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James C. Owens
Deputy Administrator, National Highway Traffic Safety Administration
M–30, U.S. Department of Transportation, West Building
Ground Floor, Room W12–140
1200 New Jersey Avenue SE
Washington, DC 20590

Re: Advance Notice of Proposed Rulemaking on Framework for Automated Driving System Safety, Docket No. NHTSA-2020-0106

Dear Deputy Administrator Owens,

Mapless AI, a developer of safety critical artificial intelligence for automated driving, based in Pittsburgh, Pennsylvania and Boston, Massachusetts, is pleased to have the opportunity to submit comments to the National Highway Traffic Safety Administration (NHTSA) concerning the Advanced Notice of Proposed Rulemaking (ANPRM) on Framework for Automated Driving System Safety per the document published 2020-12-03 in the Federal Register; D.O.T. Docket ID Number NHTSA-2020-0106. Mapless AI is encouraged by the agency's research, and we wish to provide feedback on several of the questions for which the Agency requests comment.

Highlight Comments:

1. Of great significance to safety suppliers is the voluntary application of ISO 26262, ISO 21448, and ANSI/UL 4600 enhanced by future NHTSA research. This research concerns data to support the severity determination in ISO 26262, validation per ISO 21448, and requirements elicitation supported by the prompts of ANSI/UL 4600.

2. NHTSA's mission is not to lower risks associated with ADS, it is to make the roads safer. A framework like the proposed could be used not only for ADS suppliers, but by any entity intending to put vehicles on the road.

3. A regulation framework as described including information to the public will promote acceptance of ADS products.

Preamble

Mapless AI will consider each question separately and provide responses to the most relevant items. These responses include advice received from Joseph Miller, Advisor to Mapless AI and author of "Automotive System Safety: Critical Considerations for Engineering and Effective Management". Further, one of the authors of this response co-authored the "Safety First for Automated Driving" whitepaper referenced in the Advanced Notice of Proposed Rulemaking. Where applicable, Mapless AI has included recommendations, examples, *etc.*

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 document and explain your rationale for its design.

In the ANPRM is stated, "The National Traffic and Motor Vehicle Safety Act of 1966, as amended ('Safety Act') tasks NHTSA with reducing traffic accidents, deaths, and injuries resulting from traffic accidents through issuing motor vehicle safety standards for motor vehicles and motor vehicle equipment and carrying out needed safety research and development." Within every entity developing ADS related products, similar activity is occurring. By supporting the governance of these activities within a NHTSA framework, the process and engineering measures can be ensured, supported by NHTSA research that provides metrics and data concerning traffic accidents, injuries, and deaths. This enables quantifiable reduction.

Specifically, within the framework, each supplier can internally produce a safety case, based on a deployed process of that supplier, that assures compliance with the requirements of ISO 26262 and ISO 21448, to elicit and verify safety requirements for the product, supported by consideration of the prompts of ANSI/UL 4600. **Validation of the ADS product can be supported by data from NHTSA research concerning the expected value of the types of accident and outcomes for the intended ODD of the product.** This data from NHTSA enables all ADS suppliers to argue that these expected values have been improved through validation results based on simulation, analysis, and testing. Suppliers self-certify to NHTSA in a summary form addressing two broad categories of information: 1) argumentation around sensing and core safety elements, and 2) how the expected values from NHTSA were selected and how improvement was validated. This framework is technology agnostic. It supports accident reduction.

• 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?

Data intended for ADS suppliers to use as a validation target would be immensely valuable and can only be standardized by NHTSA. Others have tried and failed to agree on standards. The data could be expressed as the expected value of miles between accident types in specific ODDs. For example, any type of accident on a limited access highway, head on collision on a limited access highway, and side to side collision on a limited access highway. This may be further subclassified for speed. Also, the severity would be useful in a form consistent with ISO 26262, for example, S3 implies greater than 10% probability of AIS 5 or AIS 6 injuries as an outcome of an accident. Individual ADS suppliers may classify more conservatively, but not less conservatively without justification. This would allow development to focus on safety of the design with clear data available to construct targets. The Agency would not restrict new development. The Agency would support innovation.

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

Suppliers self-certify to NHTSA in a summary form, addressing core safety elements as proposed in the response to question 6, as well as how the expected values from NHTSA were selected and how improvement was validated.

• 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?

By providing accident metrics from which a set appropriate for a particular ODD may be selected by the supplier, NHTSA focuses the suppliers on achieving results that are an improvement over current traffic data. This is independent of technology.

• 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?

The suppliers self-certify, and NHTSA reviews the results. NHTSA receives a summary from suppliers addressing sensing, perception, planning, and control, as well as validation. NHTSA may choose to require the summary to include a brief summary of how the safety case process of the company was applied and independently assessed within the company in accordance with the standards. Some parts may be tailored. This must always be justified.

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

There is a basis for agreement here. While "see, think, act" is sometimes seen in the industry, it comprehends sensing, perception, planning, and control. Safety has been defined as the absence of unreasonable risk. Failures in any of these areas may lead to unreasonable risk in an ADS. **However, while a set of core elements may enhance comprehension, safety does not require core elements. The result must be safe independent of the presence of a specific choice of core elements.**

• Question 7. Can you suggest any other core element(s) that NHTSA should consider in developing a safety framework for ADS? Please provide the basis of your suggestion.

Confidence in the safety of an ADS is derived from evidence supporting confidence that the safety requirements have been identified and that compliance has been achieved. Further confidence is gained from validation that the risk is no greater than what has been accepted by society based on current data. **This does not require core elements. Core elements may enhance comprehension.**

NHTSA may consider replacing the core elements listed with just two core safety elements: the safety-preserving portion of the system and the non-safety-preserving portion of the system. That could help achieve the intended focus and would align with the explicit distinction between nominal functionality and safety-preserving functionality in SAE J3016.

• 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?

Implementing a framework as described in question 1 would not restrict any technological advancement. The added cost of submitting a summary to NHTSA may be partially offset by the data provided by NHTSA. Experience using this proposal may lead to improvements including simplifications or increased focus. More prescriptive regulation is not recommended. More prescription requires more experience.

• 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?

It is not recommended that NHTSA develop a standard that requires a vehicle for use by NHTSA to evaluate the appropriateness of the standard. Such a standard may be influenced and limited by the technological capabilities of the evaluation vehicle (e.g. an AD race car that is not street legal versus a low speed people carrier). This could be avoided by developing a NHTSA standard based on the recommended framework of question 1. This fulfils NHTSA's legal obligation per the Safety Act. It supports reducing accidents.

• 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?

A safety standard developed by NHTSA to implement the framework recommended in answer to question 1 of this document should improve consumer confidence. It in turn ensures the use of ISO 26262, ISO21448, and the prompts of ANSI/UL 4600. NHTSA provides the existing safety levels for use in validation by ADS suppliers. This also may serve to put the safety of ADS vehicles in perspective. Due to the "dread factor" for new technologies, suppliers may exceed the current target provided by NHTSA by a factor of 10 or more in order to compete for sales. The NHTSA standard provides context.

• 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.

The methods discussed in Annex B of ISO PAS 21448 have been useful throughout the ISO release and may continue to be so. The target for the system is determined, for example, the rear end collisions caused by an Automatic Emergency System braking in error on dry, straight roads (the worst case). The authority, for example, .5 G braking, is used in simulations with randomized

parameters to determine probability of a collision given a false emergency braking. This probability is then used to reduce the target for false emergency braking. Other rule based methods may include Responsibility-Sensitive safety (RSS) as proposed by MobilEye and others, or Interpretive Structural Modeling (ISM) perhaps with the Cross-Impact Analysis (CIA) method as proposed by Victor A. Bañuls et al. Given insufficient practical experience and little information on the efficacy of their implementation in the context of ADS, it is too early for NHTSA to endorse a preferred method and the choice should be left to the developer at this time. Then a test plan is put together to achieve the modified target. Bayesian methods may be used to modify the required miles by achieving improved confidence using simulation (for example, to target specific edge cases and corner cases) and route modification to emphasize system limits (for example, more darkness testing).

• 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?

The minimum evidence is a combination of vehicle testing, simulation, and analyses showing that ADS has exceeded the current expected value of miles between the types of accidents that the ADS has the authority to cause.

• 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?

The data and arguments retained in the safety case of the ADS supplier will far exceed what is expected to be submitted to NHTSA. NHTSA may expect a summary addressing the core safety elements, as well as how the expected values from NHTSA were selected and how performance was validated to achieve or exceed these targets. This includes the use of methods such as described in the answer to question 11 of this document.

B. Question About NHTSA Research

• Question 14. 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?

Research by NHTSA to produce the data of question 2 would be immensely valuable to the ADS community. This data would serve to inform metrics used to achieve ADS safety. First, the data on the number of miles between different types of accidents would be most useful for ADS safety. Then the severity data would be useful for functional safety severity determination consistency. The research may be performed using the GES data or other data to which NHTSA has access. The need for specialized tools is not anticipated.

C. Questions About Administrative Mechanisms

• Question 15. Discuss the administrative mechanisms described in this document in terms of how well they meet the selection criteria in this document.

Before any administrative mechanisms are deployed, it is recommended that NHTSA start publishing the research recommended in question 14. This is foundational for both voluntary and regulatory compliance to the framework recommended in the answer to question 1. Then voluntary submission by the suppliers of self-certification to NHTSA in a summary form could be requested that addresses two broad categories of information: 1) argumentation around sensing and core safety elements, and 2) how the expected values from NHTSA were selected and how improvement was validated. Even interim summaries may be accepted due to the nascent nature of ADS. This could be used to elicit improvement recommendations for a regulation.

• Question 16. Of the administrative mechanisms described in this document, 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 document should not be considered, please explain why.

The answer to question 15 above discusses the use of voluntary and regulatory administrative mechanisms. Consumer information concerning minimum metrics, as well as ADS supplier data showing that these metrics were significantly surpassed, may improve consumer confidence.

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

After publishing the NHTSA data in the answer to question 14, interim voluntary submissions of self-certification to NHTSA could be requested of a supplier in a summary form that addresses two broad categories of information: 1) argumentation around sensing and core safety elements, and 2) how the expected values from NHTSA were selected and how improvement was validated. Such a summary could be requested even if it is an interim for a product in development. This enables improvement of the supplier's safety case, uniformity of safety criteria, improvement of consumer confidence, and a basis for improvement of future administrative mechanisms.

• Question 18. Which mechanisms might not be implementable until the mid or long term but might be a logical next step to those mechanisms that could be implemented in the near term, and why?

Regulatory administrative mechanisms requiring self-certification and submission of a summary prior to public sale may not be implementable until the long term. This is because development is ongoing, so the submission data is not yet available. Further, the proposed results of the NHTSA

research described in the answer question 14 is also not yet available and has not yet been vetted via use of voluntary submissions.

• Question 19. What additional mechanisms should be considered, and why?

In order to improve customer acceptance of ADS equipped vehicles, consumer information should be considered concerning the submissions and margins validated to be less than the current accident rates.

• Question 20. What are the pros and cons of incorporating the elements of the framework in new FMVSS or alternative compliance pathways?

The cons concerning voluntary or involuntary submissions concerning validation of ADS to be better than the current accident data independently provided by NHTSA are that it requires NHTSA to data-mine this information and make it available free to all ADS developers and perhaps to the general public, without any scaling or skewing from observations. Existing ADS developers may have based their validation on different information and may now have to adapt to the new data. This in turn may generate additional competition to exceed the mark by a greater margin than other ADS providers, incurring additional expense. Also, the submission and approval process may add time and expense to releases.

The pros are similar to the cons. The provision of validation friendly data from NHTSA allows the ADS suppliers to focus on determining which data is applicable to the intended ODD and planning and implementing a validation strategy. The three standards referenced in the framework are already well known in the automotive industry and are being included in the development process already by some ADS suppliers. The NHTSA data supports a uniform basis for competition and consistent consumer information. NHTSA fulfils its mission per the Safety Act. Technological advancement is not hindered. Compliance rewards results.

• 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 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?

NHTSA should not consider an alternative regulatory path that focuses on demonstrations of competence with respect to the core functions of ADS safety performance. While this is absolutely appropriate within the industry in support of commerce, it does not measure the results that NHTSA is required to improve by the Safety Act. Assurance of accident reduction is not measured by NHTSA when pursuing data on these functions. If these functions are somehow

combined in implementation as the technology matures, decomposition for NHTSA becomes an additional burden for the industry, without helping to fulfil NHTSA's mission. If novel approaches to validation are employed in the framework proposed in the answer to question 1 in this document, NHTSA still has the opportunity to approve. NHTSA can support further innovation. NHTSA can fulfil its mission.

D. Questions About Statutory Authority

• Question 22. Discuss how each element of the framework would interact with NHTSA's rulemaking, enforcement, and other authority under the Vehicle Safety Act.

In the framework proposed in the answer to question 1 in this document, each element appears to fall within the authority granted to NHTSA under the Vehicle Safety Act. Consideration of the data proposed to be provided by NHTSA and the validation provided by ADS suppliers may be supported by the Safety Act, sec.103(f)(1) "consider relevant available motor vehicle safety data, including the results of research, development, testing and evaluation activities conducted pursuant to this Act;".

• Question 23. Discuss how each element of the framework would interact with Department of Transportation Rules concerning rulemaking, enforcement, and guidance.

Each element of the safety standard is authorized as referenced in the previous question and by SEC. 103. (a) "The Secretary shall establish by order appropriate Federal motor vehicle safety standards. Each such Federal motor vehicle safety standard shall be practicable, shall meet the need for motor vehicle safety, and shall be stated in objective terms." The objective terms are whether or not the validation submitted is less than the accident data provided by NHTSA. This is similar to the stopping distance being less than the stopping distance prescribed by FMVSS 135.

• Question 25. If you believe that any of the administrative mechanisms described in this document falls outside the Agency's existing rulemaking or enforcement authority under the Vehicle Safety Act or Department of Transportation regulations, please explain the reasons for that belief.

Not applicable.

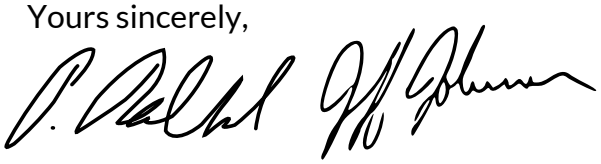
• Question 24. If your comment supports the Agency taking actions that you believe may fall outside its existing rulemaking or enforcement authority, please explain your reasons for that belief and describe what additional authority might be needed.

Not applicable.

Conclusion

In summary, Mapless AI is pleased to have this opportunity to provide comments on the DOT Docket Number: NHTSA-2020-0106. The possibilities to enhance safety are greater than ever and ADS equipped vehicles will benefit current and future generations of drivers. Mapless AI looks forward to future engagement with NHTSA on the development and implementation of ADS vehicle technologies on US roadways.

Yours sincerely,



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