April 1, 2021

Docket Management Facility
U.S. Department of Transportation
Room W12-140
1200 New Jersey Avenue SE
Washington, DC 20590-0001

Re: Docket No. NHTSA-2020-0106: Framework for Automated Driving System Safety

On December 3, 2020, the National Highway Traffic Safety Administration (NHTSA) requested comment on the development of a framework for Automated Driving System (ADS) safety which would "objectively define, assess, and manage the safety of ADS performance while ensuring the needed flexibility to enable further innovation."

Plus, a leading developer of ADS for heavy trucks, hereby offers the following comments for consideration as the NHTSA explores development of a Framework for ADS safety.

1. Introduction

Headquartered in Silicon Valley, Plus specializes in providing full-stack self-driving technology to enable large scale automated commercial transport. Plus is currently working with some of the leading truck manufacturers, largest shippers, and top fleet operators to begin mass production of its automated driving system.

Plus was founded with the vision to transform the trucking industry through automated driving technology, starting today with automated trucks supervised by professional operators and evolving into a future with driverless trucks.

We believe this incremental approach offers three key benefits:

- It's safer – real world miles is the only way to statistically prove that the system is safe enough to operate fully driverless.
- It helps build consumer confidence in and acceptance of automated trucking technology.
- It allows fleets to enjoy the benefits of automated driving technology immediately, including improved safety, enhanced driver comfort, and 10% in fuel savings and therefore reduced carbon emissions.

In the coming years, Plus will introduce a self-driving system for Class 8 tractor-trailers operating at SAE Level 4. Per SAE J3016, a Level 4 system takes full responsibility for the Dynamic Driving Task and Object and Event Detection and Response, within its Operational Design Domain.

Starting with NHTSA and then expanding to the full DOT, your leadership in publishing Guidance relating to automated vehicles has been instrumental in providing industry with a clear

viewpoint and consistent language. For truck automation in particular, AV 3.0 clarified that Federal Motor Carrier Safety Administration (FMCSA) regulations will no longer assume that the Commercial Motor Vehicle driver is always a human or that a human is necessarily present onboard a commercial vehicle during its operation. However, while regulatory guidance is valued, regulatory certainty is needed. We strongly encourage the Federal Motor Carrier Safety Administration (FMCSA) to move expeditiously to implement this principle in regulation and look forward to FMCSA releasing a Notice of Proposed Rulemaking on this topic very soon, which would launch a process to achieve regulatory certainty regarding deployment and operation of ADS-operated Commercial Motor Vehicles (CMV).

Current Status of Plus ADS Development

How the Plus ADS Works

The Plus self-driving system is equipped with a perception system that detects objects and events, which then communicates information about the vehicle's surroundings to our planner software so it can best navigate the road. The perception system uses a variety of sensors to give the truck a 360° view of its surroundings. These currently include lidar, radar, and cameras.

The localization subsystem informs the vehicle where it is on a map and its position relative to static elements of the scene including lanes, road boundaries, traffic lights, and stop lines. When available, our localization module can make use of a High Definition (HD) map, and using a combination of GPS, Inertial Measurement Units, lidar, cameras and radar positions the automated vehicle to an accuracy of a few centimeters. Even in the absence of an HD map or when a discrepancy is detected between the HD map and our online sensor data, our system can make use of standard definition navigation (ADAS) or semantic maps to drive and navigate safely.

After perception and localization come prediction, planning, and control. Once an object is accurately detected, and given that the truck knows its own location, the prediction system helps our planner understand the likely behavior of other road users. Then, the system will plan what the truck should do next, incorporating an assessment of the intention of other vehicles, and it will control the vehicle to make such a move. The control function collaborates with planning to ensure that the truck does not do anything unsafe and keeps the vehicle close to the requested trajectory from the planner. If it cannot do that, it must signal out-of-ODD.

During development and testing, each of our vehicles is always staffed with a safety driver and a vehicle operations specialist to ensure checks and balances in our safety processes.

<u>Testing Broadly Across the USA with Freight Carriers</u>
Freight industry partnerships are underway in the U.S. with several Fortune 500 companies.

Plus has tested in 17 states so far, including Arizona, California, Colorado, Illinois, Indiana, Kansas, Minnesota, Missouri, Nevada, New Mexico, Ohio, Pennsylvania, South Dakota, Texas, Utah, West Virginia, and Wyoming.

Plus believes that in order to build a technology solution that is applicable across different weather, terrains, and driving scenarios, we need to put our automated trucks through stringent safety tests, on every permissible highway in the country and in a variety of closed courses to truly test and demonstrate the readiness of our trucks.

Testing in Adverse Weather Conditions

Plus and Minnesota DOT have partnered to address self-driving truck performance in the toughest winter conditions, with an eye to inform public policy discussions. Testing at MnDOT's MnROAD facility will allow Plus to better understand how winter conditions affect the safe movement of our trucks. The testing will begin with mapping the MnROAD closed test track, followed by rigorous performance testing of Plus's self-driving trucks.

Plus Products Enter the Market in 2021

Designed to fully handle the driving task as a Level 4 system, the Plus ADS provides a full suite of sensors, software, and actuators to perform the Dynamic Driving Task and Object and Event Detection and Response. Plus is introducing driver-in products in 2021 which are powered by the Plus ADS, called PlusDrive.

Unique to the self-driving industry, PlusDrive leverages professional truck drivers to monitor the Plus ADS driving behavior, with the driver intervening only as necessary. Driver monitoring is used to ensure the driver is properly monitoring the system. PlusDrive is a driver-in system in which software designed for Level 4 is running. PlusDrive will enhance the driver's experience, reducing fatigue and stress. A less fatigued driver combined with PlusDrive will greatly enhance overall safety.

Releasing PlusDrive is key to our Level 4 rollout strategy. PlusDrive running in tens of thousands of customer trucks will enable validation of our Level 4 system based on data collected across very high mileage. Once the validation process is successfully completed, we will remove the driver in the vehicle and launch our full driverless product. The Plus approach to safety validation is described in more detail below.

Our products coming to market this year in the U.S. were created to address the desire of shippers and fleet operators to start using the semi-automated technology that is available today before Level 4 trucks become commercialized in the coming years. Once deployed, PlusDrive will be on late model vehicles with the latest active safety equipment – among the safest vehicles on the road in their own right, and when enhanced with PlusDrive will be at an unprecedented level of safety.

Plus Actively Participates in Industry and Government Discussions

Plus maintains regular contact with Federal and state officials, legislators, and law enforcement to share our progress and actions to prepare our ADS for safe deployment.

Plus actively participates in key industry organizations focused on taking the necessary steps to facilitate deployment of automated trucks. These include the American Trucking Association Technical and Engineering Policy Committee, the ATA Technology and Maintenance Council Study Group 18 on Automated and Electric Trucks, the Commercial Vehicle Safety Alliance Enforcement and Industry Modernization Committee, and the Consumer Technology Association Automated Trucking Working Group.

2. Summary of Response

In this section we discuss several key concepts that underpin our responses to specific ANPRM questions provided in Section 3.

In response to NHTSA's AV Guidance 2.0, Plus submitted a Voluntary Safety Self-Assessment (VSSA) letter to NHTSA in October 2020. A substantial portion of our comments derive from this document.

Safety Strategy

Regulatory Safety Philosophy

With the advent of commercial automated driving systems, the vehicle industry is moving beyond the current Federal Motor Vehicle Safety Standards (FMVSS). We applaud NHTSA moving forward with developing a safety framework in anticipation of increased ADS activity in the future. Regulatory modernization is crucial to realizing the tremendous potential of ADS, which will save fuel, reduce emissions, drive economic growth, and enhance safety.

In the early years of ADS commercialization efforts, unified guidance prioritizing safety for all automated vehicles was appropriate. Now that the foundation has been set, we emphasize that all ADS use cases should not be treated identically. It is essential to clearly outline the differences between automated driving systems based on how they will be used, as has been done in USDOT's draft Automated Vehicles Comprehensive Plan. With respect to safe implementation, there are vast differences between, for example, automated passenger shuttles, driverless package delivery vehicles, privately owned vehicles, and automated trucks which will be professionally deployed and maintained as a fleet.

Plus shares NHTSA's interest in promoting a framework that is, at its core, technology neutral. Prematurely locking in safety standards before demonstrating technological readiness risks inadvertently stifling the market for innovative safety systems. Proposed regulations and guidance should not pick winners and losers, or, by extension, create disincentives for investments in future improvements and enhancements to AV technologies. Safety standards should instead be made flexible and responsive to potential future technologies that may be safer than current regulation.

Regulatory certainty is very important in the introduction of new technology into road freight transport. We applaud NHTSA in thoughtfully considering ways to assure the safety of ADS within the confines of the Agency's regulatory authority. In particular, we support the agency's focus on defining how ADS can be regulated in a systematic way. We agree with NHTSA's priorities in creating the framework; while safety is paramount, remaining technology neutral and promoting innovation are vitally important. Performance-based rules are the best method for ensuring this neutrality going forward, including implementation of a flexible approach to compliance verification testing.

"NHTSA has broad investigatory and enforcement authority relating to motor vehicle safety. While NHTSA can order a recall for FMVSS non-compliance, it can also order a recall when it learns of a defect in the design, construction, or performance of a vehicle or item of equipment that poses an unreasonable risk to motor vehicle safety that increases the likelihood of a crash occurring or increases the likelihood of injury or death should a crash occur. In fact, the vast majority of recalls are issued for safety related defects that have nothing to do with FMVSS." (Footnote 63) Plus is confident that NHTSA current authority is sufficient to deal with testers and deployers who may pose a safety risk. We would emphasize that NHTSA needs tools and sufficient budget to identify bad actors and take appropriate measures. We responsible actors depend on NHTSA taking a strong role in this respect.

Standards and Best Practices

We support and implement best practices in development, testing, functional safety, and validation, such as ISO26262 Road Vehicles - Functional Safety which serves as a basis for a more comprehensive safety strategy. There are other standards for best prac-tice under development, including ISO/PAS 21448 Safety of the Intended Function (SOTIF) and UL 4600 Standard for Safety for the Evaluation of Autonomous Products which we are closely monitoring for their applicability. The Plus team is tailoring and extending Functional Safety processes for automated trucks.

Within the larger self-certification framework that currently exists, industry-developed standards coupled with significant NHTSA involvement is the way forward. Standards must be succinct in order to be effective for system designers. Standards must be developed in such a manner that the standards development organizations do not have a vested interest in the process.

A consortium or alliance of consortia are essential to come to a common definition of minimum capabilities of an ADS. This can serve to prevent "bad actors" in testing and deploying systems that present unacceptable risks.

Validation Integrated Deeply Into ADS Design and Testing

In addition to the safety checks and redundancies that we build into our system architecture, each layer in our software stack has its own safety validation process. This is important because while each layer in our system takes some responsibility for the overall correctness, it defers some to the next layer up. For example, if the perception system misleads the planner about the

state of the world around the truck, the planner may have no way to detect and correct the problem. Validating at each layer is essential for safe operation.

Test and validation are central to developing an autonomous system for the real world. Software features are extensively peer reviewed, tested in a comprehensive simulation environment, strategically tested on closed test tracks and only then deployed to public roads under the strict supervision of a safety driver and vehicle operations specialist.

We use a tiered validation strategy which starts at the software verification stage, transitions to extensive simulation, then software and hardware-in-the-loop (SIL and HIL) test (real software and hardware tested under simulated conditions), before proceeding to an actual vehicle. We test and validate our software via a combination of miles and scenarios. More miles ensures that we see a larger variety of scenarios while simulated scenarios allow us to reach an entirely different scale and test thousands of randomized scenarios before each release goes on the road.

Independent Validation Increases Confidence In ADS Safety

Plus believes an independent party should validate a self-driving system's road readiness using realistic, complex scenarios, much like humans have to pass driving tests in order to be licensed. Working with the Transportation Research Center (TRC), Plus is conducting capability tests of its self-driving system using a rigorous multi-vehicle approach. Current published standards only require a single other-vehicle test, while this testing program utilizes a multi-vehicle test approach to simulate complex, real-world driving conditions and breaks new ground in Level 4 commercial vehicle testing.

Plus's safety tests are designed and implemented by TRC. The testing evaluates the Plus self-driving system's ability to consistently handle multiple vehicle scenarios that best simulate complex, realistic driving conditions. For example, the Plus driving system will have to predict how the vehicles will react to each other, which allows it to plan a safe way to control the truck in response. This is a more rigorous test of the perception, prediction, and planning systems, involving aspects that would not be tested in a single other-vehicle approach. Tests will include highway driving in both free-flowing and stop-and-go traffic, construction zones, disabled vehicles, bicycles, and many other scenarios. These scenarios will be repeated for different weather conditions and a range of visibility and lighting.

High-Mileage Statistical Validation An Essential Step Towards Product Release

We emphasize that while we are convinced self-driving trucks will deliver significant safety and economic benefits, this must be done safely with the proper statistical validation. Applying statistical validation of a self-driving system to prove that the ADS is safer than a human driver will require billions of miles of public road testing.

Perception, in particular, is among the most challenging areas of self-driving because of the numerous permutations and anomalies that can arise in the real world. Plus uses statistical validation to show our confidence in what the system says it detects is, in fact, true. Statistical

validation ensures that anomalies or edge cases have become not-so-abnormal to the driving system over time, given its repeated exposure to the real world.

As noted above, Plus applies sophisticated simulation tools in the development and testing phase. An ADS development process can take advantage of simulation and other tools to evaluate performance, such as the in-depth independent testing being performed by TRC. However, the fact that the system works in the simula-tor or on a test track does not provide strong statistical evidence in the case of truly unexpected events – landslide, fire, hurricane, tampering and vandalism, malicious drivers, mechanical failures on the ego vehicle, or new obstacle types. To proceed beyond the development process to product release requires high mileage public road testing. Public road testing is the optimum way to show that a self-driving system is safe and works in the real world.

We achieve this goal of billions of miles via the PlusDrive approach. Given the high mileage of over-the-road trucks that we will deploy globally, we will be able to accumulate billions of real-world miles in just a few years. We envision the rollout of driverless PlusDrive to occur in conjunction with truck OEMs as they introduce L4-ready tractors mid-decade.

Responsible Approach to ADS Upgrades After Product Release

After release, it is likely that developers will incrementally upgrade their ADS to improve performance. Performing such upgrades must be done via a rigorous process, implementing industry best practices. Plus approaches upgrades as follows: after an upgrade, the updated code operates in shadow mode (i.e. operating but not in control) until validated, whereupon a new version release occurs. We recommend this type of approach be used broadly and that NHTSA address best practices in ADS software upgrades in future Guidance.

Alignment of State Traffic Laws

For ADS commercialization, it is important to ensure that there is a model in place that does not rely on a patchwork of different regulatory and licensing regimes. A framework for ADS safety is a significant step towards this standardization. NHTSA should work with states to align state traffic laws regarding AV allowance and operations. We support the Alliance for Automotive Innovation's suggestion that "a federal grant program could be established to provide funding to states that agree to work together to harmonize policies that govern the testing and deployment of AVs. In addition, a unified national approach to AV licensing and registration should be encouraged."[1] In so doing, it is vital to keep in mind key differences between the various use cases.

Bringing Roadway Infrastructure Up To Standards

PlusDrive operates at a high level of performance on today's roads. To increase safety performance further, NHTSA, along with FHWA, should take a leadership role in stimulating/funding states to upgrade physical roadway infrastructure in a manner supportive to ADS. This would also enhance the operation of existing ADAS. Examples are lane markings,

[1] "Policy Roadmap to Advance Automated Vehicle Innovation," Alliance for Automotive Innovation, December 2020.

signage, and traffic control devices. It is not essential for states to take action for initial deployment to occur, but upgraded infrastructure reduces technical challenges and therefore risk.

Plus supports the efforts spearheaded by FHWA to update the Manual on Uniform Traffic Control Devices to address aspects specific to automated vehicles.

Safe and Effective Interactions with Emergency Responders and Enforcement Personnel
Any Federal regulation or guidance regarding interaction with emergency responders and/or enforcement personnel should be performance-based, allowing AV developers/manufacturers the flexibility to develop design requirements and work with industry standards that facilitate such capabilities.

For commercial trucks, interactions with state inspection protocols must be carefully worked out. Plus is participating in ongoing discussions with the Commercial Vehicle Safety Alliance and the ATA Technology and Maintenance Council in this respect.

Creation of a New Regulatory Class of Vehicles for ADS
In their Policy Roadmap, the Alliance for Automotive Innovation also advocates for the creation of a new class of vehicle for ADS. The ANPRM states in IV.B.2. “NHTSA expects that existing vehicle classes will remain relevant for many purposes. Yet, new classes of vehicles may emerge as companies begin to consider all the possible uses and business models available for their systems. The need to define any new class in the context of the FMVSS has not been determined.”

Plus believes the implications of this type of structural change must be fully understood. Creating a new “ADS Vehicle” class deserves significant study and consultation with industry. In particular, we are concerned that efforts to create this new vehicle class could divert resources focused on the core business of adapting regulations to best support ADS deployment.

NHTSA Approach to Safety Case
NHTSA defines a safety case as “a structured argument, supported by a body of evidence that provides a compelling, comprehensible, and valid case that a system is safe for a given application in a given operating environment.” Per the ANPRM “valid” as used in this context means “verifiable.”

We support NHTSA’s use of an administrative mechanism, i.e. Guidance, both in creating a verifiable “safety case” and publishing this safety case. NHTSA should recognize that in this or any future regulatory proceedings on this topic, an ADS developer’s approach to system safety validation could be a core aspect of their intellectual property. A solid safety case can be published at a high level; pressure to disclose key IP must be avoided. The focus should instead be on providing fundamental safety metrics of system performance. We stress that a proper safety case must address both incidental and systematic faults, i.e. failure modes affecting an entire fleet. Plus provided an extensive description of safety practices and safety case in our

Voluntary Safety Self-Assessment letter to NHTSA in 2020. We will be pleased to share details of our industry leading safety performance at the proper time.

At this early stage in ADS rollout, metrics and performance thresholds should be defined by ADS developers rather than the Federal government.

Operational Design Domain (ODD) definition and management are an important part of any ADS safety case and an area that is possible to test and validate using quantifiable metrics in defining and managing the ODD within the ADS. This could be considered with regard to Guidance near term and regulations in the longer term.

Role of FMVSS Going Forward

While the philosophy behind FMVSS properly addresses objectivity, the task of ADS safety assurance is fundamentally different. NHTSA has never before issued a “driver's license.” States issue driver's licenses in a manner that is not based on totally objective measures, as evidenced by the need for test drives in which a state official observes the driving proficiency of an applicant. When it comes to ADS, FMVSS needs to be “re-invented.” New methods are essential which do not rely solely on the deterministic approaches NHTSA has employed in the past. Plus advocates an approach in which professional judgement and expertise is applied to the performance evaluation of any particular ADS, based on a substantial body of safety-relevant data. The TRC independent testing could provide a model for performance testing. Here, a respected testing facility designs the test protocol and puts the ADS system through its paces. In our case, TRC’s testing is driven by the PlusDrive ODD.

Points of Agreement

We agree with NHTSA on many of the points made in the ANPRM. We would highlight these in particular (quoting the ANPRM language):

A. “NHTSA envisions that a framework approach to safety for ADS developers would use performance-oriented approaches and metrics that would accommodate the design flexibility needed to ensure that manufacturers can pursue safety innovations and novel designs in these new technologies.” (FR78059)
B. “Premature establishment of an FMVSS without the appropriate knowledge base could result in unintended consequences. For example, a premature standard might focus on the wrong metric, potentially placing constraints on the wrong performance factors, while missing other critical safety factors. Such a standard could inadvertently provide an unreliable sense of security, potentially lead to negative safety results, or potentially hinder the development of new ADS technology.” (FR78059)
C. “The Agency anticipates that the safety framework would include both process and engineering measures to manage risks. The process measures (*e.g.,* general practices for analyzing, classifying by severity level and frequency, and reducing potential sources of risks during the vehicle design process) would likely include robust safety assurance and functional safety programs. The engineering measures (*e.g.,* performance metrics, thresholds, and test procedures) would seek to provide ways of demonstrating that ADS

perform their sensing, perception, planning, and control (*i.e.,* execution) of intended functions with a high level of proficiency." (FR78060)

D. "NHTSA believes that on-road testing is essential for the development of ADS-equipped vehicles that will be able to operate safely on public roads." (Quoting AV 3.0, FR78061)
E. "The FMVSS established by NHTSA must meet the need for motor vehicle safety; be practicable, both technologically and economically; and be stated in objective terms." and in a subsequent paragraph "sufficient information does not yet exist to establish a standard that is practicable, meets the need for motor vehicle safety, and can be stated in objective terms" speaking in terms of an ADS standard. (FS78062)
F. "A new generation of FMVSS should give manufacturers of vehicles, sensors, software, and other technologies needed for ADS sufficient flexibility to change and improve without the need for frequent modifications to the regulations. Such an approach may also benefit the safety of future vehicles through more flexible standards that focus more on the safety outcome, rather the performance of any specific technology." (FS78071)

3. Responses to Section V Questions

Below we respond to NHTSA questions where we believe we can add value. Within the ADS space there are many approaches. We speak from our perspective in developing and deploying PlusDrive and planning for Level 4 truck ADS deployment. We understand that some aspects of our comments may not apply to all ADS.

A. Questions about a Safety Framework

Question 1. Describe your conception of a Federal safety framework for ADS that encompasses the process and engineering measures described in this notice and explain your rationale for its design.

Plus supports NHTSA's use of an administrative mechanism, i.e. Guidance, both in creating a verifiable "safety case" and publishing this safety case. NHTSA should recognize that in this or any future regulatory proceedings on this topic, an ADS developer's approach to system safety validation could be a core aspect of their intellectual property. A solid safety case can be published at a high level; pressure to disclose key IP must be avoided.

Question 2. In consideration of optimum use of NHTSA's resources, on which aspects of a manufacturer's comprehensive demonstration of the safety of its ADS should the Agency place a priority and focus its monitoring and safety oversight efforts and why?

Proper system engineering and functional safety processes must be implemented in system development. As a "bottom line" measure, statistical validation via high mileage testing is fundamental.

Question 3. How would your conception of such a framework ensure that manufacturers assess and assure each core element of safety effectively?

ADS developers should voluntarily report their adherence to best safety processes/practice. Proper system engineering and functional safety processes must be

implemented in system development. Test track testing tailored to the ADS's ODD, with methodology and metrics defined by experienced test engineers, must occur.

As a "bottom line" measure, statistical validation via high mileage testing is fundamental.

Question 4. How would your framework assist NHTSA in engaging with ADS development in a manner that helps address safety, but without unnecessarily hampering innovation?

A Framework allowing multiple routes to compliance would permit greater flexibility while ensuring that baseline safety standards are met or exceeded. Regulatory certification context should account for the fact that there will be many different types of SDVs. Not every ADS developer should be subject to the same regulatory criteria. While performance based standards should be the focus, NHTSA should also consider allowing multiple avenues to satisfy safety standards for ADS so entities can choose the optimal approach.

Statistical validation, as a "bottom line" measure, does not constrict innovation. To avoid hampering innovation at this early stage in ADS rollout, ADS developers should be the ones to define metrics and performance thresholds, rather than the Federal government. Respected industry bodies such as Partners for Automated Vehicles Education, the Society of Automotive Engineers, and the American Trucking Association Technology and Maintenance Council are vital in defining best practices in metrics and setting performance thresholds, and Plus will be highly engaged with such groups as these efforts go forward.

Question 5. How could the Agency best assess whether each manufacturer had adequately demonstrated the extent of its ADS' ability to meet each prioritized element of safety?

Proper system engineering and functional safety processes must be implemented in system development. Test track testing tailored to the ADS's ODD, with methodology and metrics defined by experienced test engineers, must occur. As a "bottom line" measure, statistical validation via high mileage testing is fundamental. ADS developers should be the ones to define metrics and performance thresholds. ADS developers should voluntarily report their adherence to best safety processes/practices.

Question 6. Do you agree or disagree with the core elements (i.e., "sensing," "perception," "planning" and "control") described in this notice? Please explain why.

Given the extensive interactions between subsystems, any guidance or regulation should focus on the ADS as a whole, rather than focusing on specific subsystems. Plus would object to separate Federal regulations focusing on specific subsystems.

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?

There are too many unknowns to implement regulations at this time, therefore this can not be done effectively at this early stage. NHTSA should rely on existing enforcement authority as part of the Agency's safety oversight mission to ensure that current public road testing and deployment of ADS is safe as noted in Section I of the ANPRM Executive Summary: "as small-scale deployments start to appear in the coming years, NHTSA will address unreasonable safety risks that may arise using its defect investigation and remediation authority."

NHTSA should support industry groups and standards organizations in developing performance metrics appropriate to the various ADS use cases and ODDs.

In the longer term, regulation should be considered as a more definitive means to safeguard the public and accelerate deployment.

Question 9. If NHTSA were to develop standards before an ADS-equipped vehicle or an ADS that the Agency could test is widely available, how could NHTSA validate the appropriateness of its standards? How would such a standard impact future ADS development and design? How would such standards be consistent with NHTSA's legal obligations?

Plus does not support NHTSA developing standards before an ADS-equipped vehicle relevant to the Plus ODD is widely available.

NHTSA should regulate technology after it has an industry acceptable amount of design, development, testing, deployment, terms-of-service, real-world modifications, reputable third-party research, and overall safe operations that include a cost-benefit ROI. On page 78070 of this notice, NHTSA states:

> "Establishing FMVSS prior to technology readiness hampers safety-improving innovation by diverting developmental resources toward meeting a specific standard. Such a regulatory approach could unnecessarily result in the Agency establishing metrics and standards without a complete understanding of the technology or safety implications and result in unintended consequences, including loss of potential benefits that could have been attained absent government intervention, a false sense of security, or even inadvertently creating additional risk by mandating an approach whose effects had not been known because regulation halted the technology at too early a stage in its development."

Plus supports the proposition that FMVSS should not be adopted before the technology is ready and does not hamper safety development. NHTSA could validate the appropriateness of a standard in following the eight listed Critical Factors on page 78073 meeting or exceeding the Agency's goal for regulating ADS.

Question 10. Which safety standards would be considered the most effective as improving safety and consumer confidence and should therefore be given priority over other possible standards? What about other administrative mechanisms available to NHTSA?

As a “bottom line” measure, the results of statistical validation via high mileage testing would be readily understandable to the public, establishing system safety and providing consumer confidence.

Question 11. What rule-based and statistical methodologies are best suited for assessing the extent to which an ADS meets the core functions of ADS safety performance? Please explain the basis for your answers. Rule-based assessment involves the definition of a comprehensive set of rules that define precisely what it means to function safely, and which vehicles can be empirically tested against. Statistical approaches track the performance of vehicles over millions of miles of real-world operation and calculate their probability of safe operation as an extrapolation of their observed frequency of safety violations. If there are other types of methodologies that would be suitable, please identify and discuss them. Please explain the basis for your answers.

Test track testing tailored to the ADS’s ODD, with methodology and metrics defined by experienced test engineers, must occur.

Safety performance should be assessed via a statistical validation process based on billions of miles of real-world operation, to show that the system safety performance exceeds that of a human driver. Plus will achieve this level of performance in the next few years by deploying PlusDrive in multiple markets globally, starting in 2021.

Question 12. What types and quanta of evidence would be necessary for reliable demonstrations of the level of performance achieved for the core elements of ADS safety performance?

Test track testing tailored to the ADS’s ODD, with methodology and metrics defined by experienced test engineers, must occur.

Safety performance should be assessed via a statistical validation process based on billions of miles of real-world operation, to show that the system safety performance exceeds that of a human driver.

Respected industry bodies such as Partners for Automated Vehicles Education, the Society of Automotive Engineers, and the American Trucking Association Technology and Maintenance Council are vital in defining best practices in metrics and setting performance thresholds, and Plus will be highly engaged with such groups as these efforts go forward.

Question 13. What types and amount of argumentation would be necessary for reliable and persuasive demonstrations of the level of performance achieved for the core functions of ADS safety performance?

In demonstrating safety performance, the overall approach should be technology-neutral and validated through market-based approaches.

Test track testing tailored to the ADS's ODD, with methodology and metrics defined by experienced test engineers, must occur.

Safety performance should be assessed via a statistical validation process based on billions of miles of real-world operation, to show that the system safety performance exceeds that of a human driver. Plus will achieve this level of performance in the next few years by deploying PlusDrive in multiple markets globally, starting this year.

Relevant to this question, NHTSA posited three candidate approaches in the ANPRM (FR78071):

A. FMVSS Requiring Obstacle Course-Based Validation In Variable Scenarios And Conditions
B. FMVSS Requiring Vehicles To Be Programmed To Drive Defensively In A Risk-Minimizing Manner In Any Scenario Within Their ODD
C. FMVSS Drafted In A Highly Performance-Oriented Manner

Item A is similar to the independent testing that TRC is performing for Plus. Plus advocates an approach in which independent professional judgement and expertise is applied to the performance evaluation approach of any particular ADS. Respected industry bodies such as Partners for Automated Vehicles Education, the Society of Automotive Engineers, and the American Trucking Association Technology and Maintenance Council are vital in defining best practices in metrics and setting performance thresholds. As noted elsewhere in our response, Plus believes it is too early to define FMVSS in general; this would include Item A.

Item B represents a basic engineering requirement for any responsible ADS developer. To define "driving defensively" in regulation, with any specificity, could be challenging. This concept would benefit from further study. At this time, Plus believes it is too early to define FMVSS in general; this would include Item B.

Item C focusing on performance-oriented metrics is a valid approach in concept. Plus agrees with the approach espoused in AV 3.0, which is quoted in the ANPRM in NHTSA's discussion of this approach:

> "Future motor vehicle safety standards will need to be more flexible and responsive, technology-neutral, and performance-oriented to accommodate rapid technological innovation. They may incorporate simpler and more general requirements designed to validate that an ADS can safely navigate the real-world roadway environment, including unpredictable hazards, obstacles, and interactions with other vehicles and pedestrians who may not always adhere to the traffic laws or follow expected patterns of behavior. Existing standards assume that a vehicle may be driven anywhere, but future standards will need to take into account that the operational design domain (ODD) for a particular ADS within a vehicle is likely to be limited in some ways that may be unique to that system."

At this time, Plus believes it is too early to define FMVSS in general; this would include Item C.

B. Questions About Administrative Mechanisms

Question 16. Of the administrative mechanisms described in this notice, which single mechanism or combination of mechanisms would best enable the Agency to carry out its safety mission, and why? If you believe that any of the mechanisms described in this notice should not be considered, please explain why.

Plus supports NHTSA's use of an administrative mechanism, i.e. Guidance, both in creating a verifiable "safety case" and publishing this safety case. NHTSA should recognize that in this or any future regulatory proceedings on this topic, an ADS developer's approach to system safety validation could be a core aspect of their intellectual property. A solid safety case can be published at a high level; pressure to disclose key IP must be avoided. The focus should instead be on providing fundamental safety metrics of system performance. We stress that a proper safety case must address both incidental and systematic faults, i.e. failure modes affecting an entire fleet.

At this early stage in ADS rollout, ADS developers should be the ones to define metrics and performance thresholds, rather than the Federal government.

Question 17. Which mechanisms could be implemented in the near term or are the easiest and quickest to implement, and why?

Our response to Question 16 applies to this question as well. Plus would support NHTSA to continue developing guidance on engineering and process measures for the most appropriate approach for voluntary mechanisms.

Question 21. Should NHTSA consider an alternative regulatory path, with a parallel path for compliance verification testing, that could allow for flexible demonstrations of competence with respect to the core functions of ADS safety performance? If so, what are the pros and cons of such an alternative regulatory path? What are the pros and cons of an alternative pathway that would allow a vehicle to comply with either applicable FMVSS or with novel demonstrations, or a combination of both, as is appropriate for the vehicle design and its intended operation? Under what authority could such an approach be developed?

Plus supports NHTSA's use of an administrative mechanism, i.e. Guidance, both in creating a verifiable "safety case" and publishing this safety case. The focus should be on providing fundamental safety metrics of system performance.

We stress that, at this early stage in ADS rollout, ADS developers should be the ones to define metrics and performance thresholds, rather than the Federal government.

Consideration of an “alternative regulatory path” as described in this question should be deferred, as it is premature to proceed with regulations at this early stage in ADS development and deployment.

4. Conclusion

Plus appreciates the in-depth consideration by NHTSA regarding various approaches to administrative and regulatory amendments to support the safe deployment of ADS while not hampering innovation.

As we introduce initial products in 2021 while moving towards full Level 4 products in the coming years, Plus will remain highly engaged as contributors to the dialogues and standards development essential to this process, as well as being reliable partners with NHTSA, FMCSA, USDOT, and other federal and state government stakeholders on these issues.

Please direct any questions or communications regarding this comment to me at shawn@plus.ai.

Sincerely,

Shawn Kerrigan
COO and Co-founder
Plus