THE CITY OF NEW YORK
OFFICE OF THE MAYOR

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U.S. Department of Transportation
1200 New Jersey Avenue SE
West Building Ground Floor
Room W12-140
Washington, DC 20590-0001

Re: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation (Docket No. NHTSA-2018-0092)

New York City thanks the National Highway Traffic Safety Administration (NHTSA) for taking this thoughtful approach to scoping a national Automated Driving System (ADS) vehicle testing program, and seeking input from a wide range of stakeholders.

General Comments

We believe that such a program, if implemented carefully, could accelerate, streamline, and enrich the research and development of ADSs, while presenting an opportunity to address a number of challenges with the current nature of ADS testing. So far, companies have shown little interest in meaningful engagement, and particularly data sharing, with any level of government beyond baseline statutory compliance. By approaching states and local governments individually, effectively shopping for favorable regulatory environments, they have mostly avoided substantive operational oversight and data sharing requirements. Such a system encourages shortcuts and eliminates local negotiating power, and will lead to substantially greater risk to the public as the test fleet multiplies.

A national pilot program, particularly one tied to Federal Motor Vehicle Safety Standard (FMVSS) exemptions for otherwise non-compliant highly or fully automated systems, could change that. By creating a pathway for incentives, standardizing test procedures and data sharing asks, and possibly even developing or soliciting a channel and repository for data sharing between participants and affected states and municipalities, NHTSA could initiate a new phase of national ADS testing in which the private and public sectors are more effective partners. Such an improvement would lead to a more productive industry, better and smoother coordination, more effective preparations for automation in transportation and in the workforce, and greater public benefit across an array of policy areas.

To achieve this, we believe NHTSA must insist on a greater degree of transparency in the industry. As the number of ADSs on public roadways multiplies, more robust data sharing with the federal government

will be critical to the assessments of equivalent safety NHTSA will need to make to protect the public while granting exemptions. And to local governments, which are taking bold steps to improve traffic safety under the banner of Vision Zero, ADS-related data should be provided as both a mechanism to ensure they are not exposing the public to unnecessary risk, and a tool to more effectively measure and manage our streets, and design our future network more responsively.

While the industry is still mastering less complex environments, we know that the New York market is of great long-term interest. Without sufficient preparation, incentives for engagement, and oversight, testing on NYC streets could threaten both the safety and the basic operation of the street network. We believe that a national ADS vehicle pilot program, designed to facilitate sharing across companies, geographies, and levels of government; and to standardize more methodical testing procedures and progressions, will increase both safety and public confidence, to the benefit of all involved.

New York City's Responses to NHTSA's Questions Regarding a Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation

In addition to the foregoing general comments, New York City has answered a selection of pertinent questions posed in the Advance Notice of Proposed Rulemaking.

Question 1. What potential factors should be considered in designing the structure of a pilot program that would enable the Agency to facilitate, monitor and learn from on-road research through the safe testing and eventual deployment of vehicles with high and full driving automation and associated equipment?

New York City believes several factors would be critically important to the design of the pilot program:

1. Local choice/opt-in
2. Thoughtful methodology for establishing tiers of Operational Design Domain (ODD) complexity that can be recognized across jurisdictions
3. Whether and under what circumstances they will be allowed to carry members of the public
4. Mandatory data sharing with affected jurisdictions

If NHTSA decides to pursue a national AV pilot program, New York City hopes it will be designed on an "opt-in" basis, to defer to local control of public streets, and to ensure that municipalities are not caught unprepared. Mandatory local buy-in would increase the likelihood that AV companies would seek to be active partners in data sharing, community engagement, and possibly other important areas of communication and collaboration. Similarly, municipalities that choose to engage with ADS testing through a national program are more likely to allocate resources to facilitate safe testing and an effective interface between local law enforcement and infrastructure. Local transportation and elected officials

have strong ties with relevant civic, business, and advocacy groups and communities of interest, such as people with disabilities, and will be able to facilitate the effective communications that will be necessary to prepare the population to interact with AVs. Particularly if multiple companies may want to test simultaneously in the same geographies, each with different ODD parameters, the program will need a single effective interlocutor to communicate the nature of the testing to the public. Cities are best positioned to serve that function.

On the other hand, if cities are not consulted prior to the beginning of AV testing, the program may expose the public to unnecessary risk. Cities operate large, complex transportation systems, with many moving parts, and will need time to prepare staff on the impact of large-scale AV testing on the many systems, including communication with the public. Without clear communications about the program, other road users are less likely to be comfortable and respond rationally while sharing the street with the test vehicles, and first responders may be unprepared or under-prepared to safely disable the vehicle and assist passengers in the event of a serious crash. Any role of local law enforcement officers, such as Operational Design Domain (ODD) enforcement, will require municipal buy-in. Cities that have not approved the testing are less likely to be able to engage productively with residents, particularly with workers concerned about potential wage loss or displacement resulting from job automation.

A national program must also contemplate how to assess a candidate vehicle's ability to operate safely in the ODD of interest. New York City has advocated for a tiered, or gated, approach to on-road testing, wherein vehicles, after accumulating sufficient experience in test-track environments, begin in simpler on-road environments and graduate to more complex environments once they demonstrate competence. NHTSA should consider establishing a generalized progression of ODD typologies, focusing on roadway geometry; vehicle, pedestrian, and cyclist density; weather conditions; light levels; and any other important considerations. This could serve as a guide for assessing how previous experience in one geography applies to a new one. It must also seriously consider the baseline of previous success and experience in simpler environments, including test-track environments that a vehicle must achieve before operating on public roads in a given ODD. As we have stated in previous comments, we are concerned that over-reliance on self-regulation of ADS technologies by industry will compromise traffic safety.

In a similar vein, NHTSA must also consider how to address truly driverless operation, without a backup driver, and the conveyance of members of the general public. The California Department of Motor Vehicles' application for driverless operation, and the California Public Utilities Commission's application for transporting members of the public, may provide useful examples. Needless to say, these thresholds should be crossed only after a truly substantial body of successful, safe driving experience has been collected in the ODD of interest.

A national AV testing program must also mandate the sharing of several key types of safety and performance data with the public sector—both NHTSA and affected state and local jurisdictions. The pilot presents an opportunity not just to collect useful data, but to experiment with mechanisms and processes for collecting, storing, and analyzing that information, prior to widespread deployment of AVs. The incentives offered through a pilot program may also encourage more transparency among AV developers than would otherwise be the case, and the effort could be a vehicle to standardize the data sharing requests to minimize the burden on the private sector while still delivering critical information to involved parties. This element will be explored in more depth in response to later questions.

Finally, New York City believes that, in the development of the pilot program, USDOT should take a clear stand on the paramount issue of privacy protection. Because ADS vehicles will be roving sensor clusters, their developers must be required to communicate clearly about what types of data, such as photos of people, license plates, and business storefronts, will be collected, how it will be used, who will have access to it, and how long it will be stored. Similarly, USDOT should be aware of the non-safety and non-operational rider data companies are collecting and retaining, and how it will be used. Through the creation of this pilot program, USDOT has an opportunity to push the industry toward greater transparency on this topic.

Question 2. If NHTSA were to create a pilot program, how long would there be a need for such a program? What number of vehicles should be involved? Should NHTSA encourage the conducting of research projects in multiple locations with different weather conditions, topographical features, traffic densities, etc.?

Given the wide variance in the estimates of the amount of time required for ADSs to reach maturity, New York City advises against a fixed pilot duration. We suggest instead that the pilot be continued until NHTSA determines that it has learned enough to plot a path forward, or that further federal facilitation of testing would not yield additional safety benefits to the public.

Regarding testing in a variety of street environments and climates, please see the response to Question 1.

A. Considerations in Designing the Pilot Program

1. VEHICLE DESIGN FOR SAFE OPERATION

Question 7. What types of performance measures should be considered to ensure safety while allowing for innovation of emerging technology in vehicles with high and full driving automation participating in a pilot program?

While we will defer to the technical expertise of others more engaged in this area of research, we would like to emphasize the importance of confirming candidate vehicles' ability to accurately recognize and predict the behavior all types of road users in any condition in which they may be operating. With a complex and high-density mix of vehicles of all types; pedestrians of all ages and ability levels; cyclists using normal and electric bikes and handcycles; users of new micromobility vehicles like electric scooters, motorized longboards, and one-wheels; a colder climate that shortens the roadway striping season; regular occlusion of signage by trucks and other obstacles; and legions of traffic safety officers using hand gestures to guide vehicles, sometimes overriding active signals, New York's streets are likely to be more complex than anything ADSs have previously encountered. We believe it will be critical to demonstrate that ADSs can perceive and anticipate the actions of everyone around them, irrespective of the technology and processes they use to do it. In theory, this could be accomplished on public streets without activating the ADS, or, through simulation based on video captured by other vehicle-mounted cameras in a variety of geographic areas under different weather and lighting conditions.

3. VEHICLE DESIGN SAFETY ELEMENTS

Question 8. How should the Operational Design Domains of individual vehicle models be defined and reinforced and how should Federal, State and local authorities work together to ensure that they are observed?

Following the model piloted in Boston, cities should be enabled to design gated, spatial Operational Design Domains with conditional climatic, time-of-day, and event-based overlays, guided by federally-established best practices. This procedure will empower municipal governments to design locally-responsive testing thresholds, and decentralize NHTSA's program design burden.

For ODDs to be properly enforced, testing entities must share regular performance data updates, including a representation of actual routing, with the jurisdictions tasked with enforcement: most probably, the local police or transportation department. If multiple ADS developers will be participating in the same geographic area, each with their own evolving ODD parameters, NHTSA cannot expect law enforcement officials to keep up to date on each. Rather, participants should demonstrate on a recurring basis, perhaps quarterly, that they are only activating the ADS within the approved ODD. Alternatively, this could perhaps be accomplished in real time using participant-specific geofences and automated notifications when a test vehicle exits the geofenced area while the ADS is activated. Mechanisms to account for weather conditions and light levels, and any other important factors would also be necessary. In any case, given the multitudinous potential overlapping ODD geographies and conditions associated with the various program participants, ODD enforcement must not depend on physical observations of violations.

4. DATA AND REPORTING

Question 9. What type and amount of data should participants be expected to share with NHTSA and/or with the public for the safe testing of vehicles with high and full driving automation and how frequently should the sharing occur?

NYC DOT has engaged with interagency stakeholders on the subject of the data points relating to ADS testing and operation that the city would like to collect. The list included below reflects the data prioritized by city officials.

Some of these data sets allow NHTSA and local governments to monitor ADS safety; others would help city agencies better manage their infrastructure and design safer streets, feeding a virtuous cycle that makes streets easier for ADSs to use. Given that ADSs represent both significant additional consumers of municipal staff capacity and opportunities to generate data that can streamline other agency operations, we believe that both categories are integral to a constructive relationship between local governments and ADS developers.

NHTSA has the opportunity to use its central convening role to standardize and streamline the data asks across jurisdictions. Through the development or commissioning of an API, similar to the one that the Los Angeles Department of Transportation created to facilitate their Mobility Data Standard, NHTSA could lower the burden of sharing and using the data for both the private sector and the public sector, particularly for smaller municipalities. Relatedly, the National Association of City Transportation Officials (NACTO) and Open Transport Partnership have developed a platform called SharedStreets for the standardization, synchronization, analysis and visualization of spatial transportation data. This platform could serve as a model for the sharing of ADS-related geographic incident and observation data.

New York City also has considerable experience receiving, storing, protecting, analyzing, and otherwise managing big data sets. Since 2010, the NYC Taxi and Limousine Commission (NYC TLC) has been collecting trip records and GPS breadcrumb data from over 13,000 taxis. Pursuant to recent regulation in the for-hire vehicle (FHV) sector (in which Uber and Lyft fall), NYC TLC is collecting trip records and GPS breadcrumb data from all FHVs, including those providing services through Uber, Lyft, Via, and Juno—over 100,000 FHVs in total. NYC TLC and NYC DOT both have sophisticated data management mechanisms that protect the data security and any personally-identifiable information. Before the data is made publicly available, it is aggregated to a zonal geography that makes it impossible to track individual vehicles through the network. These are industry best practices that can be replicated in any municipal data analytics team. For municipalities without sufficient hardware or personnel resources to manage and analyze the data themselves local or regional academic partners may be able to step in as a trusted third party to assist.

Inventory of Active Test Vehicles: Update as necessary

1. Number of test vehicles and their level of automation: SAE Level 1-5
2. Test Vehicle ODD
3. Vehicle identification information

Safety – Collision Data: Within two hours of occurrence

NYC DOT's top priority is safety, and the agency considers collision notification the absolute baseline for critical reporting. Any incidents involving a testing vehicle will also likely generate significant media interest. Timely notification by the participant will enable the city to accurately answer questions from reporters, which is in the best interest of the participant, NYC, and NHTSA.

NYC DOT proposes that NHTSA require participants to notify NHTSA and the local law enforcement about collisions involving its vehicles within two hours of occurrence, regardless of whether the vehicle's automated driving system (ADS) was engaged.

1. Collision date and time: MM/DD/YY HH:MM
2. Collision location: Street segment and direction (e.g., northbound on Hudson St between Franklin St & N. Moore St.)
3. Collision type: rear end, side-swipe, t-bone, pedestrian, bicyclist, etc.
4. Vehicle identification information: plate, ID number
5. Property damage, if any
6. Injuries/fatalities, if any
7. Police Department, Fire Department, or Emergency Services response
8. Was the ADS engaged?
9. Narrative description of crash
10. Internal and external video footage of crash (can be made available on a longer time frame, possibly within 24 hours)

Safety – Non-Routine Disengagement (NRD) Data: Quarterly update

NYC DOT suggests that participants provide NHSTA and local governments with data on non-routine disengagements (NRDs) of the ADS, which we define as disengagements initiated at the test driver's discretion in the event that the vehicle is malfunctioning or expected to proceed in an incorrect and unsafe manner. These could be in response to acute collision risks, such as the test vehicle veering out of its lane in moving traffic, or a pedestrian unexpectedly stepping directly in front of the vehicle. The term "non-routine" is meant to distinguish these engagements from pre-determined, routinely-required disengagements, such as when vehicles pass through work zones.

1. NRD date and time: MM/DD/YY HH:MM
2. NRD location: Street segment and direction (e.g., northbound on Hudson St between Franklin St & N. Moore St.)
3. Other parties involved (primary external entity NRD is responding to) if any: other vehicle, bicycle, and/or pedestrian
4. Relevant vehicle movement: through, right turn, left turn, reverse
5. Vehicle speed at time of disengagement: MPH
6. Hard braking (-0.45 g or higher): Y/N, maximum if yes.

Performance and Testing Overview: Quarterly update

1. GPS bread-crumb data
    a. At 30-60 second intervals: location (longitude + latitude), date and time (MM/DD/YY HH:MM:SS)
2. Journey Link Chain
    a. Chronologically sequenced set of links travelled, and travel times per link ([Link ID, Begin Time, Time on Link, Distance Travelled)
3. Number of active test vehicles during reporting period
4. Total ADS-operated mileage during reporting period: miles
5. Total human-operated mileage during reporting period: miles
6. Total ADS-operated travel time during reporting period: hours
7. Total human-operated travel time during reporting period: hours

Question 10. In the design of a pilot program, how should NHTSA address the following issues—

a. confidential business information?

NHTSA should continue its current practice of requiring participants to proactively indicate which information is confidential and on what basis it has been determined to be confidential. NHTSA will have to be the ultimate arbiter of what qualifies for protection from Freedom of Information laws. It is worth noting that we believe much of the information discussed, particularly matters affecting public safety, should not be considered confidential business information.

b. privacy?

For enforcement purposes, NHTSA and local jurisdictions will need access to the detailed event information, including participant details. When data will be made available to the public, NHTSA and all partner jurisdictions should follow industry best practices for elimination of personally identifiable information (PII) and data aggregation. NYC TLC does this for hundreds of millions of trip records every

year that are released publicly through the city's open data platform. In addition, New York City has robust local laws designed to protect personally identifiable information.

Questions of privacy become particularly important when pilot participants begin transporting members of the public, and if they are allowed to test a ride-hailing service that charges passengers. If companies will be collecting and retaining user financial information, address, and other details, NHTSA will need to ensure additional layers of consumer protection, like those overseen by NYC TLC for New York City's for-hire vehicle industry.

c. data storage and transmission?

Data should be stored in a secure centralized repository where all relevant parties have access to download the data through a web application data portal, as well as a secure REST API.

d. data retention and reporting?

Aggregate data should be stored indefinitely and reporting should be done regularly at a reasonable interval contingent upon the frequency at which data is transmitted to the city. If real time streams are available, analytics should be computed on data in motion and made available for immediate Agency consumption. Data that is transmitted in batch should have reporting updated at least nightly and available for consumption the next calendar day.

5. ADDITIONAL CONSIDERATIONS IN PILOT PROGRAM DESIGN

Question 11. In the design of a pilot program, what role should be played by—

a. The 12 safety elements listed in A Vision for Safety*?*

New York City urges NHTSA to make Safety Assessments addressing the 12 safety elements in *A Vision for Safety* a mandatory prerequisite to participating in the program.

b. The elements listed below,

i. Failure risk analysis and reduction during design process (functional safety)?

New York City hopes that NHTSA will require evidence of failure risk analysis and reduction in pilot program applications, and more generally in documentation associated with the granting of exemptions from FMVSS for highly or fully automated vehicles.

ii. Objective performance criteria, testable scenarios and test procedures for evaluating crash avoidance performance of vehicles with high and full driving automation?

We believe that objective performance criteria, testable scenarios, and test procedures for evaluating crash avoidance performance will be the only effective way for NHTSA to judge system safety, and thereby fulfill its responsibility to enforce roadway safety and assess equivalent safety of vehicles granted exemptions from FMVSS. These objective measures will also be critical in assessing potential safety in new ODDs in different geographies.

iii. Third party evaluation?

Third party evaluation could satisfy desires for more intensive and standardized system testing, without necessarily requiring NHTSA to bear the burden of developing and performing the test procedures.

A. Failure risk reduction?

Again, we hope this would be a standard requirement in any documentation NHTSA uses to evaluate program participation or exemptions from FMVSS.

B. Crash avoidance performance of vehicles with high and full driving automation?

Any operation of highly or fully automated systems on public roadways should follow extensive crash avoidance testing on test tracks and in simulation, and should be clearly documented as a prerequisite to participation in the pilot program.

iv. Occupant/non-occupant protection from injury in the event of a crash (crashworthiness)?

This should continue to be a central consideration in NHTSA's regulation of motor vehicles. While passenger protection system configurations may change in response to changing in-vehicle roles and layouts, highly and fully automated vehicles should not be held to a lower standard of crashworthiness than conventional vehicles.

vi. Consumer education?

Consumer education will be a challenging component that should be centrally managed through the relevant municipalities, particularly in jurisdictions in which multiple participants will be operating. Given the rapidly-evolving nature of system capabilities, consumer education should be done strategically to avoid confusion and engagement fatigue. Partnership and regular coordination between the private

sector and municipalities will be critical to maintaining effective communication with the public, and must be built into the design of the program.

We would also like to stress that while consumer education related to ADS testing will be important, it will always fall short, particularly among our most vulnerable road users. Testing safety must never depend on changing public behavior; rather, testing must fit safely into the existing transportation ecosystem.

vii. Post deployment Agency monitoring?

Data sharing will be a critical enabler of post-deployment monitoring. We hope NHTSA will share this responsibility with interested local governments.

Question 12. Are there any additional critical areas to consider in the design of a safe pilot program for the testing and deployment of vehicles with high and full driving automation?

If, through this program, NHTSA intends to allow participating companies to provide for-hire transportation services to members of the general public in ADS vehicles, such services will need to comply with state and local FHV regulations in any jurisdiction in which they operate. We urge NHTSA to consider how the interaction between the program and existing regulations would work, so that the program does not unintentionally disrupt consumer protection, passenger safety, and privacy measures already in place. Further, NHTSA should evaluate the specific liability considerations, including informed passenger consent and insurance coverage, insofar as the states have not already determined these elements.

Assuming NHTSA does intend to allow participants to provide ride-hailing services to the general public, New York City sees in a national ADS pilot program an opportunity to evaluate at a national scale two other important topic areas: potential labor impacts, and consumer behavior and preferences.

USDOT recently announced and closed a comment period regarding the scope of work for a study of the potential workforce impacts of ADSs. Testing of automated FHVs through a national pilot program could give USDOT and state and local partners critical insight into the degree to which these services pose an immediate risk of wage suppression and job displacement, which could vary considerably across sectors, geographies, and regulatory environments. The ground truth could provide a valuable input to the workforce study.

Similarly, local jurisdictions, particularly those that operate transit systems and work to support energy-efficient multi-modal travel through walking and biking, are eager for data to inform long-range

assessments of the potential impact of ADSs on mode share. If participants will provide for-hire service through the pilot program, we urge NHTSA to view this as an official area of study, and collect and share with local partners aggregated data and analysis relating to consumer preferences, like comfort with sharing rides when a driver is not present, and price sensitivity. This information could help guide long-range planning at the state and local level, and ensure that cities are taking appropriate steps to prepare their transportation networks for ADS vehicles.

6. ISSUES RELATING TO ESTABLISHING A PILOT PROGRAM

I. APPLICATIONS FOR PARTICIPATION AND POTENTIAL TERMS OF PARTICIPATION

Question 13. Which of the following matters should NHTSA consider requiring parties that wish to participate in the pilot program to address in their applications?

a. "Safety case" for vehicles to be used in the pilot program (e.g., system safety analysis (including functional safety analysis), demonstration of safety capability based on objective performance criteria, testable scenarios and test procedures, adherence to NHTSA's existing voluntary guidance, including the submission of a voluntary safety self-assessment, and third party review of those materials).

i. What methodology should the Agency use in assessing whether an exempted ADS vehicle would offer a level of safety equivalent to that of a nonexempted vehicle? For example, what methodology should the Agency use in assessing whether an ADS vehicle steers and brakes at least as effectively, appropriately and timely as an average human driver?

As previously stated, it should be incumbent upon program applicants to demonstrate that their vehicles do not pose unreasonable risk to the public prior to the beginning of testing on public roads. We defer to others on the specific metrics for such a demonstration.

c. Test design (e.g., route complexity, weather and related road surface conditions, illumination and institutional review board assessment).

Test design is integrally related to the ADS's ODD, which should be specified in advance. It will be critical for NHTSA and local governments to be kept up to date on the test areas, and that they conform to the tiered ODDs local governments specify.

d. Considerations for other road users (e.g., impacts on vulnerable road users and proximity of such persons to the vehicle)

This is a critical consideration that should be vetted through robust test track and simulation experience, and documented in application materials prior to testing in any urban environment.

e. Reporting of data, e.g., reporting of crashes/incidents to NHTSA within 24 hours of their occurrence.

Please see the response to Question 9.

f. Recognition that participation does not negate the Agency's investigative or enforcement authority, e.g., independent of any exemptions that the Agency might issue to program participants and independent of any terms that the Agency might establish on those exemptions, the Agency could conduct defect investigations and order recalls of any defective vehicles involved in the pilot program. Further, the Agency could investigate the causes of crashes of vehicles involved in the program.

Program materials should make this clear to all participants.

Question 14. What types of terms and conditions should NHTSA consider attaching to exemptions to enhance public safety and facilitate the Agency's monitoring and learning from the testing and deployment, while preserving the freedom to innovate, including terms and conditions for each of the subjects listed in question 13? What other subjects should be considered, and why?

When a program participant's vehicle or fleet malfunctions in a way that creates a public safety risk, and particularly when it results in a crash, that participant should initiate an automatic, self-reported suspension of operation for the vehicle, or, perhaps in severe cases, the entire fleet, so that the issue can be addressed before the public is put further into harm's way. NHTSA should consider how to structure the terms to ensure that malfunctioning vehicles are removed from operation as quickly as possible. As with many other aspects of this program, robust data sharing with NHTSA and local partners will be critical, and must be enshrined in the program terms, rather than left to negotiation on a case-by-case basis.

NHTSA should also consider how this program will interact with existing state liability insurance and surety bond regimes, and whether the agency should create a liability insurance floor for participants in states that have not yet implemented liability regimes for ADS testing.

Finally, all ADS vehicle developers, and particularly those exempted from FMVSS, should be required to develop a law enforcement interaction plan and first responder guide. These materials will be important to minimizing disruption associated with ADS testing, and protecting the public when crashes occur.

II. POTENTIAL CATEGORIES OF DATA TO BE PROVIDED BY PROGRAM PARTICIPANTS

Question 15. What value would there be in NHTSA's obtaining one or more of the following potential categories of data from the participants in the pilot program? Are there other categories of data that should be considered? How should these categories of data be defined?

a. *Statistics on use (e.g., for each functional class of roads, the number of miles, speed, hours of operation, climate/weather and related road surface conditions).*

Please see the response to Question 9.

b. *Statistics and other information on outcome (e.g., type, number and cause of crashes or near misses, injuries, fatalities, disengagements, and transitions to fallback mechanisms, if appropriate).*

Please see the response to Question 9.

c. *Vehicle/scene/injury/roadway/traffic data and description for each crash or near miss (e.g., system status, pre-crash information, injury outcomes).*

Please see the response to Question 9.

d. *Sensor data from each crash or near miss (e.g., raw sensor data, perception system output, and control action).*

In the NTSB investigation of the causes of the Uber ADS crash and pedestrian fatality, this type of sensor output data seems to have been a critical component of establishing the ADS-related causes of the crash. We believe it will be critical for NHTSA to collect information related to the perception system output and control action, and share with local law enforcement when appropriate.

f. *Difficult scenarios (e.g., scenarios in which the system gave control back to an operator or transitioned to its safe state by, for example, disabling itself to a slow speed or stopped position).*

Please see the response to Question 9.

g. *Software updates (e.g., reasons for updates, extent to which updates are made to each vehicle for which the updates are intended, effects of updates).*

While municipalities in which vehicles are being tested should be summarily notified when vehicles undergo truly significant updates, NYC would not want to create barriers to the timely distribution of system fixes that improve the operation of deployed vehicles, nor would we be likely to have an immediate application for this information. This is likely more relevant to NHTSA's oversight.

h. *Metrics that the manufacturer is tracking to identify and respond to progress (e.g., miles without a crash and software updates that increase the operating domain).*

These metrics should be indicated in program applications. They should be consistent, and can help inform, NHTSA's own performance standards.

l. *If there are other categories of data that should be considered, please identify them and the purposes for which they would be useful to the Agency in carrying out its responsibilities under the Act.*

NHTSA should also require information from participants regarding their cybersecurity practices. Particularly:

1. Method for protecting system security, including applicable standards and certifications; and
2. Method for managing personally identifiable information (once vehicles begin transporting non-employee passengers).

NHTSA is likely to be the lead regulator on system cybersecurity, which could present as much of a safety risk as poor system design or insufficient testing experience as testing scales across the country.

m. *Given estimates that vehicles with high and full driving automation would generate terabytes of data per vehicle per day, how should the need for data be appropriately balanced with the burden on manufacturers of providing it and the ability of the Agency to absorb and use it effectively?*

The full data set produced by each vehicle will not be needed by local partners, which will significantly reduce the storage required, as well as reduce the burden of transmission from the manufacturers to USDOT or to states and municipalities. Data sets that would be of significance to USDOT, states, and local partners would be: anonymized journey information (reduced to chronologically sequenced set of links travelled, and travel times per link), aggregated safety information (number of hard braking events, crashes, etc., binned in 15 minute increments to each link), aggregated emissions (binned per link by date and hour). If real-time data is available, NYC DOT may find use in receiving information related to congestion and queue length at intersections. Additional data sets may prove to be significant, but wholly depend on what technology is available on-board each vehicle. NYC DOT is prepared to handle hundreds of terabytes of data and has the ability to quickly scale out its data processing capabilities to the public cloud, and on premises if necessary.