

Testimony of Dr. Kay Stepper

Vice President for Automated Driving and Driver Assistance
Systems

Chassis Systems Control

Robert Bosch LLC



Hearing on
Self-Driving Cars: Levels of Automation

House Energy & Commerce Committee
Subcommittee on Digital Commerce and Consumer Protection
United State House of Representatives

March 28, 2017

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Background

As a global Tier One supplier, Bosch is working diligently to make Automated Driving a reality. We currently employ more than 2,500 engineers working worldwide on the topics of automated driving and advanced driver assistance.

Key Areas

Automated Driving and Innovation: Continued federal collaboration and support for research and testing is vital to keeping the U.S. and the automotive industry at the forefront of technological innovation. Lawmakers and regulators should permit the safe and responsible testing of advanced safety and automated technologies on public roads. The Federal Automated Vehicles Policy, issued by NHTSA in 2016, represents an important step forward but critical issues must still be addressed.

Driver Assistance / Crash Avoidance Systems: The automotive industry continues to develop and bring to market innovative safety technologies that have made a significant difference in reducing fatality and injury rates. Adoption rates, however, remain low and additional actions must be taken to encourage the installation of these technologies.

Consumer Education and NCAP: The U.S. New Car Assessment Program (NCAP) is the leading mechanism through which the federal government communicates vehicle safety information to consumers. Although the NHTSA has proposed an update to NCAP, the current NCAP model, which is focused solely on crashworthiness and rollover propensity, is outdated and should be modernized.

Chairman Latta, Ranking Member Schakowsky, members of the Committee, thank you for the opportunity to testify before you today.

My name is Kay Stepper, Vice President with responsibility for the Driver Assistance and Automated Driving Systems for Bosch in the United States. At Bosch we are proud to be “Invented for Life” and I am honored to discuss an issue that is one of the pillars of our everyday work at Bosch: to save lives.

Robert Bosch founded the company in 1886, when he opened the “Workshop for Precision Mechanics and Electrical Engineering” in Stuttgart, Germany. Today, the Bosch group of companies employ more than 390,000 associates around the globe, including nearly 18,000 in the United States.

Bosch has a long history in the United States. In fact, the U.S. played a pivotal role in the history of Robert Bosch himself. At the age of just 23, he ventured across the Atlantic, traveling to the U.S. to work with Edison and gain insights into electrical engineering. He subsequently established an office in New York City in 1906. Now, in 2017, Bosch companies operate more than 100 manufacturing, development, sales, service and administrative sites across the country with a significant presence in Michigan, South Carolina, Illinois, California, Wisconsin, and Kentucky. We also have three dedicated Research and Development Centers in the U.S.; they are located in Pittsburgh, PA; Cambridge, MA and Palo Alto, CA.

Bosch has four business sectors – Mobility Solutions, Energy and Building Technology; Consumer Goods; and Industrial Technology. Mobility solutions is our largest sector, comprising approximately 60 percent of our business and representing 217,000 associates.

Bosch is very active at every level of autonomous driving. As a Tier One full systems supplier, Bosch understands the entire automated driving system from requirements derivation to turn-key solutions. Ranging from individual components such as sensors, electronic control units, brake systems, steering, to the overall system, we develop and supply almost every element required for automated driving. Bosch is the world's largest manufacturer of MEMS and radar sensors and a leading global manufacturer of mono- and stereo-vision cameras, ultrasonic sensors, braking and steering systems. With this broad product reach, combined with our expertise in cybersecurity protection, Bosch is uniquely positioned to help drive the creation of a full system approach for our customers.

Bosch is advancing artificial intelligence. At the Bosch Connected World 2017 conference in Berlin, Bosch presented an onboard computer for automated vehicles. Thanks to artificial intelligence (AI), the computer can apply machine learning methods. The AI onboard computer is expected to guide self-driving cars through even complex traffic situations, or ones that are new to the car.

Bosch believes that automated driving is the future of mobility and "Leading the way to safe, agile and automated driving" is our guiding principle. Bosch has more than 2,500 engineers working worldwide on the topics of automated driving and advanced driver assistance in order to achieve this goal and our autonomous driving testing is conducted in the U.S., Germany, Japan, and Australia.

Accident statistics indicate that more than 90 percent of all crashes are caused by human error. A forward-thinking vehicle which takes over dedicated driving tasks could make the vision of injury and collision-free driving a reality. NHTSA's preliminary numbers for the first nine months of 2016 show that an estimated 27,875 people died in crashes – an eight

percent increase over the first 9 months of 2015.¹ Preliminary 2016 data from the National Safety Council projects that as many as 40,000 people died in motor vehicle crashes last year.²

The magnitude of this safety crisis is such that we must seek active means to increase deployment of technologies that can support drivers and reduce accident and injury rates. Driver assistance systems such as Automatic Emergency Braking (AEB) and Blind Spot Detection (BSD) can assist in reducing the rising fatality and injury numbers that we are facing in the United States today. In the near term, it is critical that government and industry continue to work together to help increase consumer access to and understanding of these advanced technologies.

In January 2017, Bosch released a study “Connected Car Effect 2025”³ which investigated what mobility technology will mean specifically for the US, Germany and the major cities of China. The result: safety systems and cloud-based functions can prevent around 260,000 injury accidents, save 390,000 tons of CO2 emissions and offer drivers many hours of more time for other activities. Over 260,000 accidents involving personal injuries (US: 210,000, China: 20,000, Germany: 30,000) will be avoided annually – as many accidents as occur within two years in Germany’s capital city of Berlin. The Study predicted that 350,000 fewer people would be injured by traffic accidents – the same as 12 years without traffic injuries in Los Angeles. In the US alone, there will be 290,000 fewer (China: 25,000, Germany: 37,000).

I commend the Committee for calling this hearing and for focusing its attention on two topics that lie at the heart of this transformation in

¹ DOT HS 812 358: A Brief Statistical Summary - Early Estimate of Motor Vehicle Traffic Fatalities For the First 9 Months of 2016; January 2017

² National Safety Council Press Release, February 15, 2017, “Motor Vehicle Deaths in 2016 Estimated to be Highest in Nine Years”

³ “Connected Car Effect 2025” conducted by Bosch and the consulting firm Prognos, January 2017

vehicle mobility: the levels of automation and the importance of the deployment of driver assistance systems as a foundation for automated driving. Unfortunately, these topics are often overlooked within the overall dialogue about Automated Driving. The truth is that many drivers and passengers are already experiencing the benefits of vehicle automation every day. The active safety system Electronic Stability Control (ESC) is integrated into every new passenger car sold in the United States. This revolutionary technology, invented by Bosch engineer Dr. Anton van Zanten, has saved thousands of lives. A 2014 report from NHTSA found that ESC saved close to 4,000 lives during the 5-year period from 2008 to 2012⁴. The technology works by monitoring driver intent and vehicle direction and by automatically applying braking force as needed to prevent a loss of control. Most drivers are not even aware of its support. This intervention is communicated to the driver as a mere flash of the indicator light on the dash, but the real world result is often a life saved or a serious injury mitigated.

Automated driving will bring great benefits and pave the path toward a new vision of personal and collective transportation. However, it will take time to achieve fully automated driving and it will be an evolutionary process, building upon the stepping stones of active safety, driver assistance and crash avoidance systems. The first wave is already here in the form of driver assistance systems that utilize automation to increase safety. The next phase will consist of partially-automated functions, such as traffic jam assist, which are available in the market but not deployed in great numbers.

In discussing the evolution toward Automated Driving, I want to emphasize that Bosch strongly supports NHTSA's decision to adopt the

⁴ DOT HS 812 042, June 2014, Estimating Lives Saved by Electronic Stability Control, 2008–2012

SAE International (SAE) J3016 framework for levels of automation as part of the Federal Automated Vehicles Policy. This is a major step toward harmonizing and establishing a common set of definitions across the various stakeholders involved in these efforts. Without a common taxonomy and understanding of the different levels of automation, it will be considerably more difficult to make the necessary strides toward full automation. In fact, the lack of a common “language” and standardized descriptions is one of the obstacles that has hindered the understanding and adoption of Advanced Driver Assistance Systems (ADAS).

A 2015 study conducted by the Boston Consulting Group (BCG), on behalf of the Motor & Equipment Manufacturers Association (MEMA), determined that the widespread installation of ADAS technologies could prevent about 9,900 fatalities each year and save more than \$250 billion annually in societal costs⁵ in the United States. The BCG found that, at that time, ADAS features were not present in a high number of vehicles and that their share of the U.S. market was growing at only 2 to 5 percent annually.

Bosch wishes to highlight Automatic Emergency Braking as one clear example of how drivers are being introduced to automation in a gradual manner and also of how automation and intervention by the vehicle can provide the greatest benefit in terms of accident reduction. The full suite of AEB, also known as Crash Imminent Braking, consists of three technologies. The first is Forward Collision Warning which simply alerts the driver to the fact that he/she is getting very close to the vehicle in front of them. The next stage technology, termed by NHTSA as Dynamic Brake Support, actually prepares the brakes and pre-fills them so that the driver will immediately have full braking power when he/she engages the brakes

⁵ A Roadmap to Safer Driving Through Advanced Driver Assistance Systems (ADAS), Boston Consulting Group, September 2015

to slow or stop the vehicle. The driver does not feel a demonstrable difference in the brake but he/she receives enhanced braking power to reduce the stopping distance. AEB is the last technology in this cascade. If the driver takes no action, then the system engages the brakes on its own and stops the vehicle to prevent or mitigate the crash.

These types of crashes remain a leading safety concern in the United States. Bosch's internal analysis of NHTSA's 2013 NASS⁶ data indicated that approximately 33 percent of collisions with injuries and fatalities were rear-end crashes. Most drivers believe that they are observant and fully aware of their surroundings, but Bosch's research found that drivers often fail to detect the obstacle in rear end crashes. In cases where the driver did detect the obstacle, approximately 49 percent of the drivers failed to apply adequate braking force in order to avoid the collision. Further, 31 percent of drivers failed to even apply the brakes at all. This cascade approach optimizes the system's ability to support and assist the driver. It exemplifies the manner in which increasing levels of automation can help to supplement the driver's own abilities.

Bosch, together with its customers and other suppliers, has also devoted considerable resources to tackling the growing safety problem of pedestrian fatalities and injuries. Technology, in the form of advanced pedestrian detection and braking technologies, offers us the opportunity to notably mitigate and, in some cases, prevent crashes involving vulnerable road users. In 2015 there were 5,376 pedestrians killed in traffic crashes in the U.S., a 9.5 percent increase from the 4,910 pedestrian fatalities in 2014. This figure represents the highest number of pedestrians killed annually since 1996. On average, a pedestrian was killed nearly every 1.6 hours and injured more than every 7.5 minutes in traffic crashes in 2015.⁷

⁶ National Highway Traffic Safety Administration, National Automotive Sampling System (NASS)

⁷ DOT HS 812 375, NHTSA Traffic Safety Facts, February 2017

Bosch has developed forward pedestrian Automatic Emergency Braking systems as well as rear Automatic Braking systems to address these types of crashes. We are applying the same strategies utilized in AEB, cascading from a driver warning to a full automatic intervention. Also, as mentioned before, Bosch has been developing Artificial Intelligence for use in vehicle automation. Bosch's AI onboard computer can recognize pedestrians or cyclists.

Suppliers play an important role in the innovation cycle and many established suppliers, such as Bosch, conduct extensive testing in the lab, on test tracks, and on public roads. These activities are integral to the development and maturity of the technology needed for automated driving. Our engineers conduct extensive track testing and simulation work; but nothing can replace the importance of on the road testing and validation. In addition, these efforts are intrinsic to enabling suppliers to develop their own robust and comprehensive offerings for OEMs and support the competitive challenge to deliver the most effective and cost-sensitive software options for automakers. Prohibitions and delays that impede on-road testing will slow this process at the supplier level and; thereby, inhibit the overall progression of automated driving technology. For Bosch, reliability and robustness are the top priorities when it comes to safety systems. This requires the use of thoroughly tested and approved software. Bosch emphasizes that these development vehicles are driven exclusively by trained test drivers at Bosch and equipped with special safety concepts to enable the driver to reassert control at any time. After a successful release procedure on test tracks, we take the system on public roads to conduct evaluations in a real environment but always under supervision of a trained driver accompanied by a test engineer monitoring the system.

Suppliers presently face several obstacles in carrying out this testing on public roads and we respectfully request that the Committee consider

extending the FAST Act exemption to include suppliers with active and established research and development programs in the U.S.

Bosch has been a passionate advocate for the deployment of driver assistance systems. We continue to view these technologies as the most effective and immediate means to reducing fatalities and injuries. We have worked diligently as a company to make these systems more accessible to all consumers. By developing cost effective components, such as Bosch's mid-range radar sensor, we have sought to support the distribution of these systems to all makes and models of passenger vehicles. Series production of Bosch radar sensors began in 2000. In 2016, Bosch delivered its ten-millionth radar sensor.

Bosch's position on the need for improved consumer education is well known. We have urged NHTSA and the U.S. Department of Transportation for many years to include crash avoidance systems as a key component of the vehicle 5-star rating and to provide additional information to consumers through the Monroney Label. Bosch believes that displaying crash avoidance systems as part of the official safety portion of the Monroney Label, and particularly in the form a five star rating, is the most effective means to help drive consumer awareness and eventually consumer demand for such technologies. Without the clear presence of crash avoidance and mitigation technologies on the most recognizable feature for consumers - the physical Monroney Label as affixed to the vehicle – consumer education will continue to lag.

Support for the proposed inclusion of crash avoidance technologies was also confirmed by prominent groups such as the National Safety Council and the Insurance Institute for Highway Safety in their formal responses to the NHTSA proposed NCAP update, issued in December 2015.

The adoption of crash avoidance technologies into NCAP would be a very significant improvement and one which we believe will help bring about immediate benefits, as well as paving the path toward the attainment of automated driving in the future. Based on Bosch's analysis of the 2013 NASS data, crash avoidance technologies such as forward collision warning, automatic emergency braking, lane departure warning, lane keeping systems, blind spot detection, lane change assist and pedestrian crash avoidance systems have the potential to avoid or mitigate up to 64 percent of passenger car and light-duty truck collisions resulting in injuries and fatalities in the United States.

As part of the proposed NCAP update issued in December 2015, NHTSA had proposed separate ratings for crash avoidance and pedestrian protection, as well as a combined overall vehicle rating. Bosch acknowledges that there were many issues that still need to be addressed and fleshed out as part of the proposals and we are aware that many entities raised legitimate concerns relative to the proposed changes to the crashworthiness section of the proposal. Our intent is simply to encourage Congress and NHTSA to cooperate and find a path forward for the U.S. NCAP to become an effective means of encouraging the enhanced adoption of these life-saving systems. Bosch truly believes that a five star rating is the most effective means to translate the presence and performance of crash avoidance technologies into an easy-to-understand indicator for consumers.

Thank you again for the opportunity to speak before the Committee. I welcome any questions you may have.