Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, MassDOT Secretary & CEO

massDOT
Massachusetts Department of Transportation

Application to Test Highly Automated Vehicles (HAVs) on Public Ways in Massachusetts

- Purpose: This document, accompanying supplements, the MOU, and the signed certification constitute an Application to Test Highly Automated Vehicles (HAVs) on public ways in the Commonwealth of Massachusetts, including public ways controlled by state agencies and any municipality or political subdivision which agrees to HAV testing on ways under its control.

- An Applicant who desires to test HAVs in Massachusetts must review and understand the policy issued September 2016 by the National Highway Traffic Safety Administration (NHTSA) entitled Federal Automated Vehicles Policy and Executive Order No. 572 issued by Governor Baker on October 20, 2016.

- If the Massachusetts Department of Transportation (MassDOT) approves this application, it will issue an approval to test motor vehicles with levels of automation defined by SAE International, ranging from SAE Level 3 to SAE Level 5 (as more fully explained herein)[1]. The "lead agency" (MassDOT) may approve testing at SAE Levels 3, 4 and 5 (Highly Automated Vehicles or HAVs) when it is satisfied that:

  a. the Applicant is a responsible and capable "manufacturer" or "other entity" qualified to road test vehicles equipped with various levels of automation on public ways;
  b. the prior testing conducted by the Applicant was conducted in a safe and efficient manner and did not unnecessarily endanger other vehicles, the driving public, pedestrians, or public or private property; and
  c. based upon the application and the results of previous testing, further testing of HAVs is reasonably expected to be conducted safely and efficiently.

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[1] At SAE Level 0, the human driver does everything;
At SAE Level 1, an automated system on the vehicle can *sometimes assist* the human driver to conduct *some parts* of the driving task;
At SAE Level 2, an automated system on the vehicle can *actually conduct* some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task;
At SAE Level 3, an automated system can both actually conduct some parts of the driving task and monitor the driving environment *in some instances* but the human driver must be ready to take back control when the automated system requests;
At SAE Level 4, an automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions; and
At SAE Level 5, the automated system can perform all driving tasks, under all conditions that a human driver could perform them.
SAE Levels 3-5 are considered to be Highly Automated Vehicles (HAVs)
Source: NHTSA, Federal Automated Vehicles Policy (Page 9, September 2016)

- For purposes of such testing on public ways in the Commonwealth per Executive Order No. 572, the Massachusetts Department of Transportation (MassDOT) is designated the lead agency 2 . Only approval issued by MassDOT shall authorize testing of HAVs on public ways. The MassDOT HAV Review Committee shall review and approve or deny any Application and any motor vehicle, driver or HAV testing proposal. The Review Committee may also address any other issues, requests or controversies that arise in the course of testing or review.

- Memorandum of Understanding: An Applicant for Approval to Test Highly Automated Vehicles (HAVs) on the public ways of Massachusetts is required to enter into a Memorandum of Understanding (MOU) with the "Lead Agency" (MassDOT) before any Application for HAV testing is considered. In addition, if the Applicant intends to do HAV testing on public ways under the control of state agencies, municipalities or other political subdivisions of the Commonwealth, the Applicant may be required to seek approval for such testing from the governmental entities controlling those public ways. MassDOT will not provide approval for HAV testing on public ways controlled by other government entities if any requirements of those entities are inconsistent with the requirements of this Application, including the Memorandum of Understanding (MOU).

- Timeline for Processing Applications: If an Application is complete, the Review Committee will review the Application in detail and provide approval, rejection, or request for more information within 30 business days. If the Committee requires additional information to assess the Application, the Applicant should submit such information or relevant explanation of such omission from the Application within 15 business days, and the Committee will review and respond within 15 business days of receipt of the additional information. MassDOT reserves the right to withdraw an approval at any time, and to request a meeting with the Applicant prior to issuing an Approval to Test.

[2]http://www.mass.gov/courts/case-legal-res/law-lib/laws-by-source/exec/eo550-599.html

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Submit Form

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Massachusetts Department of Transportation

APPLICANT INFORMATION:

- ***Name of Organization Applicant:*** Optimus Ride Inc.
- ***Street Address of Company's Headquarters Office:*** 88 Black Falcon Ave., Ste. 188
- ***City, Town of Headquarters Office:*** Boston ***State*** MA ***Zip Code*** 0221 ***Country*** USA
- ***Mailing Address of Headquarters Office (if different):***
- ***Name of AV Testing Program Director at Headquarters Address:*** Ryan Chin
  Title: CEO ***Email Address:*** [redacted] ***Tel. No.:*** [redacted]

PHYSICAL PRESENCE IN MASSACHUSETTS:

- ***Name of Organization Applicant:*** Optimus Ride Inc.
- ***Street Address of Company's MA Office:*** 88 Black Falcon Ave., Ste. 188
- ***City, Town of MA Office:*** Boston ***State*** MA ***Zip Code*** 02210 ***Tel: No.*** [redacted]
- ***Mailing Address of MA Office (if different):***
- ***Name of AV Testing Program Director at MA Address:*** Ryan Chin
  Title: CEO ***Email Address:*** [redacted] ***Tel. No.:*** [redacted]

ORGANIZATION TYPE:

☐ ***Manufacturer:*** **An individual or company that manufacturers AV's for testing and deployment on public roadways.** It includes *"original equipment manufacturers"* (OEMs), *"multiple and final stage manufacturers," "alterers"* (individuals or companies making changes to a complete vehicle prior to first retail sale or deployment) and *"modifiers"* (individuals or companies making changes to existing vehicles after first retail sale or deployment).

☑ ***Other Entity:*** **An individual or company that is not a manufacturer, and is involved with designing, supplying, testing, selling, operating, deploying, or helping to manufacture AVs.**

CERTIFICATION:

The Applicant understands and agrees that this Application is complete and will be reviewed when this form is completed and signed by the proper person, all required Supplements are completed, any required documents are attached, and a Memorandum of Understanding (MOU) is entered into between MassDOT and the Applicant.

[signature]	Jenny Larios Berlin	02/17/2017
Signature of Applicant's Representative	***Printed Name***	***Date of Signing***
COO & Secretary	[redacted]	[redacted]
Position and Title	***Email address***	***Tel. No.:***

Ten Park Plaza, Suite 4160, Boston, MA 02116
Tel: 857-368-4636, TTY: 857-368-0655
www.mass.gov/massdot

SUPPLEMENTAL INFORMATION:

1. **Experience with Autonomous Vehicles:**
   Information describing the Applicant's business as a "Manufacturer" or "Other Entity" of HAVs as self-identified above.

2. **Safety Assessment for Testing Vehicles:**
   The Applicant must provide a safety assessment for testing the vehicles in accordance with NHTSA's Vehicle Performance Guidance, or similar documentation which addresses the safety issues contained therein. Applicants should not disclose any confidential information or other material considered to be trade secrets.

3. **Applicant's Initial Driving Plan:**
   The Applicant must define the public and/or private ways, specific geographical areas and environmental conditions in which the testing will occur.

4. **Vehicles in Testing Program:**
   Each vehicle used in an AV testing program is required to follow the Performance Guidance set by NHTSA. Every vehicle must be registered and titled and display a current inspection sticker from the state in which the vehicle is registered. Each vehicle must meet applicable Federal Motor Vehicle Safety Standards (FMVSS), or the Applicant must provide a "waiver" for the particular standard issued by NHTSA.

5. **Drivers in Testing Program:**
   The Applicant must identify each operator testing HAVs in Massachusetts, and each operator must be properly licensed in his/her jurisdiction of residence. No vehicle used in the HAV testing program may be operated in modes SAE 3 through SAE 5 except by a licensed operator approved by MassDOT.

6. **Summary of Training:**
   The Applicant must provide the training materials for its operators who are testing HAVs in Massachusetts.

7. **Insurance Required:**
   No Application shall be approved unless the Applicant has filed with MassDOT, through its Registry of Motor Vehicles, a policy of insurance or a surety bond in the amount of a minimum of $5,000,000 issued by a company licensed to do business by the Commissioner of Insurance of the Commonwealth of Massachusetts and such policy or bond shall be for the purpose of satisfying any judgment or judgments for damages for personal injury, death or property damage caused by a vehicle being tested in the Commonwealth.

Supplement # 1: Experience with Autonomous Vehicles

Please provide information generally describing the Applicant's business as a "Manufacturer" or "Other Entity" of HAVs as self-identified above. Please include:

i. *a brief history of the Applicant's business as regards HAVs;*

Optimus Ride is a MIT spinoff company that combines over 30 years of experience in building self-driving technology. Our founders built self-driving technology while at MIT and entered into the DARPA Urban Challenge in 2007 (one of the six teams that finished the race). Since then, we have built fully autonomous cars, trucks, forklifts and other ground vehicles. Our team also has experience in designing and building shared-electric vehicles (MIT CityCar) as well as managing shared fleets (Zipcar). Optimus Ride was founded as a Delaware corporation in August 28, 2015. Our goal is to develop self-driving vehicles that enable safe, sustainable, and equitable mobility access. We design fully autonomous (level 4) systems for electric vehicle fleets.

ii. *a summary of the Applicant's experience in "off-road" testing of HAV's on private facilities (closed to the public), and include the approximate number of miles and/or hours of testing completed, the types of vehicles used for such testing, the SAE Levels at which the vehicles were tested, the operational design domains which were tested (including but not limited to the roadway types, geographic areas, speed ranges, and environmental conditions), and the results of the testing;*

Optimus Ride has been testing continuously since 2015. We have been conducting off-road testing in collaboration with the City of Boston and the Perkins School for the Blind. The City of Boston has provided private lots (6 Tide Street and C1 Lot) in the Raymond Flynn Marine Park for our tests. The Perkins School for the Blind has allowed us to collect data and conduct user-engagement workshops on their 38 acre campus in Watertown, MA. We test up to 40 hours per week. We have tested vehicles manufactured by Textron and Polaris. Optimus Ride has been testing SAE Level 4 technology. We have tested in daytime hours and we limit our vehicles to 25-30 mph. Our testing on private roads along with our AV experience prior to starting Optimus Ride, gives us sufficient confidence in our software to begin testing on public roads. Optimus Ride has collected significant data on private lots, private roads, and public roads, including in light rain conditions. Optimus Ride has done limited autonomous driving in light rain conditions on private lots.

iii. *a summary of the Applicant's experience in "on-road" testing of HAV's on public ways while the road was open to other motorists, and include the approximate number of miles and/or hours of testing completed, the types of vehicles used for such testing, the SAE Levels at which the vehicles were tested, the general location of the road testing, the operational design domains which were tested, the identity of the governmental entity that approved and/or monitored the testing, and the results of the testing;*

Optimus Ride has not yet conducted "on-road" testing of HAVs on public ways. We seek to conduct our initial testing (SAE Level 4) in collaboration with MassDOT, MassPort, and the City of Boston. Optimus Ride has collected significant data on private lots, private roads, and public roads, including in light rain conditions. We have not done testing in nighttime conditions and do not expect to autonomously drive in those conditions.

iv. *a description and summary of any crashes (regardless of the degree of seriousness) that resulted during testing of HAVs by the Applicant, whether on "off-road" or "on-road" courses, a description of the nature of physical damage to the vehicle or vehicles and or other personal or private property, whether any personal injuries occurred as a result of the crash(es), the seriousness of those injuries, whether any fatalities resulted and whether an official report of the crash or crashes were reported to police or other governmental agencies, and if a report or reports were filed, to whom they were filed; and*

Optimus Ride has had zero crashes of any kind during our testing.

v. *if the Applicant is currently testing HAVs in other jurisdictions, a summary of where testing is taking place and whether it has an agreement or agreements in place to test HAVs in other jurisdictions at a future date.*

Optimus Ride is not currently testing in any other jurisdictions to date.

Supplement # 2: Applicant's Safety Assessment for Testing Vehicles

Attach a safety assessment for testing the vehicles in accordance with NHTSA's Vehicle Performance Guidance, or similar documentation which addresses the safety issues contained therein. This assessment should include a "self-certification" of testing for the technology in the test vehicles under controlled conditions that simulate the real-world conditions. These conditions include various weather and various types of roads, different times of the day and night, etc., to which the Applicant intends to subject the vehicle on public ways in Massachusetts. Applicants should not disclose any confidential information or other material considered to be trade secrets.

Optimus Ride is developing an autonomous vehicle platform for testing and transportation-as-a-service (TAAS) purposes. By contrast, NHTSA's Draft Vehicle Performance Guidance is specifically applicable to production vehicles that will be sold on the consumer market. Optimus Ride vehicles will be operated solely by highly trained test drivers and Optimus Ride will have exclusive ownership of the vehicles. As such, some of NHTSA's Draft Vehicle Performance Guidance do not directly apply to Optimus Ride's testing and operations. However, in this document, we address each of the concerns brought up by the NHTSA Draft Vehicle Performance Guidance in order to convey that our system design and safety life cycle have been developed with industry best practices.

Data Recording and Sharing

The Optimus Ride autonomous system has been designed to collect event, incident, and crash data, for the purposes of recording the occurrence of malfunctions, degradation, or failures in a way that can be used to establish the cause of any such issues. Data will be collected for both testing and operational purposes including for event reconstruction from the sensors onboard the vehicle. For crash reconstruction purposes, this data will be stored, maintained, and readily available for retrieval. We will collect data associated with all events including, but not limited to, fatalities and personal injuries as well as damage to any vehicle involved. Our vehicles will record all information relevant to any event as well as the performance of the system during the event such that the event can be reconstructed. This data includes information relating to the status of the autonomous system and if the system or the test driver was in control of the vehicle at any time.

Privacy

During our testing and pilot phases, Optimus Ride vehicles will only be operated by trained test drivers employed by the company. Along with the engineers and other employees of the company, they will be the only users capable of accessing the data. Employees of Optimus Ride are aware of what specific data will be collected, how it will be stored, and how it will be used. All employees of Optimus Ride have signed confidentiality agreements as part of their employment with the company. Through these agreements, all of our employees have promised not to disclose confidential information without the company's authorization unless required by law. All of our pilot participants must read and sign a consent form that conforms with Massachusetts law and clearly and transparently explains what data will be collected, how it will be stored, and how it might be used. In the event that Optimus Ride chooses to disseminate any recordings taken during our testing or pilot phases, we will remove any personally identifying information including, but not limited to, license plate numbers of vehicles and pedestrian faces.

System Safety

The Optimus Ride system is in the process of testing and developing a Level 4 High Automation system. The general assumptions for this safety assessment of our autonomous functionality are based on the fact that our vehicles will only operate within the driving limits as defined in Supplement 3 - Initial Driving Plan. Any further assumptions, constraints, or exceptions that could be required are explained as necessary. For all of our autonomous testing, an appropriately trained safety driver (trained test driver level and above, as defined in Supplement 6 - Test Driver Training Summary) will always operate the vehicle based on the operating conditions.

The Optimus Ride Automated Driving System (ADS) enables the vehicle to operate in an autonomous mode where brake, throttle and steering commands are controlled via a networked system of computers instead of a human driver. The ADS system requires supervision from a human safety driver to take control of the vehicle in situations where a component of the system fails or the autonomous system is not capable of responding to the driving situation in an acceptable manner. The autonomous control of the vehicle can be overridden by the Trained Test Driver by several mechanisms:

1. **Application of the brake pedal** - The brakes can be used to disable the autonomous control of the brake, throttle, and steering. When the brake pedal is depressed during Computer Control mode, it will cause the Vehicle Control Board (VCB) to disengage the emulation of the transmitted steering, throttle, and brake commands and will also apply the mechanical brakes of the vehicle.

2. **Emergency stop (E-Stop enable)** - The E-Stop system is intended to be used by the Test Driver when override controls are non-responsive or for any autonomous system failure where the safe operation of the vehicle cannot be maintained. The E-stop will send a message to engage the brake as well as disregard the control message from the throttle pedal. It will also remove all emulated inputs from the VCB and only allow the pass-through vehicle circuits to operate nominally. The E-stop button is operated by pressing down (contacts open) and can be return to its nominal condition (contacts closed) by twisting. The E-stop switch is located on the control panel in the center console.
3. **Application of the manual parking brake -** The manual parking brake can be used to apply the brakes and bring the vehicle to a complete stop. The test driver can then disable the autonomous system to remove any influence from the computer control signals.

Optimus Ride has performed a preliminary Hazards Analysis & Risk Assessment (HARA) to comply with ISO26262-3. As is best practice, we will perform additional assessments as our system matures to ensure compliance. Based on the hazards and the assumptions, a set of functional safety requirements were derived in order to comply with ISO 26262, including a subset of functional safety requirements that specifically pertain to the safe operation of the vehicle in the testing and pilot phases.

For the proposed pilot routes, the object detection and classification shall be verified through repeated testing (both indoor and outdoor) to understand where the system limits are in detecting each type of object.

Optimus Ride follows the state-of-the-art in the industry with respect to test-driven development practices, static code analysis, and bug reporting, tracking, and analysis.

Vehicle Cybersecurity

The Optimus Ride system is designed to utilize bi-directional SSL for authentication, complete with data encryption. Our state-of-the-art data logistics allow high security and access control over a secure protocol, which is consistent with best industry practices for cyber security. Our sensors have not been modified so all cyber security features inherent in those systems has persisted into our system.

Human Machine Interface

As described in the safety assessment, all of our autonomous testing will have an appropriately trained safety driver (trained test driver level and above, as defined in Supplement 6 - Test Driver Training Summary) operating the vehicle based on the operating conditions. For the phases defined as “pre-pilot”, “phase 1”, and “phase 2” in

Supplement 3 - Initial Driving Plan, an additional trained safety driver will be present to actively monitor the autonomous system while the vehicle operator will actively monitor the vehicle and environment. Our driver takeover methods have been designed to comply with industry best practices in order to ensure the HMI is clear, consistent, gives context, and provides real feedback for test driver actions.

Crashworthiness

Optimus Ride has chosen the Polaris GEM models e4 and e6 as our manufacturer models for our autonomous vehicles. These vehicles meet all US federal safety standards for low-speed vehicles (LSVs) including NHTSA FMVSS 500. Optimus Ride has retrofitted our vehicles to accompany our autonomous technology. The major vehicle changes we have made are a redesign of the OEM braking system, the steering motor, and the pedal sensor wiring. These changes enable us to actuate the vehicle using our own commands rather than the actuation of the pedals and the steering wheel. After finishing these changes, our vehicles undergo a standard, documented electromechanical testing in-house to verify that each vehicle continues to meet all US federal safety standards for LSVs including NHTSA FMVSS 500. We have also made additions to the vehicles as part of our retrofit such as wheel encoders and computing hardware. These additions do not interfere with any safety critical functions on the vehicles nor do they alter the vehicle frames or any other item related to crashworthiness.

Consumer Education and Training

Optimus Ride has done a substantial amount of work to understand and integrate potential users' experience into our vehicle and pilot service. This has taken form in several different ways, namely through focus groups in Key Biscayne, FL and Perkins School for the Blind located in Watertown, MA. In Key Biscayne, FL, we had potential users participate in a human-machine interface demonstration and subsequent surveys.

At Perkins School for the Blind, we held an exhibit of our vehicle as well as a detailed exhibit of our hardware and system architecture. Optimus Ride presented the system to users at Perkins, teaching them how the system functioned and performed. The users actively participated in a question and answers session to ensure a complete understanding of the system. Subsequently, users participated in a demonstration of the system by riding as passengers while the vehicle operated autonomously. This demonstration also included an interactive study of user interaction around our human-machine interface to specifically address the needs of this underserved community. Finally, the users at Perkins School for the Blind participated in focus groups to discuss potential improvements to the system which were then taken into consideration during subsequent system design iterations.

The Optimus Ride proposed pilot program seeks to educate consumers in the Boston area about autonomous vehicles while simultaneously learn from the user experiences of our passengers. After our initial pilot, Optimus Ride will contribute to efforts towards designing consumer education and training material in order to further our mission of equitable mobility solutions.

Registration and Certification

The registration and certification for Optimus Rides' vehicles are included in Supplement 4 below. Optimus Ride is eager to cooperate with any official regulatory bodies regarding any additional certifications in the future.

Post-Crash Behavior

As part of our driver training materials, Optimus Ride specifically educates test drivers on how to handle crash situations, which is outlined below:

1. **Assess any possible injuries**. For basic injuries including, but not limited to, bruises and superficial cuts, apply first aid. For moderate to severe injuries, immediately request an ambulance when speaking to the 9-1-1 operator.
2. **Call 9-1-1.** The test driver *must* call 9-1-1, even if there are no apparent injuries, to allow the police to investigate the accident
3. **Exchange appropriate information**. In accordance with MA Motor Vehicle Law, the test driver shall exchange the appropriate information with paramedics, police, and persons involved in the crash in order to complete the Crash Operator Report Form
4. **Secure crash data**. Test drivers are instructed to specifically tag and preserve all data related to the crash so that the data can be easily retrieved upon request.

Every trained test driver is educated and tested on this process and how to implement it. Each Optimus Ride vehicle is equipped with a document describing these instructions in greater detail. These documents and training supply our employees with the knowledge on how to report an accident to the authorities in accordance with the MOU and MA Motor Vehicle law.

Federal, State, and Local Laws

The Optimus Ride system will be trained to make the correct behavioral decisions to any in-road situation and will act according to the MassDOT Driving Manual. Our autonomous system is designed to follow all traffic laws including federal, state, and local laws. Optimus Ride test drivers are educated on how to correctly respond to emergency situations when operating a vehicle equipped with an activated Autonomous Driving System (ADS). Test drivers can recognize when the ADS and/or vehicle is not functioning properly so that they compensate and report as needed. Test drivers know

how to take over the steering, braking, and acceleration of the vehicle when necessary, and how to handle the vehicle appropriately when operating in degraded modes. Our test drivers are specifically instructed to take control of the vehicle in order to avoid a violation of any traffic laws. Our system is designed to prioritize safety over compliance but to violate the traffic laws as minimally as possible to avoid the safety risk.

Ethical Considerations

The mission of Optimus Ride is *to develop self-driving technologies that enable safe, sustainable, and equitable mobility solutions*. Our goal is that self-driving technologies will lead to a decrease in the frequency of traffic collisions and, ultimately, fatalities caused by traffic-related incidents. In order to reasonably attain this goal, autonomous vehicles must use their skills in optimized path planning, improved perception, reduced latency, and robust performance to ultimately execute driving tasks more safely than human drivers. The Optimus Ride system strives to intelligently avoid situations in which safety risks create ethical dilemmas.

The Optimus Ride system is designed to prevent any collision or maneuver that would risk human injury or fatality. Our system does not discriminate humans along any dimension nor does it assess the number of people in a vehicle before executing driving commands. Optimus Ride is eager to research and collaborate with others to solve the ethical issues surrounding autonomous technologies.

Operational Design Domain

The detailed description of our Operational Design Domain (ODD) can also be found in our initial driving plan, Supplement 3.

The roads designated for our testing and ultimately for our pilot program are all urban roads in the Seaport District of Boston, MA. Our vehicles are low-speed vehicles, as defined by NHTSA in FMVSS 500, and, therefore, will only operate from 0-25 MPH. We seek to conduct our driving under fair weather conditions throughout the daytime hours. We will most likely encounter a few days of driving through light rain but will not perform any outdoor testing during moderate to heavy rain periods, defined as a rate of precipitation greater than 2.5mm/hour. We will not drive in any inclement weather including snow or fog.

Although we are proposing to drive on urban, public roads, there are no signalized intersections in our testing region but, instead, only posted signage. As such, our first phase of testing will seek to test primarily on roads with stop signs, crosswalks, lane markings, and any other standard road signage. Our vehicles are designed to handle roads with potholes, faded markings, and signage with visible wear. As a portion of the

roads in the proposed testing region exhibit some of these characteristics, we will focus a large amount of our initial data collection and preliminary testing on those areas. Given our restricted driving area, we will not encounter roads with significant grading.

The general assumptions for our testing and pilot program are based on the fact that our vehicles will only operate within the driving limits as defined in Supplement 3 - Initial Driving Plan. The Optimus Ride system will be shown to operate in all driving scenarios within our Operational Design Domain (ODD) The safety requirements that have been determined through our safety assessment process will be maintained during operation to ensure the correct response can be provided by the safety driver. The operation of the Optimus Ride vehicles are only considered valid under the assumptions described and within the constraints of the pilot driving plan. Any changes in the pilot driving plan would need to be re-validated to assess the system's ability to maintain safe operation.

Object and Event Detection and Response (OEDR)

The Optimus Ride vehicles are designed to handle all objects and obstacles commonly found on public driving roads. This includes but is not limited to pedestrians, motorists, and bikers. Our system will be trained to make the correct behavioral decisions to any in-road situation and will act according to the MassDOT Driving Manual. In the event of unusual or unforeseen circumstances that create obstacles to safe operation, the Optimus Ride system will assess the condition and plan a safe path around the obstacle. If unable to successfully plan a safe path, the Optimus Ride system will safely stop and the test driver will take over control of the vehicle. For the proposed pilot routes, the object detection and classification shall be verified through repeated testing (both indoor and outdoor) of each driving scenario to understand where the system and sensor limits are in detecting each type of object.

Fall Back (Minimal Risk Condition)

The Optimus Ride system requires supervision from a human safety driver to take control of the vehicle in situations where a component of the system fails or the autonomous system is not capable of responding to the driving situation in an acceptable manner. For all of our autonomous testing, an appropriately trained safety driver (trained test driver level and above, as defined in Supplement 6 - Test Driver Training Summary) will always operate the vehicle based on the operating conditions. The autonomous control of the vehicle can be overridden by the Trained Test Driver by several different mechanisms in any fall back situation. The test driver can take over at any point in vehicle operation, no matter what functions or maneuvers the autonomous system is executing. For the phases defined as "pre-pilot", "phase 1", and "phase 2" in Supplement 3 - Initial Driving Plan, an additional trained safety driver will be present to

actively monitor the autonomous system while the vehicle operator will actively monitor the vehicle and environment.

Optimus Ride is eagerly researching and developing supplemental, remote fall back systems that do not rely on in-vehicle manual takeovers.

Validation

Optimus Ride is committed to creating safe autonomous technologies, first and foremost. Our company safety culture has been clearly defined and promoted. The Optimus Ride validation process is designed with regards to industry best practices and relevant vehicle safety and validation standards. The components of our safety life cycle are outlined below:

1. **Hazard Analysis & Risk Assessment (HARA)** - In accordance with ISO26262-3, we perform a thorough HARA related to all of our testing and pilot areas.

2. **Functional Safety** - In accordance with ISO26262, we define the functional safety management process for our vehicles and associated hardware. This includes developing a set of functional safety requirements that enable the safety life cycle for the development of our system.

3. **Simulation Testing** - Optimus Ride believes that autonomous technologies cannot be fully realized through in-vehicle testing alone. As such, we have integrated a highly sophisticated simulation platform to conduct complex testing virtually, based both on in-vehicle tests and variations of real data. Our simulations capabilities are high-fidelity in terms of vehicle dynamics, sensor models, and traffic patterns.

4. **Indoor Testing** - Optimus Ride has the capabilities to perform tests on our custom indoor test track. This track allows us to test and validate hardware and software subsystems as well as test driving scenarios and various variations safely without any possible danger to the public.

5. **Outdoor Testing** - Once our system has been thoroughly tested using the methods listed above, our safety engineers perform a final assessment of our vehicle for public road use before approving outdoor testing. When performing outdoor tests, Optimus Ride is highly aware and concerned for public safety. All our drivers and vehicle systems prioritize safety above all else and strive to avoid all potential safety risks.

In order to validate our system for the proposed pilot program, we will rely on a detailed recording of system performance and statistical and proven-in-use arguments as well as collaboration with MassDOT, City of Boston, and Massport. Optimus Ride is eager to work closely with these agencies to ensure our system is ready for a public road pilot program.

Supplement # 3: Initial Driving Plan

The Applicant must define the specific geographical areas and roads on which testing will occur, and the Operational Design Domain(s) in which the testing will occur, including but not limited to roadway types and environmental conditions.

Please find Optimus Ride's Test Plan with the City of Boston attached as Part III of our Application.

Supplement # 4: Motor Vehicles in HAV Testing Program

Attach a photocopy of the vehicle registration form for each vehicle to be used in the HAV testing program. If the Title number for the motor vehicle is not displayed on the registration itself, please provide a photocopy of the Title.

Each vehicle used for testing should follow the Performance Guidance set forth by NHTSA and meet applicable Federal Motor Vehicle Safety Standards, or provide a waiver or exemption from NHTSA, unless otherwise approved by MassDOT.

Optimus Ride is currently in the process of obtaining registrations for our vehicles and will forward them to the City of Boston as soon as they are available.

Optimus Ride has chosen the Polaris GEM models e4 and e6 as our manufacturer models for our autonomous vehicles. These vehicles meet all US federal safety standards for low-speed vehicles (LSVs) including NHTSA FMVSS 500. Optimus Ride has retrofitted our vehicles to accompany our autonomous technology. The major vehicle changes we have made are a redesign of the OEM braking system, the steering motor, and the pedal sensor wiring. These changes enable us to actuate the vehicle using our own commands rather than the actuation of the pedals and the steering wheel. After finishing these changes, our vehicles undergo a standard, documented electromechanical testing in-house to verify that each vehicle continues to meet all US federal safety standards for LSVs including NHTSA FMVSS 500. We have also made additions to the vehicles as part of our retrofit such as wheel encoders and computing hardware. These additions do not interfere with any safety critical functions on the vehicles nor do they alter the vehicle frames or any other item related to crashworthiness.

Supplement # 5: Drivers in Testing Program

Attach a photocopy of the current driver's license of each person who has been designated to operate an AV in Massachusetts by the Applicant.

The Applicant shall ensure that while the AVs are operated without human piloting, drivers trained and experienced in the operation and control of AVs who possess a valid driver's license and have clean driving records must be seated and secured in the driver seats of such AVs and available and able to take command of the AVs as needed.

Each operator of a vehicle used in an AV test on a public way or a way to which the public has a right of access as invitees shall be at least 21 years of age, possess a valid driver's license and have driving records free of any pending cases or convictions for operation of a motor vehicle while under the influence of alcohol or drugs, which shall include any cases that were disposed of under Chapter 90, Section 24D or equivalent if the offense occurred in another jurisdiction.

If the Applicant uses a driver licensed in another state, it shall provide a copy of the license and a certified copy of the driving record (no more than 30 days old) of the driver.

Please find a set of photocopies of the driver's licenses of the individuals who will be operating Optimus Ride's vehicles, attached as Part V of our Application.

Some of our drivers are licensed in other states and countries. We are currently in the process of obtaining certified copies of their driving records and will forward them to the City of Boston as soon as they are available.

Supplement # 6: Summary of Training

Attach a summary of the types of training provided to employees, contractors and/or other persons designated by the Applicant as operators of the AV test vehicles.

Driver training is a primary component of a safe testing program because it prepares the test driver for both complex and routine situations likely to be experienced during test-driving. At Optimus Ride, we believe training ensures that a test driver will know the best actions to take in any situation to minimize risk. We believe our test driver training reflects this idea and specifically addresses safety as the top priority.

We divide our test drivers into three main groups:

EXPERT TEST DRIVERS
ROLE: FULL-TIME ENGINEERS AND/OR DESIGNERS
BACKGROUND: ENGINEERING DEGREE

- Technical experts in HAV and underlying autonomous system
- Install and test experimental software and/or hardware interfaces
- Design and develop test plans and procedures for system and subsystem testing
- Prepare information for trained test drivers to safely operate HAV under all applicable conditions

TRAINED TEST DRIVERS
ROLE: HOURLY CONTRACTOR
BACKGROUND: HIGH SCHOOL DEGREE/NON-TECHNICAL COLLEGE DEGREE

- Informed about HAV and autonomous system at high-level
- Not specifically qualified to test experimental software and/or hardware interfaces
- Execute test plans and procedures prepared by expert test drivers
- Provide high-level observations to expert test drivers for further development

NOVICE TEST DRIVERS
ROLE: HOURLY CONTRACTOR
BACKGROUND: HIGH SCHOOL DEGREE/NON-TECHNICAL COLLEGE DEGREE

- Little to no experience with HAV and autonomous systems
- Not qualified to operate HAV without close supervision by expert test drivers equipped with emergency stop/takeover system
- Observe test drives and gradually learn how to operate vehicle safely, systematically, and smoothly

Expert Test Drivers - Expert drivers are specifically skilled and trained personnel who are able to activate, monitor, and de-activate the highly automated vehicle (HAV) and underlying Automated Driving System (ADS) using experimental software and/or hardware interfaces. Expert drivers are trained to respond correctly to emergency situations due to ADS and/or vehicle failures. Expert test drivers are typically engineers and/or designers of the self-driving car under test.

Trained Test Drivers - Trained test drivers are informed about the ADS but are not specifically qualified to activate, monitor, and de-activate it using experimental software and/or hardware interfaces. Trained drivers are able to respond correctly to emergency situations due to ADS and/or vehicle malfunctions or failures by exercising a dedicated system override that restores the vehicle to non-automated operation.

Novice Test Drivers - Novice test drivers are not fully informed about the ADS, nor trained in its use before training. These test drivers do not operate the HAV at first but accompany expert and trained test drivers on test drives to learn through observation. These drivers gradually begin operating the HAV but are always accompanied during a test drive by an expert test driver in the front passenger seat equipped with a fully validated remote control driving system and/or a fully validated emergency stop; the expert test driver would be responsible for maintaining safe operation of the test vehicle at all times that a novice test driver occupies the driver's seat.

The Optimus Ride Test Driver Training trains test drivers to be very familiar with the HAV under test and, in order to react correctly to various situations, test drivers are trained on any applicable malfunction warning systems, software, hardware, and how the vehicle and underlying ADS perform under normal conditions. We have the following program sequence for training novice drivers:

We first introduce our novice drivers to the system through informational briefings. We give our drivers a high-level view of the system and subsystems as well as major interactions that occur across subsystems. We train drivers with the end goal that our drivers will be able to do basic software tasks to quickly adjust and improve the on-board software and hardware performance without the direct assistance of the engineering team. This empowers our drivers to be able to not only have a deep understanding of how to operate the vehicle but also how to react to any possible situation that could arise. We want all of our drivers to be competent in our system at a high-level because we believe that a thorough understanding of the system will benefit both the test efforts as well as the engineering development efforts.

After classroom training, the next phase of training is centered around observation of test drives on our vehicles. We begin this phase by allowing our novice test drivers to accompany expert test drivers on different test drives. Through observation, we believe that the novice drivers can learn about the nominal driving conditions. Once the expert drivers have certified that the novice driver under training can move on in their training, the novice test drivers advance to operating the vehicle in controlled environments, primarily in our indoor test facility. In this controlled environment, we can clearly validate our test driver's abilities and give them hands-on experience with the ADS.

Our final phase of training is hands-on real-world training. This training prepares the test drivers for operating the vehicles under a variety of on-road scenarios. Such hands-on training introduces our drivers to routine maneuvers, road environments, and general operating conditions. We then gradually introduce progressively more difficult test procedures, such as emergency maneuvers, as test drivers become more experienced.

All drivers are trained to maneuver the general position and speed of the vehicle safely, systematically and smoothly, using road and traffic conditions to progress unobtrusively and skillfully through on-road traffic under a wide range of road and weather conditions. In addition to these routine skills, test drivers benefit from a high level of driving competence based on concentration, effective all-round observation, anticipation, and planning, as well as excellent vehicle handling skills. Furthermore, all trained test drivers are qualified to activate and deactivate the HAV and, specifically the ADS, in order to do their job.

The Optimus Ride Test Driver Training includes any "rules of engagement" generally expected of all test drivers. These rules may include, but are not limited to, whether or when another vehicle may be passed during an on-road test drive, prohibitions on excessive speeding, maximum number of consecutive hours a test driver may operate a test vehicle, and restrictions on use of portable electronic devices.

Optimus Ride test drivers are educated on how to correctly respond to emergency situations when operating a vehicle equipped with an activated Autonomous Driving System (ADS). Test drivers can recognize when the ADS and/or vehicle is not functioning properly so that they compensate and report as needed. The test driver knows the limitations of the ADS and the vehicle so they do not inadvertently exceed those limits. Test drivers know how to take over the steering, braking, and acceleration of the vehicle when necessary, and how to handle the vehicle appropriately when operating in degraded modes.

Our expert-level drivers prepare the necessary information that trained test drivers will require in order to safely operate the HAV under applicable on-road test conditions. This information includes relevant instructions regarding the nominal, compromised, and emergency operation of the vehicle during the ADS activation, as well as instruction for managing emergency situations that pertain to all motor vehicles, such as a brake or power steering system failure. Situations covered by instruction include, but are not limited to, parking, high/low volume traffic, merging, following distance, turning and stopping. Trained test drivers are informed in advance of any updates to the ADS that will or may affect HAV performance.

Finally, our test drivers are given specific instructions on when and how to report various HAV behaviors of interest. Test drivers are provided with means that are compatible with the test driving environment which may include reporting incidents after the test drive.

Supplement # 7: Insurance Requirement

Attach a copy of the policy of insurance or a surety bond in the amount of a minimum of $5,000,000 issued by a company licensed to do business by the Commissioner of Insurance of the Commonwealth of Massachusetts. The policy or bond shall be for the purpose of satisfying any judgment or judgments for damages for personal injury, death or property damage caused by a vehicle being tested in the Commonwealth.

Please find a copy of our insurance policies attached as Part VII of our application.

MASSDOT DRIVING PLAN

May 11th, 2017

OPTIMUS RIDE

Contents

CONTACT INFORMATION

Ryan Chin
Co-Founder & CEO
[redacted]

Jenny Larios Berlin
Co-Founder & COO
[redacted]

The Purpose of Boston's Autonomous Vehicle Testing Program

The City of Boston's autonomous vehicles testing program is rooted in the transportation priorities of our constituents.

In the public engagement for our long term transportation plan, GoBoston2030, our constituents voiced a clear call for a transportation network that is safer for all modes, that is more accessible for all neighborhoods, and that is more reliable for all trips. They also voiced a desire to cut carbon emissions and free up more of our streets for pedestrians and cyclists.

We believe that autonomous vehicles have the remarkable potential to help achieve all of these goals, if they are electric, if they are shared, and if they integrate well with pedestrians, cyclists and mass transit. We believe, however, that that future is not a given and may not be realized in our nation's urban areas where our streets are most complex.

Our testing program, consequently, is established with those outcomes in mind.

We want to support the technical testing of autonomous vehicles in Boston so that autonomous vehicles can bring greater transportation safety, accessibility and reliability to our constituents. And, we want to support the development of uses of AVs that, in particular, cut emissions, free up streets for alternative uses, and extend access to areas of our city least well served by transit today.

With those goals in mind, the three requirements of our testing program are outlined below.

Requirement #1: Phased Roll Out

For the safety and understanding of both partner companies and other road users, testing on Boston streets takes a phased approach. As you gain experience on our streets, you gain flexibility in the time, place and manner you can conducting testing.

During all training phases, all partners must conduct testing in accordance with all state and local traffic laws, including abiding by all rules of the road, speed limits, and traffic signs and signals.

Optimus Ride Driving Plan

Optimus Ride is proposing to test drive in a sequenced, staged manner in order to ensure that its system can execute all driving tasks in different environments and conditions safely, systematically, and smoothly. The following driving plan prepares both its drivers and vehicles for all situations it will ultimately operate in after testing. The proposed process allows for the assessment, testing, and validation of a variety of perceptual and behavioral competencies that are applicable for the highly automated vehicle (HAV). To proceed from one letter phase to the next, Optimus Ride must submit written documentation of their testing milestones to the City of Boston and request approval for entering the next testing phase.

In addition to thorough virtual testing using our simulation capabilities, below is the proposed series of in-vehicle live testing phases (outlined in full detail on the next page):

- PHASE A1 : Off-Road Vehicle Testing
- PHASE A2 : Public Road Data Collection
- PHASE B : Public Road Autonomous Testing
- PHASE C : Public Road Autonomous Demo

PHASE A1

OFF-ROAD VEHICLE TESTING

Objective – Manual off-road driving with data collection by test drivers and engineers, basic autonomous driving functionality in indoor test track and outdoor private lot

Milestones – Electrical and mechanical parts pass all safety standards, basic autonomous functionality validated including lane following, emergency takeover methods, and obstacle detection and avoidance in reconfigurable indoor urban test track

PHASE A2

PUBLIC ROAD DATA COLLECTION

Objective – Manual outdoor driving with data collection by test drivers and engineers

Milestones
- 100 miles of data collection, preliminary focus on mapping with subsequent focus on obstacle and situational awareness data
  - Collect 25 miles (out of 100 total miles) in light rain and/or nighttime conditions
- Additional 25 miles of autonomous driving in light rain and/or nighttime conditions in outdoor private lot

PHASE B

PUBLIC ROAD AUTONOMOUS TESTING

Objective – Outdoor autonomous vehicle testing on approved roads

Milestones
- 100 miles of autonomous driving with a focus on situational awareness and ride comfort
  - 25 miles of autonomous driving (out of 100 total miles) will be done in light rain conditions
  - Neither light-rain nor nighttime conditions will be part of the outdoor autonomous demo (Phase C). We will be strictly driving manually in those conditions.

PROPOSED PHASE C

PUBLIC ROAD AUTONOMOUS DEMO

[PENDING AN UPDATED APPLICATION TO MASSDOT AND THE CITY OF BOSTON]

Objective – Demonstrate basic autonomy while providing transportation services

Milestones
- Provide a comfortable in-vehicle experience, educate users on autonomous driving, and gather feedback
- This testing phase to be approved by MassDOT and the City of Boston*

** Upon completion of phase B, Optimus Ride may apply to advance to the next training phase by submitting complete documentation to the City of Boston and MassDOT confirming the safe, successful completion of the preceding testing phase(s). The City of Boston and MassDOT will review the documentation provided and issue a written determination as to whether Optimus Ride may advance to the next testing phase.*

Testing Program

Before proceeding to drive autonomously on public roads, all autonomous functionality will be validated outdoors in the Optimus Ride private lot located in the Marine Park, which closely mimics the road conditions we expect to drive on the public way. Aside from these validation tests, we will primarily focus our outdoor autonomous testing on the roads listed below. By doing this, we will have customized our testing, allowing our system to fully and completely understand the driving environment, hazards, and all possible exterior objects and obstacles. The proposed testing roads, in the Raymond L. Flynn Marine Park, include the following streets:

- 6th Street
- Ballard Way
- Black Falcon Ave
- Channel Street
- Design Center Pl
- Drydock Ave
- Fid Kennedy Ave
- Harbor Street
- Northern Ave
- Seafood Way
- Silver Line Way
- Tide St

There are challenges that are somewhat unique to the Marine Park roads themselves. The first challenge is the SL2 bus that runs on these roads every day. These larger, articulated buses with a unique geometry, will require additional data collection and system training to correctly and safely address. The next challenge is the intersection of Tide St and Drydock Ave, which is a large three-way intersection with some visibility issues. Similar to the first challenge stated, we will focus our data collection period on this intersection to ensure safety and reliability. As several roads converge on this intersection, we will build up a large database focused specifically on this intersection from various viewpoints. Another challenge is traversing the roads in low-light conditions. Though this is not a challenge unique to the Marine Park, we are prepared to address any issues that may arise as a result of poor lighting conditions. Another notable challenge is the portion of Black Falcon Ave that runs between the Innovation and Design Building and the Cruise Terminal, which has areas with less accurate GPS signal than anywhere else in the Marine Park. We have already begun addressing this problem by collecting the appropriate data and deriving solutions for future implementation.

Requirement #2: Sharing Key Data Publicly

The intent of the data sharing, at this stage, is to ensure public transparency of the results of the testing that is occurring. The following data must be shared with the City:

Crash Reports:

The City of Boston must be notified of any crash, no matter the severity. In addition, within 24 hours, the partner must submit a crash report detailing any crash that occurs with the autonomous test vehicle, regardless of the reason for the crash. A more detailed analysis of the crash and any corrective measures taken will be detailed in a future report delivered within a reasonable time period.

Progress Reports (to be updated once a quarter, at a minimum):

These reports detail the use of the autonomous vehicle including, by vehicle:

- Miles driven
- Locations driven
- Conditions driven in
- Crash reports
- Failures with autonomous mode
- Disruptions while driving in autonomous mode
- Narrative description of research achievements

In a narrative section, a description of the conditions relating to unintended transitions from autonomous to safety driver-operated. Reports are submitted to all signatories on the MOU.

Requirement #3: Sharing Research Accomplishments

We have a research agenda. We want to learn:

- What infrastructure do we need on our streets?
- What policies do we need at the City and State level?
- What data should we collect and what structures do we need for governance?
- What partnerships do we need to enable with other transit providers?

We also want to know and share your agenda. We believe that this will accelerate a common understanding of the state of autonomous vehicles and build energy around solving some of the hardest challenges. To support this objective, you agree to participate in a minimum of two community events or collaborative activities, where you will demonstrate your technology and answer questions.

As you solve challenges, we want to help you share those accomplishments with a broader audience. This would include posting links to your research on the City's website and distributing information on it to partner cities.

As part of this testing plan, Optimus Ride will agree to collaborate with the City of Boston on at least three public events over the course of the MOU term to share their work with a broader audience in Boston and foster better understanding of the technology being developed.

Updating Testing Requirements

These requirements may change as the testing program evolves and as the City evaluates data generated by the program. The City reserves the right to periodically update and supplement these requirements in its sole discretion.

OPTIRIDE

ACORD™ INSURANCE BINDER

DATE 02/24/17

THIS BINDER IS A TEMPORARY INSURANCE CONTRACT, SUBJECT TO THE CONDITIONS SHOWN ON THE REVERSE SIDE OF THIS FORM.

PRODUCER	PHONE (A/C, No, Ext): 516-327-2700 FAX (A/C, No): 516-327-2800
NFP P&C Services, Inc 45 Executive Drive Plainview, NY 11803	
CODE:	SUB CODE:
AGENCY CUSTOMER ID: 17425	
INSURED: Optimus Ride Inc 88 Black Falcon Ave., Ste. 188 Boston, MA 02210	

COMPANY: Liberty Insurance Corporation				BINDER #: [redacted]			
EFFECTIVE DATE	EFFECTIVE TIME			EXPIRATION DATE	EXPIRATION TIME		
02/23/17	12:01	X	AM	02/23/18	X	12:01 AM	
			PM			NOON	

☐ THIS BINDER IS ISSUED TO EXTEND COVERAGE IN THE ABOVE NAMED COMPANY PER EXPIRING POLICY #:

DESCRIPTION OF OPERATIONS/VEHICLES/PROPERTY (Including Location)

Veh#1: 2016 Polaris GEM E6 Private Passenger [redacted] MA
Veh#2: 2017 Polaris GEM E4 Private Passenger [redacted] MA
(See Special Conditions Below)

COVERAGES

TYPE OF INSURANCE	COVERAGE/FORMS	LIMITS: DEDUCTIBLE	COINS %	AMOUNT
PROPERTY — CAUSES OF LOSS: ☐ BASIC ☐ BROAD ☐ SPEC				
GENERAL LIABILITY — ☐ COMMERCIAL GENERAL LIABILITY; ☐ CLAIMS MADE ☐ OCCUR	RETRO DATE FOR CLAIMS MADE:	EACH OCCURRENCE		$
		DAMAGE TO RENTED PREMISES		$
		MED EXP (Any one person)		$
		PERSONAL & ADV INJURY		$
		GENERAL AGGREGATE		$
		PRODUCTS - COMP/OP AGG		$
AUTOMOBILE LIABILITY — ☐ ANY AUTO; ☐ ALL OWNED AUTOS; X SCHEDULED AUTOS; X HIRED AUTOS; X NON-OWNED AUTOS	Underinsured: 1,000,000	COMBINED SINGLE LIMIT		$ 1,000,000
		BODILY INJURY (Per person)		$
		BODILY INJURY (Per accident)		$
		PROPERTY DAMAGE		$
		MEDICAL PAYMENTS		$ 10,000
		PERSONAL INJURY PROT		$
		UNINSURED MOTORIST		$ 1,000,000
				$
AUTO PHYSICAL DAMAGE — DEDUCTIBLE: ☐ ALL VEHICLES X SCHEDULED VEHICLES X COLLISION: 500 X OTHER THAN COL: 500		X ACTUAL CASH VALUE ☐ STATED AMOUNT ☐ OTHER		$
GARAGE LIABILITY — ☐ ANY AUTO		AUTO ONLY - EA ACCIDENT		$
		OTHER THAN AUTO ONLY: EACH ACCIDENT		$
		AGGREGATE		$
EXCESS LIABILITY — ☐ UMBRELLA FORM; ☐ OTHER THAN UMBRELLA FORM	RETRO DATE FOR CLAIMS MADE:	EACH OCCURRENCE		$
		AGGREGATE		$
		SELF-INSURED RETENTION		$
WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY		☐ WC STATUTORY LIMITS		
		E.L. EACH ACCIDENT		$
		E.L. DISEASE - EA EMPLOYEE		$
		E.L. DISEASE - POLICY LIMIT		$
SPECIAL CONDITIONS/ OTHER COVERAGES: (See attached Spec Conditions/Other Covs page.)		FEES		$
		TAXES		$
		ESTIMATED TOTAL PREMIUM		$

NAME & ADDRESS

☐ MORTGAGEE ☐ ADDITIONAL INSURED
☐ LOSS PAYEE

LOAN #

AUTHORIZED REPRESENTATIVE: Stuart B. Wallace

CONDITIONS

This Company binds the kind(s) of insurance stipulated on the reverse side. The Insurance is subject to the terms, conditions and limitations of the policy(ies) in current use by the Company.

This binder may be cancelled by the Insured by surrender of this binder or by written notice to the Company stating when cancellation will be effective. This binder may be cancelled by the Company by notice to the Insured in accordance with the policy conditions. This binder is cancelled when replaced by a policy. If this binder is not replaced by a policy, the Company is entitled to charge a premium for the binder according to the Rules and Rates in use by the Company.

Applicable in California

When this form is used to provide insurance in the amount of one million dollars ($1,000,000) or more, the title of the form is changed from "Insurance Binder" to "Cover Note".

Applicable in Delaware

The mortgagee or Obligee of any mortgage or other instrument given for the purpose of creating a lien on real property shall accept as evidence of insurance a written binder issued by an authorized insurer or its agent if the binder includes or is accompanied by: the name and address of the borrower; the name and address of the lender as loss payee; a description of the insured real property; a provision that the binder may not be canceled within the term of the binder unless the lender and the insured borrower receive written notice of the cancellation at least ten (10) days prior to the cancellation; except in the case of a renewal of a policy subsequent to the closing of the loan, a paid receipt of the full amount of the applicable premium, and the amount of insurance coverage.

Chapter 21 Title 25 Paragraph 2119

Applicable in Florida

Except for Auto Insurance coverage, no notice of cancellation or nonrenewal of a binder is required unless the duration of the binder exceeds 60 days. For auto insurance, the insurer must give 5 days prior notice, unless the binder is replaced by a policy or another binder in the same company.

Applicable in Nevada

Any person who refuses to accept a binder which provides coverage of less than $1,000,000.00 when proof is required: (A) Shall be fined not more than $500.00, and (B) is liable to the party presenting the binder as proof of insurance for actual damages sustained therefrom.

SPECIAL CONDITIONS/OTHER COVERAGES (Cont. from page 1)

Named Insured: Optimus Ride Inc

Loc#1: Garage Location, Boston, MA 02210

Endorsements / Exclusions:

Business Auto Declarations
Temporary Substitute Auto Physical Damage Insurance
Exclusion of Terrorism Involving Nuclear, Biological or Chemical Terrorism
Exclusion of Terrorism Involving Nuclear, Biological or Chemical Terrorism
above Minimum Statutory Limits
Common Policy Conditions
Nuclear Energy Liability Exclusion Endorsement Broad Form
Massachusetts Mandatory Endorsement

BINDER

INSURED
Optimus Ride Inc 88 Black Falcon Ave., Ste. 188 Boston, MA 02210

DATE
February 24, 2017

POLICY/BINDER #	[redacted]

CLIENT CODE	OPTIRIDE

CARRIER North American Specialty Insurance Co. (Swiss Re)

POLICY TERM 02/23/2017 to 02/23/2018

NAMED INSURED

Optimus Ride Inc

COMMERCIAL EXCESS LIABILITY

COVERAGE	LIMITS
Each Occurrence	$4,000,000
Policy Aggregate	$4,000,000

EXTENSIONS AND EXCLUSIONS

Follow Form Excess Liability
Employments Practices Exclusion
Asbestos Exclusion
Nuclear Energy Liab Exclusion
War Exclusion
Economic or Trade Sanctions Condition Endorsement

SCHEDULE OF UNDERLYING POLICIES

AUTOMOBILE LIABILITY

COMPANY	POLICY #	EFF DATE	EXP DATE
Liberty Insurance Corp.	[redacted]	02/23/2017	02/23/2018

COMBINED SINGLE LIMIT
$1,000,000

PREPARED BY: Peter A. Colaianni

AUTHORIZED REPRESENTATIVE: _____

NFP

BINDER

INSURED
Optimus Ride Inc 88 Black Falcon Ave., Ste. 188 Boston, MA 02210

DATE
February 24, 2017

POLICY/BINDER #	[redacted]

CLIENT CODE	OPTIRIDE

CONDITIONS

This Company binds the kind(s) of insurance stipulated on the previous pages. The Insurance is subject to the terms, conditions and limitations of the policy(ies) in current use by the Company.

This binder may be cancelled by the Insured by surrender of this binder or by written notice to the Company stating when cancellation will be effective. This binder may be cancelled by the Company by notice to the Insured in accordance with the policy conditions. This binder is cancelled when replaced by a policy. If this binder is not replaced by a policy, the Company is entitled to charge a premium for the binder according to the Rules and Rates in use by the Company.

Applicable in California

When this form is used to provide insurance in the amount of one million dollars ($1,000,000) or more, the title of the form is changed from “Insurance Binder” to “Cover Note”.

Applicable in Delaware

The mortgagee or Obligee of any mortgage or other instrument given for the purpose of creating a lien on real property shall accept as evidence of insurance a written binder issued by an authorized insurer or its agent if the binder includes or is accompanied by: the name and address of the borrower; the name and address of the lender as loss payee; a description of the insured real property; a provision that the binder may not be canceled within the term of the binder unless the lender and the insured borrower receive written notice of the cancellation at least ten (10) days prior to the cancellation; except tin the case of a renewal of a policy subsequent to the closing of the loan, a paid receipt of the full amount of the applicable premium, and the amount of insurance Coverage. Chapter 21 Title 25 Paragraph 2119

Applicable in Florida

Except for Auto Insurance coverage, no notice of cancellation or nonrenewal of a binder is required unless the duration of the binder exceeds 60 days. For auto insurance, the insurer must give 5 days prior notice, unless the binder is replaced by a policy or another binder in the same company.

Applicable in Nevada

Any person who refuses to accept a binder which provides coverage of less than $1,000,000.00 when proof is required: (A) Shall be fined not more than $500.00, and (B) is liable to the party presenting the binder as proof of insurance for actual damages sustained therefrom.

88 Black Falcon Ave., Ste. 188
Boston, MA, USA, 02210
www.optimusride.com

April 10, 2017

John Englander
General Counsel
massDOT
10 Park Plaza, Ste. 4160
Boston, MA 02116

Dear Mr. Englander,

It is our pleasure to be working with massDOT on our Application to Test Highly Automated Vehicles in the Commonwealth of Massachusetts. We are thankful for your review and questions, which we received in PDF letter on April 7, 2017.

This letter is in response to question number four of the document:

"Regarding the liability insurance documentation, please provide a cover letter which explains the insurance policy in general terms and how it satisfies the requirement set forth within the MOU and Application Supplement #7."

In the application Supplement #7: Insurance Requirement asks for the following:

"Attach a copy of the policy of insurance or a surety bond in the amount of a minimum of $5,000,000 issued by a company licensed to do business by the Commissioner of Insurance of the Commonwealth of Massachusetts. The policy or bond shall be for the purpose of satisfying any judgment or judgments for damages for personal injury, death or property damage caused by a vehicle being tested in the Commonwealth."

Optimus Ride has primary auto vehicle coverage through NFP P&C Services Inc. It covers up to $1,000,000 as a combined single limit for each accident through Liberty Mutual Insurance. On top of that we have excess liability coverage for another $4,000,000 through North American Specialty Insurance Co. (Swiss Re). This insurance protects against uninsured motorists as well as satisfying any judgment(s) for damages (e.g., personal injury, death, and/or property damage) caused by our vehicles. With both coverage's combined we fulfill the $5,000,000 insurance coverage requirement.

We hope this helps further explain our insurance program and address any pending questions on the matter. We also look forward to meeting on April 14th, where we can provide additional information as needed.

Best regards,

Jenny Larios Berlin
Secretary/Treasurer

88 Black Falcon Ave., Ste. 188
Boston, MA, USA, 02210
www.optimusride.com

Optimus Ride MassDOT Application Follow-Up

i) Previous Off-Road Testing
We will discuss this issue more in a follow-up conversation with MassDOT. In this conversation, we will present photographs of roadways on which testing has previously occurred which should provide the appropriate detail to compare the previously tested roadways and road conditions with the facilities found within the Raymond L. Flynn Marine Industrial Park roadway network and desired testing route.

ii) Manual Takeover Methods
The driver takeover methods used in the Optimus Ride vehicles have been designed to comply with industry accepted best practices in order to ensure the Human Machine Interface (HMI) is clear, consistent, gives context, and provides real feedback for test driver actions. We will discuss the specifics of this issue more in a follow-up conversation with MassDOT.

iii) Testing Milestones and Objectives
Our driving plan consists of four total phases, starting with indoor testing and culminating in an outdoor autonomous demo.

PRE-PILOT: Indoor Vehicle Testing

- *Objective*: Manual indoor driving with data collection by test drivers and engineers, basic autonomous driving functionality indoors
- *Milestones*: Electrical and mechanical parts pass all safety standards, basic autonomous functionality validated including lane following, emergency takeover methods, and obstacle detection and avoidance.

PHASE 1: Outdoor Data Collection

- *Objective*: Manual outdoor driving with data collection by test drivers and engineers
- *Milestones*: 100 miles of data collection, preliminary focus on mapping with subsequent focus on obstacle and situational awareness data

PHASE 2: Outdoor Autonomous Testing

- *Objective*: Outdoor autonomous vehicle testing on proposed demo route
- *Milestones*: 100 miles of autonomous driving with a focus on situational awareness and ride comfort

PHASE 3: Outdoor Autonomous Demo

- *Objective*: Demonstrate basic autonomy while providing transportation services to pre-defined individuals
- *Milestones*: Provide a comfortable in-vehicle experience and educate users on autonomous driving while gathering feedback from new users

We can discuss specific metrics and goals for these phases in a follow-up conversation with MassDOT.

88 Black Falcon Ave., Ste. 188
Boston, MA, USA, 02210
www.optimusride.com

MEMO

To: MassDOT AV Testing Application Review Team
From: Optimus Ride Application Team
Date: April 23, 2017

Re: Off-street Testing

Optimus Ride began testing its vehicles on private roads in the spring of 2016. With the city of Boston's support we began by testing at an enclosed location on Tide St. within the Raymond L. Flynn Marine Park to start assessing the capabilities and performance of our autonomous systems.

While tests were being performed, the need for a simulated city environment became evident. As such, our team constructed a city scene with a realistic urban network, which included marked lanes, facades, sidewalks, signage, and other elements to emulate everyday traffic situations. This testing facility allowed us to continue developing our software and hardware such that we could demonstrate our autonomous functionality to one of our partners -- the Perkins School for the Blind. Our goal with our partners is to provide transportation that is safe and sustainable, while enabling equitable mobility access. The Perkins School is an ideal partner not only in getting feedback from potential users, but also addressing the mobility needs of the disadvantaged as well as developing scalable technology given the more difficult use case. At the Perkins School for the Blind, we were able to conduct several demonstrations with Perkins School community members as passengers within a private property, to educate the users about our technology while understanding the user experience itself. Through all this work, we determined that an indoor testing space with reconfigurable traffic simulations was optimal to continue development.

In late January, Optimus Ride moved into 88 Black Falcon Ave. and, in early February, we began setting up our workspace that included an interior testing area of approximately 10,000 sq.ft. Based on the Tide St. testing environment we had previously used, we designed our testing space to be reconfigurable, complete with flexible road markings and features that allowed us to test virtually any driving scenario that we would experience on the public roads found in the Raymond L. Flynn Marine Park. Like M-City in Michigan, we built a testing environment complete with facades and sidewalks, while also allowing for multi-vehicle maneuverability. And unlike, other closed circuit campuses, we can easily replicate urban driving conditions, much like what we expect to encounter in the Marine Park and Boston at large. Below is an example of the various configurations explored in our testing track.

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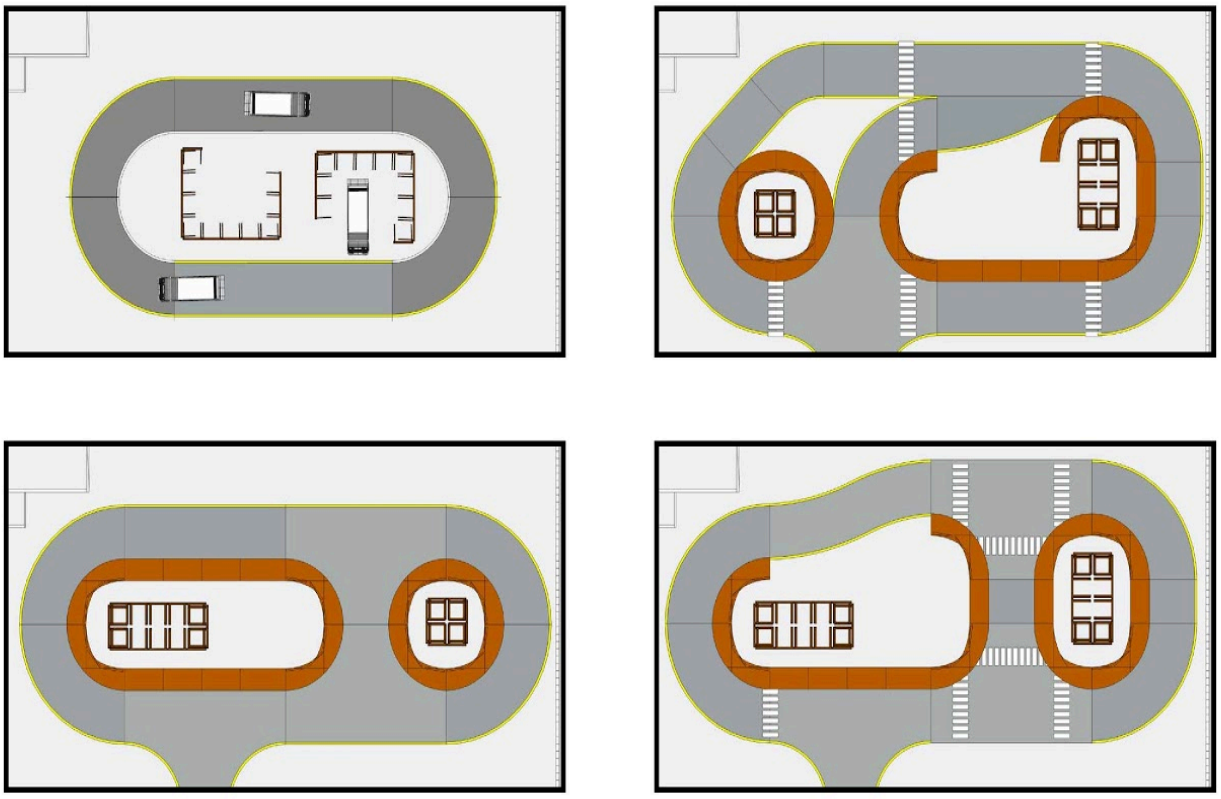
RECONFIGURABLE TEST AREA



In early March, we began to do safety analysis to the design of our space in order to ensure that indoor testing could commence safely without any potential damage to property or personnel. The adaptation included several vehicle tests and electromechanical testing, as well as stopping distance analysis applied to different scenarios, as well as critical areas for safety features such as jersey barriers. The materials and features we use in this space include, but are not limited to, the following:

- Pavement marking tape (reflective glass bead coated engineering grade paper; complies with ASTM D4592-12)
- Traffic cones (meets NCHRP-350 and MUTCD standards)
- Jersey barriers (meets NCHRP-350 TL3 and MUTCD specification 6F.66)
- Signage (retro-reflective grade high intensity prismatic signs; meets MUTCD specification)

These features ensure that our indoor testing reflects the reality of signage and features found on the public roads in the Raymond L. Flynn Marine Park.

Since early April Optimus Ride began utilizing the indoor testing area as the center of its testing and validation process. In that short period of time we have accrued over 80 miles of driving on the course, which equates to nearly 70 hours of testing. These miles were driven using our Polaris GEM E4 and E6 vehicles; the same vehicles will be used to

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test on the public roads located in the Marine Park. In this testing we incorporated several complex scenarios such as vehicle following, intersections with pedestrians, driving with bikers, and constructions zones. We continue to ramp up our operations and we are currently on target to do well over 100 miles in our indoor testing area by the end of April.

We also benefit from the ownership of an outdoor property next to our workspace that allows us to do outdoor testing. Part of the space is often occupied by large commercial semi-trailer trucks as well as automobiles (cars, trucks, SUVs). This property provides us with the flexibility of testing with different vehicle types that we will encounter around the Marine Park. Unlike other controlled testing sites, this area allows us to perform tests with the exact features and obstacles that we will be encountering on the unique Marine Park roads. Successful tests performed in this outdoor testing lot are a clear indicator of the safety and maturity of our system before we continue onto the public roads in the Marine Park.

We will continue scaling up our efforts indoors, accumulating another 100+ miles indoors, as well as increasing our outdoor data collection efforts. We anticipate collecting over 150 miles of outdoor data to use for testing our system in simulation, on our indoor track, as well as on our outdoor private lot. Starting in June, we would begin to gradually test our autonomous system along the proposed Marine Park routes we have previously defined.

Our layered testing approach allows us to gradually add more complexity, it also enables us to collaborate with MassDOT and provide with a first-hand look at real-time data and development of our self-driving technology as well as the benefits it can bring to communities in the Boston and surrounding areas. We are happy to discuss this topic further - should you have any additional questions on this point please do not hesitate to contact us.