds of respondents (64%) expressed concern about sharing the roads with driverless cars.[47] When asked if they support DOT developing safety standards for new features related to the operation of driverless cars, 73% responded affirmatively.

Other surveys have yielded similar results. In a May 2018 poll commissioned by the American Automobile Association (AAA), 73% of American drivers said they would be too afraid to ride in a fully self-driving vehicle, up from 63% in late 2017.[48] A Reuters/Ipsos poll found that 67% of Americans were uncomfortable with the idea of riding in self-driving cars.[49] Lastly, in a May 2018 Public Policy Polling/Consumer Watchdog poll, 80% of respondents agreed that federal and state governments should regulate driverless vehicles for the safety of riders, pedestrians and other drivers.[50] To realize the safety benefits promised by the deployment of AVs, public acceptance and support are needed. Right now families know that when they go into auto

showrooms to buy a new car, the federal government has protections in place to ensure their safety. Similar oversight and regulation are needed for AVs to both assure and safeguard consumers.

Upgrades to America's Infrastructure Are Required for the Safe Deployment of Autonomous Vehicles

According to the American Society of Civil Engineers (ASCE), one in eleven of the Nation's nearly 615,000 bridges in the National Bridge Inventory are structurally deficient.[51] America's roads continue to receive a grade of "D" from ASCE which noted that 20 percent of the Nation's highways alone had poor pavement conditions in 2014.[52] This does not include those highways with mediocre conditions and all other non-highway roads.[53] The Federal Highway Administration (FHWA) estimates that $142 billion in capital investment would be needed on an annual basis over the next 20 years to significantly improve conditions and performance.[54] Undoubtedly, additional substantial investments in our infrastructure will be required to ensure that AVs can safely operate on America's roads.

Infrastructure design and implementation is currently guided by a library of manuals such as the Manual on Uniform Traffic Control Devices, the American Association of State Highway and Transportation Officials (AASHTO) "Green Book", the Highway Safety Manual, and the Transportation Research Board (TRB) Highway Capacity Manual, to name just a few. In many cases, these documents provide guidance which is open to engineering interpretation at the federal, state, and local levels to enable roadway designs to adapt to specific conditions or requirements. Federal oversight will be critical to ensure uniformity. However, the linchpin for much of the guidance in these manuals is human performance behind the wheel. From sight distances for signs, to lettering, to the curvature and super elevations of roads, the design criteria

of our infrastructure has understandably been developed to enable the safe operation of vehicles by human drivers. With the introduction of AVs, much of the basic premises may change and have to serve a dual purpose while a mixed fleet of both human and machine driven vehicles exist side-by-side for decades to come.

AVs will not be operating in a vacuum or closed environment. Instead, they will be operating on public roads and that is why ensuring that our Nation's infrastructure can accommodate the safe and successful deployment of AVs is so important. "Stand-alone" AVs (those that will not communicate with other vehicles) will be limited by the capability of the sensors installed in the vehicle and therefore, will largely suffer from the same types of limitations that afflict human drivers. If an AV's camera, or radar, or lidar cannot "see" an object, the AV cannot respond to its presence whether it is an emergency vehicle, a bicyclist or a baby stroller. Likewise, if the AV cannot decipher what an object is, even if it has seen something, the AV will have trouble responding to its presence. In the 2016 Tesla crash in Florida, the "Autopilot" system was unable to identify the truck crossing the path of the vehicle and thus did not respond.[55] In January of this year, a Tesla reportedly on "Autopilot" struck the rear of a fire truck stopped on a freeway which was responding to a separate incident.[56] In the fatal Tesla crash that occurred just two months later in Mountain View, California, it appears that the "Autopilot" system failed to maintain lane position before striking a crash attenuator.[57] Each of these highly publicized crashes illustrates some aspect of how infrastructure changes could improve the safety and performance of AVs, as described below, yet those upgrades are likely many years away.

Connected Vehicles

Connected vehicle technologies allow a vehicle to send and receive communications with other vehicles (vehicle-to-vehicle (V2V)) and the infrastructure (vehicle-to-infrastructure (V2I)).

These messages can relay information ranging from the relative location and direction of motion of other vehicles to warning messages that traffic lights are about to change or weather conditions are soon to be encountered. These systems will likely help fill in gaps in the performance of AVs. For instance, V2V communication can provide safety applications for advanced driver-assistance systems (ADAS) such as Left Turn Assist (LTA) and Forward Collision Warning (FCW). LTA warns drivers to the presence of oncoming, opposite-direction traffic when attempting a left turn. FCW warns drivers of stopped, slowing or slower vehicles ahead. In a 2017 Notice of Proposed Rulemaking to require V2V technology, NHTSA noted that "[b]ecause of V2V's ability to provide vehicles with information beyond a vehicle's range of perception, V2V is the only source of information that supports applications like Intersection Movement Assist (IMA) and Left Turn Assist (LTA). These applications have the unique ability to address intersection crashes, which are among the most deadly crashes that drivers currently face in the U.S."[58]

These technologies surely would have been of use in the fatal crash in Florida between the Tesla and the left turning tractor trailer, and the California crash where the Tesla struck the rear of a stopped fire truck. Likewise, V2I applications could have provided information to the vehicle in the California crash about the emergency response underway on the highway, or in the Florida crash to inform the Tesla that it was operating on a road outside of the AV's operating design domain (ODD) where it was intended to operate. The International Association of Fire Chiefs submitted comments endorsing a federal requirement for V2V technology, noting the significant number of firefighter deaths and injuries coming from crashes.[59] Advocates also filed comments in support of mandating V2V because of the technology's ability to help prevent serious

crashes.[60] However, despite the identified safety benefits of V2V technology, this rule is languishing at DOT.

Road Design

As noted above, the design of our roads from the asphalt, to the signage, to the lighting, to the speed limit is largely based on the history of human performance behind the wheel and the capability of the vehicles. The introduction of AVs stands to essentially require a re-write of many of these guidelines in the future. However, in the near term, there will need to be an evaluation of how standards for design can be modified to accommodate both human and machine "drivers". The recent Tesla crash in California highlights how both human and machine "drivers" could benefit from improved lane marking as well as establishing standards for pavement resurfacing to ensure that repair seams and color differences do not confuse AV systems. Establishing uniform standards for signage color, lighting, contrast, letter size, and other roadway features will also reap similar benefits. Many of the current manuals' guidelines and recommendations are almost always open to engineering interpretation. With the advent of AVs, more emphasis must be placed on consistency, and consideration must be given to the effects variations can have on autonomous technology. While a human driver can see a unique situation and interpret those circumstances fairly well, an AV may not be able to do the same. Research has already shown that minor distortion of a sign can cause havoc for AVs, causing stop signs to be interpreted as speed limit signs, a confusion which can have serious, and even potentially fatal, results.[61]

Roadway deterioration and delayed repair, which are common occurrences on existing infrastructure, will have a negative impact on AV operation. Every driver has experienced road signs or markings that have been damaged, intentionally altered or blocked by objects. This

could lead to misinterpretation of highway cues and result in stopped or misdirected AVs that will present dangerous highway hazards. These findings and similar research illustrate not only that standards for roadway design can be critical to performance, but also that road design improvements alone may not suffice to ensure the safe operation of AVs. Combining standards for design with infrastructure improvement like V2I would help to provide additional awareness for human drivers and unambiguous inputs for machine "drivers."

America's crumbling infrastructure poses significant safety and economic concerns. The AV industry has often claimed that the introduction of these vehicles will reduce congestion, improve environmental quality, and advance transportation efficiency.[62] However, many of these claims may amount to nothing more than fanciful theories. Instead, AVs may bring about so-called "hyper-commuters" who work from their vehicles on long commutes to enable living further from offices and/or city centers. Likewise, the possibility of empty AVs adding substantial miles on the roads as they re-position autonomously after dropping off riders could undermine many of the benefits claimed.[63] Significant consideration must be given to how AV driving could change wear patterns on roadways. The lower variance of an AV's position within a lane could lead to accelerated wear in lanes, and condensed convoys of automated trucks, commonly known as platooning, could place further strain on roads and bridges. All of these concerns must be evaluated to consider operational constraints for AVs before further damage is inflicted upon our Nation's roads and bridges. For example, the spacing between automated commercial motor vehicles (ACMVs) in a platoon could have wide ranging implications. If these large vehicles travel too closely together, their combined weight load could place severe stress on a bridge. In addition, lengthy platoons that consist of many ACMVs could be difficult to pass and affect merging and exiting from roadways.

Taking into account the long term ramifications, the budgetary constraints, and necessary coordination among a diverse group of interested parties when it comes to infrastructure projects at any level, research is needed now more than ever on the impact of AVs on our roads. Large comprehensive studies of the implications of the introduction of AVs such as the National Cooperative Highway Research Program Project 20-102 are necessary to identify the strengths of the current infrastructure, but more importantly where coordination and standards need to be improved or created. The project astutely noted in one of its reports that "the line between vehicle regulations, infrastructure and operations is further blurred" when road standards are needed to enable the safe operation of AVs.[64] This statement underlines how critical infrastructure improvements are going to be to the safe deployment of this new technology. In addition, further research is also required to examine the differing infrastructure upgrades that will be required for urban, suburban and rural regions. More consideration must be given to this complex issue before AVs can be deployed on a large scale.

In Addition to Infrastructure Upgrades, Proper Government Oversight is Needed for the Safe Deployment of Autonomous Vehicles

Over fifty years ago, Congress passed the National Traffic and Motor Vehicle Safety Act of 1966 because of concerns about the death and injury toll on our highways.[65] The law required the federal government to establish minimum vehicle safety performance standards to protect the public against "unreasonable risk of accidents occurring as a result of the design, construction or performance of motor vehicles."[66] While motor vehicles have changed dramatically since that time and will continue to do so in the future, the underlying premise of this crucial law and NHTSA's safety mission have not.

Unfortunately, NHTSA has chosen to issue only "voluntary guidelines" for the development of AVs.[67] Voluntary guidelines are not enforceable because they are not legally binding, and, therefore, are inadequate to ensure safety and protect the public. Manufacturers may unilaterally choose to deviate from the guidelines or ignore them entirely at any time and for any reason including internal corporate priorities such as cost or marketing considerations.

The AV START Act Fails to Ensure Public Safety

Compounding NHTSA's inaction are the deep flaws of The American Vision for Safer Transportation through Advancement of Revolutionary Technologies (AV START) Act (S. 1885) currently pending before the Senate. We are disappointed that the bill, in its current form, falls well short of the oversight and accountability necessary to ensure public safety. Moreover, the bill unnecessarily takes aim at the current federal regulatory scheme that has been in place for decades protecting those traveling on America's roads. We continue to push for reasonable improvements to the bill. Furthermore, for the Senate to fully consider all of the public safety implications associated with the mass deployment of AVs, the AV START Act should not move forward until the ongoing multiple investigations by the NTSB of the serious and fatal crashes involving AVs noted above are completed.

Section 6 of the AV START Act will allow millions of vehicles to be deployed into the public domain that are exempt from existing critical Federal Motor Vehicle Safety Standards (FMVSS). Providing broad statutory exemptions from the FMVSS for AVs is both unnecessary and unwise. There is already a statutory process in place for manufacturers to seek an exemption from the FMVSS. Moreover, Section 24404 of the Fixing America's Surface Transportation (FAST) Act[68] permits auto manufacturers to test or evaluate an unlimited number of vehicles exempt from one or more of the FMVSS.[69] Furthermore, the exemption provision in current law, 49

USC Section 30113(a), provides that manufacturers may receive an exemption from compliance with the FMVSS for the sale of 2,500 vehicles to be sold in the United States in any 12-month period. No evidence has been presented to show that the development and deployment of AVs requires wholesale exemptions for an untold number of AVs from critical federal safety standards that are essential to protecting public safety.

Additionally, the legislation currently contains no prohibition on AVs receiving an exemption from crashworthiness or occupant protection standards which protect the vehicle's passengers. Such exemptions can diminish the level of occupant protection that has been established through years of research under the existing regulations.[70] Prohibiting such exemptions will in no way inhibit the development of AV technology but will ensure that passengers of AVs are properly protected in a crash.

Section 7 of the AV START Act drastically alters current federal law which prohibits manufacturers from rendering safety systems, such as the brakes and brake pedal, inoperable. This provision is a dangerous change in settled law because it would allow automakers to "turn off" safety systems while the AV is being driven by the computer. This could unnecessarily dilute safety at the discretion of the manufacturer and sets a precedent of Congress allowing manufacturers to unilaterally circumvent many of the existing safety standards. Currently, automakers cannot turn off safety systems without government oversight.

Section 9 of the AV START Act requires manufacturers of AVs and AV technology to submit to NHTSA a Safety Evaluation Report (SER) that details the development of the technology and its expected performance in real world conditions. While Advocates supports the mandatory

submission of such information, this provision as currently written only directs manufacturers to "describe" their AV systems. In the absence of a legislative directive to require that sufficient information and data are included in the SER, manufacturers will continue to submit slick marketing brochures such as those already released by two manufacturers[71] instead of providing data and documentation that will allow the public and NHTSA to accurately evaluate the safety of the technology.

The AV START Act should ensure that consumers are given essential information about an AV. Every manufacturer should be required to provide each consumer with information about the capabilities, limitations and exemptions from safety standards for all vehicles sold in the U.S. at the time of sale. This information should be made available to consumers from day one, even before NHTSA issues a rule. Additionally, it would be useful for consumers and researchers to be able to automatically identify AVs by the vehicle identification number (VIN).

NHTSA should also be required to establish a public website with basic safety information about AVs for consumers and for use in safety research. This online database would be similar to the safercar.gov website that NHTSA maintains to inform the public about safety recalls applicable to their vehicle. This would enable consumers to enter their VIN to obtain critical information about their AV such as the level of automation, any exemptions granted by NHTSA from the FMVSS, and the operational design domain which includes limitations and capabilities of each autonomous driving system with which a vehicle is equipped. Such a database will be critical for consumers who purchase AVs and will also allow NHTSA and other research groups to perform independent evaluation of the comparative safety performance of AV systems.

Additionally, data sharing among manufacturers is essential to improve overall safety among AVs. Data and information about known flaws or problems encountered during development and while in use must be shared among manufacturers and with NHTSA and the public to ensure that all AV systems are learning about problems in real time and can benefit from the experience of other AV systems. This type of collaborative development is already taking place in the industry with respect to cybersecurity issues with the creation of the Automotive Information Sharing and Analysis Center (Auto ISAC). Data sharing will expedite solutions to unusual or unique safety problems and ensure they are readily identified and corrected. The NTSB in their investigation of the fatal Tesla crash in Florida noted that event data recorders (EDRs) are not required nor would current standards mandate the capturing of data necessary to evaluate the performance of AVs. The AV START Act does not require that this critical safety data generated by AVs will be recorded, shared or even provided to NHTSA. It is also essential that the legislation require all crashes involving AVs be reported immediately to NHTSA by manufacturers.

Commonsense Improvements Must Be Made to the AV START Act

Without essential changes and additions to AV START Act, this legislation, which will establish our Nation's AV policy for years to come, will needlessly put all road users at risk. The additional improvements outlined below will not inhibit the development and deployment of AVs. Rather, these commonsense recommendations will ensure public safety and industry accountability.

Include Level 2 AVs

The AV START Act does not include Society of Automotive Engineers (SAE) Level 2 AVs, which require a human driver monitor their performance and be available to take over the driving

task when necessary, like the Teslas which have been involved in several crashes. During a September 12, 2017, hearing on the 2016 crash conducted by the NTSB, deadly failures of Tesla's Level 2 "Autopilot" system were readily identified.[72] The NTSB found that similar problems also exist in other Level 2 AVs across many manufacturers.[73] In the near term, Level 2 AVs will likely comprise a majority of the passenger vehicle AV fleet. Proper safeguards to curb Tesla-like failures must be put in place. At a minimum, Level 2 AVs should be covered by the SER, consumer information disclosure and cybersecurity provisions in the AV START Act.

Require Cybersecurity Standards

A failure to adequately secure AV systems and to protect against cyber-attacks could endanger AV passengers, non-AV motorists, pedestrians, bicyclists and other vulnerable roadway users. It could also clog roads, stop the movement of goods and hinder the responses of emergency vehicles. The real possibility of a malevolent computer hack impacting hundreds or thousands of AVs, perhaps whole model runs, makes strong cybersecurity protections a crucial element of AV design. Yet, Section 14 of the AV START Act merely requires manufacturers to have a cybersecurity plan in place with no minimum standards of protection or effectiveness. Instead, the legislation should require NHTSA to establish a minimum performance standard to ensure cybersecurity protections are required for AVs of all levels. Considering the recent record of high-profile cyber-attacks,[74] allowing manufacturers merely to have a cybersecurity plan in place is grossly inadequate to ensure that AVs are protected against potentially catastrophic cyber-attacks and breaches.[75]

Direct NHTSA to Proscribe Standards to Prevent Driver Distraction

In AVs that require a human to take control from the AV system (Levels 2 and 3), the automated driving system must keep the driver engaged in the driving task. Research demonstrates that

even for a driver who is alert and performing the dynamic driving task, there is a delay in reaction time between observing a safety problem and taking appropriate action.[76] For a driver who is disengaged from the driving task during autonomous operation of a vehicle, that delay will be longer because the driver must first be alerted to re-engage, understand the situation, then take control of the vehicle before taking appropriate action. The failure of the automated driving system to keep the driver engaged in the driving task during the trip was identified as a problem by the NTSB Tesla crash investigation. The NTSB found that the Tesla "Autopilot" facilitated the driver's inattention and overreliance on the system, which ultimately contributed to his death.[77] The "Autopilot" was active for 37 minutes of the 41 minute trip and during the 37 minutes, the system detected the hands on the steering wheel only 7 times for a total of 25 seconds.[78] The NTSB also found that these problems are widespread across manufacturers with similar systems.[79] The AV START Act fails to address this critical safety problem, yet technology to discern distraction and provide alerts is already available, and NHTSA should be directed to establish a minimum performance standard to ensure driver engagement throughout the trip.

Provide for Standards to Protect the Electronics that Power Safety Systems

Motor vehicles and motor vehicle equipment are powered and run by highly complex electronic systems and will become even more so with the future deployment of autonomous driving systems. Interference from non-safety systems can affect the electronics that power critical safety systems if they share the same wiring and circuits. For example, in one reported instance a vehicle model lost power to its dashboard lights when an MP3 player was plugged in and used.[80] Similar to FAA requirements to protect the electronics and their functions in aircraft under any foreseeable operating condition,[81] NHTSA should require minimum performance standards for the electronics in all motor vehicles, particularly AVs. However, the AV START

Act fails to direct NHTSA to develop and issue performance standards for the electronics systems of modern motor vehicles as the FAA does for aircraft which, like AV cars, are highly dependent on electronic systems.

Require an AV "Vision Test" to Ensure Operating Safety

In order for an AV to properly interact with its surrounding environment, it must not only detect other vehicles and roadway infrastructure but also other participants using our Nation's transportation systems such as pedestrians, bicyclists, wheelchair users, construction workers in work zones, first responders providing assistance after crashes, and law enforcement officers directing traffic. A failure to properly detect and react to any of these could have tragic results similar to the recent Tesla crash where the vehicle while operating on the "Autopilot" system reportedly drove into a roadside barrier.[82] AVs and automated driving systems must be subject to objective testing to ensure that they properly detect other road users, as well as pavement markings and infrastructure, can correctly identify the type of object that has been detected, and can then also respond properly and safely. Therefore, the AV START Act should direct the Secretary to initiate a rulemaking proceeding to require automated driving systems, including SAE Level 2 automated driving systems, to meet a minimum performance standard for detecting and reacting to the AV's driving environment.

U.S. DOT Requires Sufficient Funding and Authority to Properly Regulate Automated Vehicles

Regulating AVs presents unique challenges for the U.S. DOT, and those issues warrant additional tools and funding to protect against potentially catastrophic defects and failures. NHTSA should be granted imminent hazard authority in order to expedite the grounding of vehicles that the agency has identified as having a potentially dangerous, widespread problem or when it detects a cybersecurity threat that could lead to inordinate crashes, deaths and injuries.

Additionally, because of the potential serious nature of software defects that could imperil safety in thousands of vehicles, the ability to levy enhanced penalties is essential. The unacceptable level of current motor vehicle crashes, fatalities and injuries combined with the demands being placed on NHTSA with regard to AV technology necessitates an increase in agency funding.

Today, 95 percent of transportation-related fatalities, and 99 percent of transportation injuries, involve motor vehicles on our streets and highways.[83] Yet, NHTSA receives only one percent of the overall DOT budget.[84] The AV START Act requires NHTSA to take on new significant responsibilities. In order to efficiently execute all of these tasks, an office dedicated to AV safety should be established within NHTSA. The protection of public safety should not be compromised and progress should not be slowed because the agency does not have adequate technical expertise, organization, resources and funding to oversee the development and deployment of AVs.

Moreover, it is the statutory mission of NHTSA to regulate the design and performance of motor vehicles to ensure public safety which, in modern day terms, includes AVs and automated driving system technology. However, in the absence of comprehensive federal standards and regulations to govern the AV rules of the road, the states have every legal right, indeed a duty to their citizens, to fill the regulatory vacuum with state developed proposals and solutions for ensuring public safety.

Lastly, additional funding for infrastructure upgrades to accommodate AVs will likely need to be authorized as driverless cars are deployed so that states can make the requisite improvements to their roadways.

Conclusion

Every day on average 100 people are killed and 6,500 more are injured in motor vehicle crashes in the U.S. Advocates has consistently promoted technology to reduce this unacceptable death and injury toll. So too, does Advocates believe that automated technology has the potential to make significant and lasting reductions to this public health epidemic. However, AVs should not be prematurely deployed and sold before they can be safely operated on public roads and without commonsense government oversight in place. Serious and fatal crashes involving AVs which have already occurred reveal significant flaws in this still developing technology. These crashes have also shown that coordination at the federal, state and local levels regarding infrastructure development and upgrades will play a significant role in the safe and successful development of AVs. Synchronization by governing bodies and safeguards are essential to turn around the current skepticism widely held by the public to build trust. In sum, the path to the safe and effective introduction of AVs must require government oversight, transparency and a comprehensive regulatory framework in all aspects from vehicle standards to infrastructure design.

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