Statement for the Record
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U.S. House of Representatives
Committee on Energy and Commerce
Subcommittee on Digital Commerce and Consumer Protection
"Self-Driving Cars: Levels of Automation"
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Dear Chairman Latta, Ranking Member Schakowsky, Members of the Subcommittee, thank you for holding a hearing on this important topic and for the opportunity to share my views with you.

Mobileye is a global leader in vision technology for advanced driver assistance systems (ADAS) and autonomous driving. Our core mission is to save lives and prevent injuries by reducing vehicle collisions.

Our ADAS technology (Level 1 and Level 2) is adopted by most of the world's major auto manufacturers and there are currently over 15 million vehicles on the road that utilize Mobileye technology. In addition to our technology being installed by the auto manufacturers at the factory level, Mobileye also offers aftermarket ADAS products which can be installed in any vehicle, making it an ideal solution for fleets looking to improve safety.

Beyond ADAS, which purpose is to avoid and/or mitigate vehicle collisions, Mobileye technology is being used by a variety of automakers as an important enabler for future Level 3-5 autonomous vehicles. These include a Level 3 program with Audi where production vehicles are expected to launch in second half of 2017, a Level 4 program with BMW to be launched in 2021, and a partnership with Delphi Automotive to create a Level 4 autonomous platform for use by many automobile manufacturers by 2019.

Mobileye's technology is centered around proprietary software algorithms deployed on a family of proprietary computer chips called EyeQ®. The technology turns raw camera data into usable information that a vehicle system can use to enhance safety and eventually, we believe, to drive autonomously. The technology performs detailed interpretations of the visual field in order to anticipate collisions with other vehicles, pedestrians, animals, debris, and other obstacles. Our products are also able to detect roadway markings such as lanes, road boundaries, barriers, and to read traffic signs and traffic lights. These products are validated by Mobileye and its customers to the highest level of accuracy and automotive-grade standards and have been proven over millions of miles of real-world driving conditions.

Mobileye's unique capability focuses on interpreting data from a camera fitted onto vehicles. We'd note that Mobileye has been able to demonstrate fulfillment of all ADAS functions with high accuracy through a single monocular camera sensor configuration, thereby reducing cost

and simplifying tooling and packaging within the vehicle. For Level 3-5 vehicles, other sensors like radar and lidar will be necessary for redundancy; however, only a camera can identify both shape (i.e. vehicles, pedestrians, general objects, etc.) and texture (traffic sign text, lane markings, subtle road boundaries, traffic lights, etc.) which leads us to believe that camera will be the primary sensor in Level 3-5 vehicles.

The Problem

According to the U.S. Department of Transportation's National Highway Traffic Safety Administration, 35,092 people died and 2,443,000 were injured as a result of vehicle collisions on United States roads in 2015.[1] The number of deaths has increased by 7.2 percent from the previous year, the highest increase in over fifty years. Over 90 percent of vehicle collisions are attributed to human factors, including distracted driving, fatigue and drunk driving.

Moreover, according to a Boston Consulting Group (BCG) report titled *A Roadmap to Safer Driving Through Advanced Driver Assistance System*, "the cost [of vehicle collisions] to society totals about $910 billion annually, equivalent to roughly 6 percent of U.S. GDP." The BCG report further states that ADAS technologies alone have the potential to prevent 30 percent of all crashes, and together with fully autonomous vehicles, vehicle collisions could be reduced by 90 percent.[2]

We at Mobileye believe that the number of deaths and injuries caused by vehicle collisions is unacceptable and are working hard to significantly reduce and/or mitigate collisions through our investment in and development of innovative ADAS and autonomous vehicle solutions.

Different Levels of Automation

Mobileye's ADAS technologies--those installed by auto manufacturers at the factory as well as our aftermarket products--significantly reduce vehicle collisions, saving lives, preventing injuries, and reducing costs associated with collisions. There are also notable improvements in driver behavior which appear to result in substantial reductions in fuel consumption.

As Mobileye continues to innovate and deploy its ADAS technology, the company is leading the efforts in autonomous vehicle innovation and development.

There are five generally accepted levels of automation.

Level 0

- No automation. The human driver is in control. This includes the majority of vehicles on the road today.

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[1] https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812318?_ga=1.154839546.33277525.1477595715

[2] https://www.mema.org/sites/default/files/MEMA%20BCG%20ADAS%20Report.pdf

Level 1 and Level 2: Advanced Driver Assistance Systems

- **Some automated features are introduced, like automatic braking, stability control and cruise control, but a human is still in charge**. Level 1 means the car can only work one automated system at a time, while Level 2 means that multiple automated functionalities can work in tandem. For example, Automatic Emergency Braking (AEB) plus Lane Keeping Assist (LKA).
- Mobileye technology supports many Level 2 systems on the road today. In 2018, introduction of EyeQ®4, the tri-focal lensed camera, and higher complexity algorithms will result in substantially higher ADAS functionality, as well as initial Level 3 systems.

Level 3 through Level 5: Autonomous Driving

Level 3 – Autonomous Under Certain Circumstances

- **Level 3 automation means the vehicle can take over all driving functions under certain circumstances.** The less-complex highway environment (all vehicles moving in the same direction, no pedestrians, no complex intersections) is the most logical circumstance.
- All major functions are automated, including braking, steering, and acceleration. **At this level, the driver can fully disengage until the vehicle tells you otherwise.** This is where the vehicle crosses into true "autonomous capability," and when technology begins to enable substantial benefits beyond safety, such as increased productivity.
- Going from Level 2 to Level 3 requires substantial increases in functional safety levels and system redundancies. In certain circumstances, the vehicle will need to ask the driver to re-engage. Since the driver cannot be assumed to take control instantaneously, the system will need to ensure safety for a period of time when the driver is still not engaged (for example, to pull over and stop if the driver does not respond to repeated requests to re-engage).
- Mobileye expects this additional redundancy to be covered by additional sensors like radar and lidar (for shape and object detection) and by Mobileye's REM™ localization map for identification of safe drivable paths and knowledge of intersections and other traffic signage or instructions.

Levels 4 & Level 5 – Fully Autonomous

- **Level 4 and Level 5 vehicles are autonomous in all situations and driving environments, not just "under certain circumstances," as in Level 3.**
- In Level 4 there does not have to be a driver because the vehicle is prepared for every situation and the human has moved from being the driver to just a passenger. **Level 5 vehicles will not have a steering wheel or other human-used vehicle controls.**
- We believe the initial deployment of this technology will be for "ride-sharing" fleets within confined areas.
- Driverless vehicles make the ride-share model much more cost-effective and compelling, as they eliminate the biggest cost of ride-share fleets: the driver. Initial deployment into ride-share fleets brings two other significant benefits: We expect initial usage will include a trained operator in the driver seat, to enable consumers to gain experience with the technology with the assurance of a trained operator monitoring the situation, and the

ability to generate real-world performance data in a safe way. Once enough data is generated, we would expect the regulatory framework to approve widespread usage.
- By using our crowdsourced REM™ Roadbook technology, the move from "somewhere" autonomy to "everywhere" autonomy is simply a switch of a button because the maps will be continuously updated everywhere, not only in confined, geo-fenced areas.
- Eventually, we will see auto companies scale-up from ride sharing to "shared ownership" where people and organizations share ownership of a car that can drive anywhere. This is even more transformative than ride sharing because it opens up completely new business models for transportation.
- In 2016 Mobileye announced its partnership with BMW and Intel intending to bring a fully autonomous vehicle into serial production by 2021.
- Also in 2016, Mobileye announced a partnership with Delphi Automotive to produce a turnkey autonomous driving system designed for rapid adoption by a variety of automakers.

Mobileye has ADAS programs with more than 25 automakers around the world, 5 programs for Level 3 Semi-Autonomous, and 5 programs for Level 4 Autonomous Vehicles, including with BMW and Delphi.

Path Forward

Autonomous vehicles and the benefits they will provide through reducing collision-related deaths, injuries, cost, and enhancing mobility to underserved communities such as the elderly and physically disabled individuals, are immense. Mobileye is fully committed to the vision of autonomous vehicles and are one of the leading companies working on making it a reality.

However, we have some years to go before fully autonomous vehicles are ubiquitous on U.S. roads and there is much more that can and should be done to save lives today without waiting for fully autonomous vehicles.

ADAS technologies already exist and have proven to significantly reduce collisions. Adoption rates are increasing but can and should be expedited with the help of prudent policy initiatives. Every day that goes by over 90 lives are lost in the U.S. due to vehicle collisions. Many lives can be saved by using ADAS technologies available today. It is simply unacceptable to not use proven technologies that are readily available today.

Moreover, ADAS technologies being used in vehicles today serve as fundamental building blocks for autonomous vehicles of tomorrow. They are paving the way towards autonomy in terms of technology validation and public perception and acceptance, all of which will be critical to the safe and widespread deployment of autonomous vehicles.

Policy Recommendations

ADAS and autonomous vehicle technologies could significantly decrease the number of vehicle collisions caused by human factors, reducing the amount of deaths and injuries. Legislators and

regulators can and should play an important role in expediting the adoption of these technologies.

1) NHTSA should update and strengthen U.S. New Car Assessment Program (NCAP) standards to give ADAS technologies greater weight. To receive credit, ADAS technologies should be included in the standard fit of a new vehicle similar to seat belts, front airbags, and anti-lock brakes, not as optional equipment. The features must also verifiably meet the highest standards. Technologies that do not meet these standards should not receive credit under the system.

2) Federal Motor Carrier Safety Administration (FMCSA), should expedite the development and implementation of its "Beyond Compliance" program, as directed by the FAST Act, providing credits to motor carriers who take concrete safety measure, including the installation of advanced safety equipment.

3) The U.S. government should lead by example in promoting road safety by adopting ADAS technologies on government owned vehicles. For instance, USPS is about to replace its aging fleet with up to 180,000 new delivery vehicles. This and other vehicle procurements for government departments and agencies should require that ADAS technologies be included with the new vehicles. Vehicles that will be on the road for years to come and don't have ADAS technology should be equipped with aftermarket ADAS products.

4) Policymakers should implement a federal tax incentives program to encourage greater and faster adoption of ADAS technologies. At the very least, trucks carrying hazardous materials and other higher-damage risk vehicles should receive financial incentives to expedite adoption of ADAS technologies.

5) Auto manufacturers should be allowed to use ADAS features to meet Corporate Average Fuel Economy (CAFE) standards.

6) Policymakers should establish a single national standard for autonomous vehicle safety, preventing a patchwork of state laws. A patchwork of laws could prohibit autonomous vehicles from traveling from one state to another, stifling investment, innovation and deployment of these much-needed technologies.

Thank you again for holding this important hearing and for allowing Mobileye to submit this statement for the record.