

Optimus Ride - Q3 Report 2019

Introduction

Participating in the Autonomous Vehicle Testing Program established by the City of Boston and MassDOT enables Optimus Ride to explore the promise of autonomous vehicles to improve road safety, expand access to public transit, enhance sustainability, and promote economic growth. To date, Optimus Ride has driven over 4,000 miles autonomously on public roads in Boston and logged many thousands more in the state of Massachusetts alone.

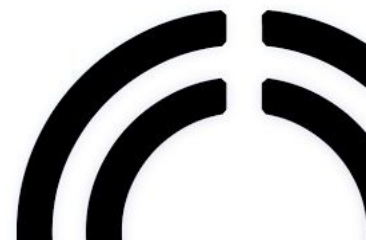
Optimus Ride began testing its autonomous driving system on public roads in the Seaport in the summer of 2017 and has been operating commercially since 2018. At the beginning of 2019, we announced the launch of additional commercial programs in three communities across the United States: *Halley Rise* by Brookfield Properties in Reston, VA, the *Brooklyn Navy Yard* in Brooklyn, NY, and *Paradise Valley Estates* in Fairfield, CA.

During the third quarter of 2019, Optimus Ride officially launched its first commercial service route open to the public at the Brooklyn Navy Yard. At this location, Optimus Ride provides a closed-loop passenger service from the Brooklyn Ferry dock to the entrance of the Brooklyn Navy Yard at Flushing Avenue. After extensive testing of our autonomous capabilities and overall service experience in the Raymond L. Flynn Marine Park, Optimus Ride felt confident in the safety, reliability, and comfort of its service. During this time period, Optimus Ride also began to prepare for its next two site launches of 2019 - Halley Rise (VA) and Paradise Valley Estates (CA).

We are continuously grateful to the State of Massachusetts and the City of Boston for enabling the development of the autonomous vehicle industry and for its support of Optimus Ride.

Thank you.

The Optimus Ride Team



Research Achievements

The safety and satisfaction of our passengers is our utmost priority. To prepare for the launch of our passenger service programs, the Optimus Ride engineering and operations groups have been focused on improving ride comfort, autonomous 3-point turns, and designing our in-vehicle experience.

- **Ride Comfort:** Optimus Ride made continued improvements to the control performance of our vehicles. Our focus on this component of the autonomous ride service experience has led us to receive very positive feedback from passengers and guests, including often receiving the feedback that we provide the smoothest self-driving ride they've ever been in.
- **Autonomous 3-point turns:** Many of our first and last-mile use cases have constrained operating environments that require tight turnarounds. We are actively developing and testing the ability for our vehicles to make 3-point turns autonomously in a safe and robust manner.
- **In-vehicle Experience:** As we shared in our Q2 report, we are in the process of actively researching and designing what a driverless future will look like for Optimus Ride. Said another way, we are thinking holistically about how passengers will interact with self-driving vehicles when there is no driver behind the wheel. Since the last quarter, we've moved from basic research to prototyping and evaluating several concepts. Ultimately, as we define our vision for the development and commercialization of autonomous - and eventually, driverless - vehicles, the public will begin to see updates to the fleets at our deployment sites and on public roads in the Marine Park.

We believe that investing in developing these components at this stage will provide the most value to our users and improve their overall mobility. We continue to be enthusiastic in paving the way for the safe, sustainable, and equitable development of the autonomous vehicle industry.



Takeovers

The driver takeover methods used in the Optimus Ride vehicles have been designed to ensure the Human Machine Interface (HMI) is clear, consistent, gives context, and provides the necessary feedback about the system.

The system is designed to disengage autonomous control and enable manual control by the safety driver when a takeover is initiated. The safety driver can immediately take control using the brakes, throttle, or steering wheel. Takeover events occur largely due to environmental factors, such as unclear or faded lane markings. However, since our vehicles share the road with pedestrians, this quarter, we'll share examples of common takeovers during Q3 2019 that occur due to distracted walking or driving:

- **Scenario 1:** A distracted pedestrian who is looking at their phone suddenly steps out onto the road, immediately in front of our vehicle.
- **Scenario 2:** A driver becomes distracted in an oncoming vehicle and begins encroaching into our lane. Out of precaution, our safety driver took over the vehicle's controls, stopping until the vehicle passed by.



A photo of an oncoming vehicle captured by the Optimus Ride system as it begins encroaching into the path of an Optimus Ride vehicle.



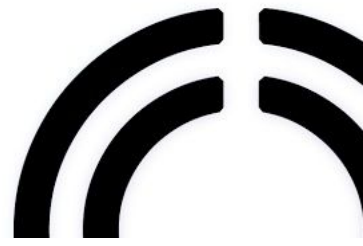
In an effort to shed light on these types of takeovers for the general public, in August, we discussed this specific incident with Winnie Hu of the New York Times for her article, *Driverless Cars Arrive in New York City*. Describing this takeover event, she wrote, “Ruijie He, the vice president of engineering for Optimus, sat beside him with a laptop that was connected to the dashboard. The screen showed the car’s real-time calculations as its sensors registered other cars, pedestrians and cyclists. Not long ago, Mr. He hit the brakes when a man on his phone darted in front of the car. The car is programmed to stop on its own, but Mr. He said he did not want to take any chances.” From our Safety Drivers to our VP of Engineering, safety is our top priority.

During live vehicle testing and operation, our Safety Drivers are given the utmost discretion to prioritize safety by taking over controls and/or braking in these scenarios. They have been trained thoroughly to recognize potentially unsafe behaviors on the road which are external to our own vehicle’s operation. These edge-case scenarios, such as the two above, are then reported to our operations team, who then turns these into actionable insights for our engineering team to digest and design a safe autonomous response.

Community Engagement

In September, Optimus Ride, MassDOT, and the City of Boston’s Office of New Urban Mechanics co-hosted a workshop for first responders from the greater Boston area to learn more about autonomous vehicles. Members of the local and state police forces and ambulance services participated in a roundtable discussion oriented around the question, “What will emergency response protocols look like when a vehicle is fully driverless?”

To achieve this, participants received a primer on how connected and autonomous vehicles function, covering topics from the SAE automation levels, basic sensor components, to the testing program in Massachusetts. Attendees also received facilities tours and garage visits to learn more about the manufacturing and R&D process. At the end of the day, participants had a Q&A session with members of the Optimus Ride engineering and operations team to learn more about our First Responder Plan and provide feedback from their point of view. Optimus Ride’s First Responder Plan will be published in early 2020 by MassDOT and the City of Boston as part of our Memorandum of Agreement to Test Automated Driving Systems on Public Ways in Massachusetts.



Safety Record

Optimus Ride continues to foster a Safety Culture by maintaining and continuously improving the safety of our daily activities and overall operations record. We maintain an excellent safety record and have no accidents, failures, or disruptions of our vehicles to report.

