Steven Cliff, Acting Administrator
National Highway Traffic Safety Administration
U.S. Department of Transportation
1200 New Jersey Avenue S.E.
Washington, DC 20590-0001

RE: Request for Comment on Framework for Automated Driving System Safety

Dear Acting Administrator Cliff:

Thank you for the opportunity to provide comments on the National Highway Traffic Safety Administration's (NHTSA) Advanced Notice of Proposed Rule Making (ANPRM) concerning the development of a framework for Automated Driving System (ADS) safety, published on December 3, 2020.

I applaud the Department of Transportation (DOT) and NHTSA's leadership in promoting continued development of ADS vehicles, and I fully support NHTSA's recognition of the necessity in beginning work developing this framework. To reach the full potential of ADS vehicles, NTHSA should remain steadfastly committed to an iterative approach that is flexible to meeting new demands and open to welcoming new technologies, establish mandatory reporting and disclosure standards for autonomous vehicle manufacturers, and closely work with state and local government.

If implemented correctly, this framework and the vehicles it serves to regulate will save countless lives and offer numerous other societal benefits. Beginning work now on the framework will also benefit the car makers and other companies engaged in development of ADS vehicles and components.

ADS Systems & NHTSA Regulatory Actions to Date

There are six distinct stages of autonomous driving function. Stage 0, wherein the driving is completely manual, and the driver is fully responsible in carrying out all driving tasks, is where many cars on the road today likely are. Stage 5, where the car is fully automated with no driver needed, is what this framework is seeking the regulate. Even the most advanced automated driving systems seen on the road today are still likely firmly in Stage 2, where a driver

must permanently monitor the system, even if it is capable of performing tasks such as driving, lane changes, and parking.

In September 2016, NHTSA and DOT issued the *Federal Automated Vehicles Policy*, which outlined an initial approach to facilitating innovation while providing safety assurances. In September 2017, DOT released *Automated Driving System: A Vision for Safety 2.0*, DOT became more actively engaged in federal guidance surrounding ADS vehicles while maintaining a flexible approach that encouraged the automotive industry and other stakeholders to consider best practices focused on Levels 3-5 of automation.[1] *Preparing for the Future of Transportation: Automated Vehicle 3.0,* released in October 2018, built upon the guidance provided in ADS 2.0. Finally in January 2020, *Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0* expanded on the guidance released to date by expanding the scope of federal government activities surrounding autonomous vehicle development to cover 38 relevant US Government components that "have direct or tangential equities in safe development and integration of AV technologies."[2]

Though there is no consensus on when we will reach Stage 5, the most optimistic expectations still suggest that we are likely more than a decade away. Still, with the support and leadership of DOT and NHTSA, there are already several cities across the country that are serving as testing grounds for localized, real-world deployments of ADS-equipped vehicles. These cities were chosen following a Federal Register Notice soliciting proposals for a pilot program for automated vehicle proving grounds in November 2016, and which saw applicants including academic institutions, state Transportation Departments, cities, private businesses, and public-private partnerships.[3] I encourage DOT considers expanding the number of cities soon. In addition to the invaluable real-world testing that fosters continued innovation, expanding the program to more cities will help the general public become better acquainted with and ideally more strongly support the adoption of autonomous vehicles on roads.

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[1] NHTSA, *U.S. DOT Releases New Automated Driving Systems Guidance; https://www.nhtsa.gov/press-releases/us-dot-releases-new-automated-driving-systems-guidance*

[2] Automated Vehicles 4.0: Ensuring American Leadership in Automated Vehicle Technologies; https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/360956/ensuringamericanleadershipav4.pdf

[3] US DOT: DOT Designates 10 Automated Vehicle Proving Grounds to Encourage Testing of New Technologies; https://www.transportation.gov/briefing-room/dot1717

To date, NHTSA's regulatory actions have primarily focused on unnecessary regulatory barriers and obstacles to ADS vehicle development. These actions have been relatively minor, such as NHTSA's example within the ANPRM of proposing to remove the requirement for advanced air bag systems in delivery trucks with no occupant compartment. NHTSA also acknowledges that these minor actions may continue moving forward as necessary.

Regulatory Authority

NHTSA has broad jurisdiction over motor vehicle safety (including operational and nonoperational safety) pursuant to the Safety Act (49 U.S.C. Chapter 301), the purpose of which is "to reduce traffic accidents and deaths and injuries resulting from traffic accidents." Under Chrysler Corp v. Department of Transportation (1972), NHTSA also has authority to issue Federal Motor Vehicle Safety Standards, even in cases where "standards which require improvements in existing technology or which require the development of new technology, and…is not limited to issuing standards based solely on devices already fully developed."[4] In addition, as outlined in 49 CFR § 5.5, DOT and NHTSA have broad authority to issue regulations.[5]

Of note, 49 CFR § 5.5 Subsection (f) asserts that regulations should be designed to minimize burdens and reduce barriers to market entry whenever possible and should be narrowly tailored when imposing burdens. As discussed below, I recommend NHTSA maintain a performance-based, technology-neutral approach to the development of this safety framework in order to ensure barriers to market entry are sufficiently reduced and autonomous vehicles are commercialized as efficiently as possible with no sacrifice to safety.

Benefit of ADS Systems

ADS systems have an opportunity to greatly reduce the number of crashes and by extension the health and safety of drivers and passengers, as well as pedestrians, cyclists, and other vulnerable road users. Today, car crashes are a leading cause of unintentional death and injury in the US. They were responsible for more than 37,000 deaths in the US in 2019[6], and

[4] NHTSA Framework, p 44
[5] The ANPRM highlights statutory authority of NHTSA in FMVSS regulations under 49 CFR § 5.5 when discussing whether it should specify minimum levels of safety performance in order to comply with cost benefit standards.
[6] Center for Disease Control and Prevention WISQARS Data Visualization Tool; https://wisqars-viz.cdc.gov

more than 100,000 pedestrian and bicyclist injuries annually.[7] These numbers can be drastically lowered via ADS. It is estimated that more than 90% of all serious crashes were due to human error.[8] ADS vehicles, meanwhile, will not suffer from mistakes driving due to human error. "Autonomous vehicles are never drunk, distracted, or tired; these factors are involved in 41%, 10%, and 2.5% of all fatal crashes, respectively."[9] By mitigating, if not completely removing, the human error element to driving, lives will be saved, and injuries will be lessened.

There are societal and economic benefits that may stem from the adoption of autonomous vehicles too. As autonomous vehicles become the primary means of transport in the US, nearly an hour can be saved per day for drivers. Costs associated with driving (including cost to maintain a car, cost of insurance, etc.) may decrease, and the footprint required for parking today could be drastically lowered or repurposed as the car would not need to remain in the same physical location as the owner when not in use.[10] The time, money, and space savings will greatly improve the lives of people and communities across the country.

ADS can also provide several benefits for young, elderly, and individuals with disabilities: They could open up new employment opportunities, ensure transportation issues do not get in the way of medical appointments, and even lead to increased voter turnout in future elections.[11] To meet these health and societal goals though, it is imperative that NHTSA develops an effective framework that lets innovation flourish in these nascent stages of development.

Importance of Technology Neutrality & Flexibility

In the ANPRM, NHTSA states that it wants to ensure that any regulatory safety mechanism remains technology neutral.[12] DOT has also included neutrality among its six

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[7] NHTSA, *Fatality, and Injury Reporting System Tool; https://cdan.dot.gov/query*
[8] Stanford Law School Center for Internet and Society, *Human Error as A Cause of Vehicle Crashes;* http://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes
[9] RAND Corporation; *Driving to Safety: How Many Miles of Driving Would it Take to Demonstrate Autonomous Vehicle Reliability; https://www.rand.org/content/dam/rand/pubs/research_reports/RR1400/RR1478/RAND_RR1478.pdf*
[10] McKinsey & Company, *Ten Ways Autonomous Driving Could Redefine the Automotive World;* https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/ten-ways-autonomous-driving-could-redefine-the-automotive-world
[11] Ruderman Family Foundation, Self-Driving Cars: The Impact on People with Disabilities; https://rudermanfoundation.org/wp-content/uploads/2017/08/Self-Driving-Cars-The-Impact-on-People-with-Disabilities_FINAL.pdf
[12] NHTSA, ADS Safety Principles ANPRM; https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/ads_safety_principles_anprm_website_version.pdf

automation principles in overseeing autonomous vehicle regulatory development.[13] I applaud this commitment and implore the agency to remain dedicated to this goal as the framework is gradually developed. Based upon the sheer number of comments received already, it seems clear that there is no single way in developing a safe autonomous vehicle. Any future regulations concerning autonomous vehicles that harm neutrality may risk not keeping pace with the breakneck pace of the developments of the emerging technology, and more concerningly threaten to stifle ongoing innovation at these companies, and numerous others that may not have even been created yet.

A study on autonomous vehicle safety found that in order to statistically demonstrate with 95% confidence that an autonomous vehicle would have a lower human fatality rate than a human-driven vehicle, a fleet of 100 autonomous vehicles (driving 365 days a year, 24 hours a day, at an average speed of 25 miles per hour) would need to drive 275 million miles for more than 12 consecutive years. In order to demonstrate that autonomous vehicles are at least 20% better than human drivers under those same conditions, the fleet of vehicles would need to drive 11 billion miles or 500 years. These real-world driving scenarios are not practical. Even if the necessary miles driven for autonomous vehicle testing were just a fraction of what is discussed above, the equipment behind the vehicles may be outdated by improvements to the technology during the real-world testing time thus causing further delays to implementation and commercialization of the autonomous vehicles.

There is also a question of whether it would even be legal to mandate such rigorous and lengthy testing. NHTSA discusses in the Framework a foundational court case surrounding FMVSS, wherein the Court of Appeals for the Ninth Circuit found that "because of unforeseen problems in the development of the new braking systems, the Standard was neither reasonable nor practicable at the time it was put into effect." It is reasonable to assume that such strict testing standards for systems that can otherwise be deemed safe through other means (such as virtual testing, modeling, pilot studies, etc.) may be determined to be neither reasonable nor practicable at the time the standards were put into effect.

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[13] US Department of Transportation, *Automated Vehicles 3.0: Preparing for the Future of Transportation;* https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf

Regardless of legality, considering the benefits outlined above, principally the safety benefits to all road users, any delay to technology that has proved safe should simply not be an option. NHTSA should thus continue to maintain a flexible approach not just to its framework but also to individual vehicles and their purposes, so as not to impede any specific innovation, or the underlying technologies and business models of these vehicles as they continue to evolve. For example, two real-world scenarios which will likely see ADS-equipped vehicles are that of public transportation, such as city buses, and delivery vehicles for products such as food and grocery orders. While the city bus would likely have any number of people inside depending on route and time, it is unlikely a delivery vehicle may ever necessarily have people.

While road safety is of paramount importance for all autonomous vehicles and in all scenarios, the design, technology, safety, and use-case scenarios of autonomous vehicles may be distinctly different. NTHSA should not impede the commercialization of one due to potential issues of another. The framework should serve as a guide for ADS manufacturers in their continued development, and no successful use-case should be held back from entering commercialization because of potential failures of another. As NHTSA notes in the Framework, "each FMVSS must also be reasonable, practicable, and appropriate for each type of vehicle to which it applies." While this discussion revolves around NHTSA's safety standard setting authority more broadly, in this specific case I believe that NHTSA should be legally bound to creating separate standards under a unified FMVSS for each type of autonomous vehicle depending on their function and use-case.

In this same vein, NHTSA should not create a separate regulatory class for ADS from non-ADS vehicles. The Framework notes that existing classes of vehicles are based largely on "observable physical features (e.g., number of designated seating positions), objectively measurable specifications (e.g., gross vehicle weight rating), or performance (e.g., top speed)."[14] At such an early stage of development for ADS vehicles, it is possible that any features, specifications, or performance of an ADS system in development today will be vastly different from when it reaches market. Creating a separate class today would be a detriment to the development autonomous vehicles and should be delayed at least until much later in the process (or NHTSA should avoid creating a separate class altogether). Doing so at such an early stage of

[14] NHTSA Framework, p. 47

development of these vehicles may create unnecessary hurdles and slow innovation. Instead, NHTSA should lay a broad groundwork that would apply to all ADS vehicles *and* be flexible in its approach as it considers future approval and roadworthiness of them.

Additionally, while investment in the emerging autonomous vehicle sector is strong today, any framework that is developed that does not take technology-neutrality and flexibility in mind – or worse the absence of any type of framework – may have significant and undesirable impacts in the future. Today, 13 of the 14 largest automakers and 12 of the 14 largest technology companies have announced plans or are already actively engaged in development of autonomous vehicles or technologies to support them.[15] There are well over 250 companies engaged in development of autonomous vehicle technologies, from the world's largest companies to early-stage start-ups that have still yet to see a dollar of revenue.[16]

These companies are all actively investing billions of dollars developing their vision for ADS because they are certain the technology is capable, and the regulations will not stifle the innovation. However, studies have shown that any increase in uncertainty can lead to decreases in investment.[17] Being possibly more than a decade away from reaching market, autonomous vehicle development is sustained entirely through investment. Thus, NHTSA should recognize that any future regulations concerning ADS safety, including the forthcoming framework, must appropriately take this into account and be sure to not add regulatory uncertainty. At such an early stage of fully autonomous vehicle development, it would be unnecessary - and potentially damaging – to add uncertainty to the industry by reaching too far and imposing overly burdensome regulations.

Need for Regulatory Mechanisms Mandating Reporting and/or Disclosure

The Framework discusses the necessity of demonstrating safety of ADS in facilitating public confidence and adoption of autonomous vehicles in the future. ADS 2.0 (*A Vision for Safety)* introduced Voluntary Safety Self-Assessments (VSSA). These Self-Assessments allowed autonomous vehicle manufacturers to demonstrate to the public that they are, among other things, considering the safety aspects of their ADS vehicles and communicating and

[15] Madrona Venture Group; *The State of Today's Autonomous Vehicle Market; https://www.madrona.com/avmarket/*
[16] CBInsights Research Briefs; *Corporations Working on Autonomous Vehicles; https://www.cbinsights.com/research/autonomous-driverless-vehicles-corporations-list/*
[17] Leavy, John and Whited, Tony; *The Effect of Uncertainty on Investment: Some Stylized Facts; https://www.jstor.org/stable/2077967*

collaborating with the U.S. DOT. To fully and effectively facilitate public confidence, however, it may be necessary for NHTSA to establish *mandatory* safety self-assessments or other regulatory mechanisms to more strictly mandate reporting of incidents, especially as the prevalence of autonomous vehicles becomes more widespread with continued testing across the country.

One poll in 2019 found that "half of Americans think autonomous cars are more dangerous than human-driven ones, while two-thirds said they would not buy a fully autonomous car."[18] Another found that 71% of American's are afraid to ride in a self-driving car – a number that rose since 2017.[19] Part of the reason for these negative numbers is that public opinion toward autonomous vehicles has faltered due to the news they have read and seen, including stories – as few as they are – about self-driving car accidents. To combat this, and to prepare the public for autonomous vehicles, NHTSA must educate the public about the safety of an ADS vehicle.

To do so, NHTSA and car manufacturers must be as transparent as possible about the safety and efficacy of autonomous vehicles. Throughout the Framework, NHTSA discusses the benefits of transparency. It even includes transparency as a critical factor in designing, assessing, and selecting administrative mechanisms for a safety framework due in part because it can "build public confidence and acceptance." To truly reach a level of public confidence and acceptance, NHTSA must mandate safety disclosures.

Role of State, and Local Governments in ADS Development & Safety Framework

In the ANPRM, NHTSA noted that it recognized that role of state and local governments in traffic safety, and in the oversight of on-road testing of ADS vehicles. NHTSA's recent launch of its Automated Vehicles Transparency and Engagement for Safe Testing (AV TEST) Initiative, which includes workshops where governments can discuss lessons learned and best practices for testing – as well as hear from NHTSA on its research and rulemaking activities – highlights the instrumental nature of collaborative government efforts in the development of ADS vehicles and the NHTSA safety framework. NHTSA should remain committed to these collaborative efforts

[18] World Economic Forum; *Look No Hands: Self-Driving Vehicles' Public Trust Problem*; https://www.nhtsa.gov/automated-driving-systems/voluntary-safety-self-assessment
[19] AAA: Three in Four Americans Remain Afraid of Fully Self-Driving Vehicles; https://newsroom.aaa.com/2019/03/americans-fear-self-driving-cars-survey/

and seek additional ways it can closely work with state and local government in developing an effective safety framework.

One such way NHTSA can achieve this would be to closely work in partnership with state transportation departments both in upgrading roadway infrastructure and in supporting states as they adapt their roadways to the developing technology. The framework notes that NHTSA expects states and localities to enforce all traffic laws for autonomous vehicles, just as they would today. It is therefore reasonable that NHTSA works in close collaboration with state and local governments to identify any issues in any traffic laws, as well as upgrading roadway signage, traffic lights, street markings, etc. as necessary to ensure that all are sufficiently and appropriately readable by autonomous vehicles.

Regardless of technology, all ADS vehicles – and drivers, cyclists, and pedestrians alike – would benefit from upgraded, easy to read signs, street markings, and infrastructure upgrades. In addition, NHTSA and its state and local partners should determine how to best improve the roadways of today to accommodate for the cars of tomorrow. This could include determining whether technological improvements such as adding, for example, cellular network capabilities to road signs, streetlights, and other infrastructure could benefit autonomous vehicle safety by providing another data source from which the ADS vehicles could collect data from.

Finally, NHTSA should also engage with states to ensure its traffic laws regarding autonomous vehicle operations and any necessary licensing are all aligned as best as possible by the time ADS vehicles are ready to enter the market. If this is not done, it could risk safety hazards if, for example, some states are more lenient on ADS capabilities or some roadways are not equipped for ADS vehicles. Encouraging unified standard setting across the country should be a priority for NHTSA.

Additional Questions for Comment

Question 8: At this early point in the development of ADS, how should NHTSA determine whether regulation is actually needed versus theoretically desirable? Can it be done effectively at this early stage and would it yield a safety outcome outweighing the associated risk of delaying or distorting paths of technological development in ways that might result in forgone safety benefits and/or increased costs?

Throughout my response I believe I have provided several reasons why NHTSA should act on regulation now rather than waiting for the technology to develop. However, the regulation should be sure to not delay or distort any paths of technological development. So long as NHTSA maintains a technology-neutral approach that is flexible to innovation, any regulation should serve as guide for the continued development of ADS technology, leading principals engaged in ADS development on a path toward safety but not directing them in any specific way.

Q14: What additional research would best support the creation of a safety framework? In what sequence should the additional research be conducted and why? What tools are necessary to perform such research?

Cybersecurity will be a key issue for ADS system safety in the future when autonomous vehicles enter the market. The ability for malicious actors to access an autonomous vehicle could lead to significant harm for passengers in the car and any other nearby road users. As discussed in my response to Q6, above, if a malicious actor is able to tamper with any one of the four core elements it would render the entire system unsafe.

NHTSA should research cybersecurity threats on ADS vehicles and to the extent possible should be involved in the development of any regulations safeguarding vehicles from any potential threats. NHTSA should outline a proposal for a cross-cutting agency advisory group to develop and implement these regulations.

Conclusion

Thank you again for the opportunity to provide comment on the ANPRM on the development of a framework for Autonomous Driving System safety. As outlined above, ADS vehicles will greatly benefit drivers, passengers, cyclists, and other road users while providing significant societal benefits far beyond the scope of just safely driving to a destination.

In order to meet these benefits though, NTHSA should remain steadfastly committed to an iterative approach that is flexible to meeting new demands and open to welcoming new technologies. NHTSA should also establish mandatory reporting and disclosure standards for autonomous vehicle manufacturers. Finally, NHTSA should also closely work with state and local government to ensure the states laws, roadways, and infrastructure are ready and capable of handling autonomous vehicles.

I look forward to monitoring developments of the regulatory framework and welcome any questions you may have.

Sincerely,

John Guy