[01] Future technologies driving current Bosch growth

[02] Glossary of Bosch driver assistance systems

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Press release

Automated driving
Future technologies driving current Bosch growth

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- Booming market for driver assistance systems will usher in automated driving
- Bosch expects driver assistance systems to generate sales of one billion euros in 2016
- In 2014, Bosch delivered more than 50 million surround sensors for the first time
- Bosch expects to manufacture its ten-millionth radar sensor (77 GHz) in 2016
- Increasing automation has the potential to cut accident rates by up to another third in Germany alone

Stuttgart – For Bosch, automated driving is not just a pipe dream. The supplier of technology and services is already achieving commercial and technological success in this area today. “Automated driving will be ushered in by the booming market for driver assistance,” says Dr. Dirk Hoheisel, member of the board of management of Robert Bosch GmbH. Bosch’s sales in this field are currently increasing by a third every year. Hoheisel adds: “In 2016, our sales in driver assistance will exceed one billion euros.” As a systems supplier and one of the world’s largest automotive suppliers, Bosch benefits especially from its broad product portfolio.

From powertrain to connectivity – Bosch provides everything from a single source

Like barely any other automotive supplier, Bosch is an expert in all the technologies needed for automated driving. These include not just the powertrain, brakes, and steering, but also sensors, navigation systems, and connectivity solutions inside and outside the car. As Hoheisel says: “Bosch develops everything, from the individual components to the entire system.” For example, Bosch sensors are in great demand: Last year, the company set a new record by selling more than 50 million surround sensors for driver assistance systems. The number of radar and video sensors sold doubled in 2014 – and will do so again in 2015. When it comes to the radar sensors used in systems such as ACC adaptive cruise

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control, Bosch leads the market worldwide. Its ten-millionth radar sensor (77 GHz) is expected to roll off the line this coming year.

Some 2,000 engineers work on driver assistance at Bosch

The number of associates Bosch employs in this field attests to the growing success that the company enjoys. Currently, about 2,000 engineers are working on refining driver assistance systems at Bosch. That's a good 700 more than just two years ago. Driver assistance systems serve as the basis for automated driving. Even today, they are helping drivers change lanes, stay in their lane, and brake when encountering an obstacle. But development doesn't stop there: a European automaker is now offering production vehicles that feature not only assistance systems for taking evasive actions and turning against oncoming traffic, but also the Bosch traffic jam assistant. "As we move toward self-driving cars, we will be premiering many new assistance systems," Hoheisel says. The insights and experience that Bosch gains from these will feed directly into the development of automated driving, giving it some serious momentum.

In 2020, cars should be driving themselves on the freeway – just as Bosch prototypes have been doing on the A81 in Germany and US Interstate 280 since the beginning of 2013. However, if this is to happen, the legal framework will have to keep pace with technological developments. Currently, there is a legal constraint in the form of the Vienna Convention on Road Traffic of 1968, which dictates that drivers must retain control of their vehicle at all times. In other words, highly automated driving is not yet legal. Nonetheless, there are signs of impending changes to the regulations that apply both in Germany and in many other countries. One possibility would allow automated driving so long as the driver is able to override or disable it. Discussions are underway on how to revise the regulations to permit this exception. But validation puts up another obstacle: using current methods, an autopilot system has to complete several million kilometers' worth of testing before it can be released for production. Bosch is working on new approaches here as well.

Automated driving improves safety, efficiency, and comfort

For Bosch, automated driving is about making road traffic safer. Every year, an estimated 1.3 million people around the world are killed in road accidents. In 90 percent of cases, the accident can be attributed to human error. "In critical traffic situations, the right support can save lives," Hoheisel says. Bosch accident research predicts that increasing automation can lower accident rates even further – by up to a third in Germany alone. And automated driving makes road traffic not only safer, but also more efficient. U.S. studies indicate that applying predictive driving strategies when on the freeway can result in fuel savings of

up to 39 percent. However, a car with an autopilot also opens up a new driving experience – it becomes a home on wheels.

Related link: www.automated-driving.com

Press photos: 1-CC-21179, 1-UBK-20767, 1-UBK-20782

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Mobility Solutions is the largest Bosch Group business sector. In 2014, its sales came to 33.3 billion euros, or 68 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers. The Mobility Solutions business sector combines the group's expertise in three mobility domains – automation, electrification, and connectivity – and offers its customers integrated mobility solutions. Its main areas of activity are injection technology and powertrain peripherals for internal-combustion engines, diverse solutions for powertrain electrification, vehicle safety systems, driver-assistance and automated functions, technology for user-friendly infotainment as well as car-to-car and Car2X communication, repair-shop concepts, and technology and services for the automotive aftermarket. Bosch has been responsible for important automotive innovations, such as electronic engine management, the ESP anti-skid system, and common-rail diesel technology.

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Press release
Bosch Compact

Glossary of Bosch driver assistance systems
From ACC to cross-traffic alert system

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Driver assistance systems: These invisible co-pilots help drivers in monotonous or difficult traffic situations. They monitor the car's surroundings with the help of radar, video, and ultrasonic sensors. They help to steer and brake the car when parking, changing lanes, or sitting in traffic. Driver assistance systems can prevent accidents and are precursors to automated driving.

Invisible co-pilots make driving in road traffic safer

Adaptive cruise control: ACC can accelerate and brake a car autonomously. With the help of a radar sensor, the system maintains both the driver's chosen speed and a programmed safe distance to the vehicle in front. This helps drivers reach their destination more relaxed, while the more even driving style saves fuel. In the Stop&Go version, ACC can even stop the car completely and restart the engine once traffic gets moving again after a brief pause.

Evasive steering support: Evasive steering support helps drivers avoid obstacles by way of specific steering interventions. This means the maximum steering angle is reached 25 percent faster. Prior to the maneuver, radar and video sensors detect whether the vehicle's surroundings permit a swerve of any kind.

Automatic emergency braking (rear): It can be difficult to see small children when reversing. Automatic emergency braking (rear) is based on radar and ultrasonic sensors in conjunction with the ESP electronic stability program. At speeds of up to 15 kilometers per hour, the system automatically performs an emergency braking maneuver if it detects a person or an obstacle dangerously close to the rear of the reversing vehicle.

Construction zone assist: The construction zone assist system keeps the car within a narrower lane by way of steering corrections. To do this, the system takes data from video and ultrasonic sensors and calculates a safe distance on either side to vehicles in the neighboring lane as well as to the crash barrier. The video sensor also measures clear spaces ahead of the vehicle. This enables the

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system to provide a timely warning in case the lane in a freeway construction zone is too narrow for the vehicle.

Driver drowsiness recognition: Drowsiness at the wheel causes imprecise steering maneuvers and lots of steering corrections. The drowsiness recognition system constantly analyzes the driver's steering behavior by way of the steering angle sensor, so it can recognize signs that the driver is nodding off before it happens. It also takes into account factors such as the time of day and the length of the journey. Tired drivers are warned optically and acoustically, and are reminded to take a break.

Intelligent headlight control: When driving at night or in a tunnel, this system automatically activates the headlights. Outside of built-up areas, it will also automatically switch on the high beams as long as it does not detect any vehicles ahead or any oncoming traffic via the video sensor. This means the road ahead is always ideally lit.

Left-turn assist: When turning left involves crossing the other side of the road, it is easy to overlook oncoming traffic. The left-turn assist system monitors oncoming traffic using two radar sensors in the front of the vehicle. If the gap in traffic is too small to permit a turn, the system prevents the vehicle from moving forward. If a collision with an oncoming vehicle is imminent, the system will stop the turn in time by performing an automatic emergency braking maneuver.

Lane keeping support: The lane keeping support system helps drivers to keep their vehicle within a traffic lane. It uses a video sensor to detect the lane markings to the right and left of the vehicle. If the vehicle's distance to the lane boundary falls below a defined minimum, the lane keeping support steps in. In vehicles with electric power steering, it steers gently but firmly in the opposite direction in order to keep the vehicle in the lane. In vehicles without electric power steering, it achieves the same effect by utilizing the ESP electronic stability program to brake individual wheels. Drivers can override the function at all times, so they retain control of the vehicle. If they activate the turn signal in order to change lane or turn, the system does not intervene.

Lane-departure warning: The lane-departure warning system alerts drivers to the fact that they are about to unintentionally drift out of the lane by, for example, causing the steering wheel to vibrate. A video sensor detects the lane markings ahead. If the vehicle risks leaving the lane unintentionally, the system sounds a warning. This enables the driver to change course in time. If the driver has activated the turn signal in advance of a lane change, the system sounds no warning.

Lane change assist: Radar sensors fitted in the rear of the vehicle constantly monitor the traffic situation up to 90 meters to the side and behind the vehicle. Prior to a lane change, the function warns the driver, for instance by lighting up a symbol in the exterior rear-view mirrors, if it detects another vehicle either approaching from behind at speed or already in the blind spot.

Traffic jam assist: The traffic jam assist system is based on the sensors and mechanics of ACC Stop&Go and of the lane keeping support. Up to a speed of 60 kilometers per hour, the system automatically follows the vehicle ahead in heavy traffic. Not only does the traffic jam assist accelerate and brake, it also keeps the vehicle in its lane by way of steering interventions. This relieves drivers so they can focus on monitoring the system.

Side view assist: In contrast to the lane change assist with its radar sensors, the side view assist system uses ultrasonic sensors. These permit it to monitor the hard-to-see areas up to four meters to the side and just behind the car. When turning or changing lanes, for instance, the system warns drivers that there is a vehicle in their blind spot by lighting up a symbol in the exterior rear-view mirrors.

Road sign recognition: The road sign recognition system helps drivers to navigate the “road sign jungle.” By way of a video sensor, this system detects all relevant road signs – including speed limits and no-passing warnings – and presents them as information on the cockpit display. This not only ensures drivers are always informed of the current applicable speed limit, it also means they can be warned when they are exceeding it.

Predictive pedestrian protection: Pedestrians are the most vulnerable road users. The proactive pedestrian protection system uses radar or video sensors for early detection of pedestrians who step out into the road without warning and might be hit by the car. The system then reacts faster than any human to automatically perform an emergency braking maneuver. This either avoids an impact or at least reduces the speed of impact and hence the severity of injuries.

Predictive collision warning: This system uses a radar sensor to detect whether there is a risk of collision with an obstacle in the road. It then builds up braking pressure in an instant to prepare the braking system for an emergency braking maneuver. At the same time, it warns the driver of the risk of collision with either an optical or acoustic signal. If the driver then steps on the brakes, maximum braking power is available immediately and the braking distance is much shorter as a result.

Automatic emergency braking: If a radar or video sensor detects a potential obstacle ahead of the car, this system first of all prepares the braking system for an emergency braking maneuver and warns the driver. If the driver doesn't respond, the system performs a partial braking maneuver in order to increase the time available to react. As soon as the driver steps on the brakes, the system helps to avoid an accident by calculating the braking power needed and increasing the braking power applied should the driver brake too gently. If the driver also fails to respond to the partial braking maneuver and the system detects that a collision is unavoidable, it performs an emergency braking maneuver itself. This helps to greatly mitigate the consequences of the accident.

Electronic assistants turn parking into child's play

Smart trailer parking: Maneuvering a car and trailer into a parking space is truly an art. The smart trailer parking system offers a convenient way for drivers to control their vehicle and trailer from the curbside using a smartphone or tablet computer. It is based on electric power steering, the ESP electronic stability program, the electronic gas pedal, and a trailer hitch featuring a trailer angle sensor. Users can select steering angle and vehicle speed with an app. The driver can stand anywhere that offers a good view of the procedure.

Parking aid: Most accidents occur when parking. At speeds of up to ten kilometers per hour during parking maneuvers, ultrasonic sensors integrated into the bumpers constantly monitor the distance to any obstacles in the parking area. Drivers are also warned optically and/or acoustically about other vehicles that are parking. The closer the car gets to an obstacle, the more frequently the acoustic warning is sounded, until it becomes a continuous tone.

Remote park assist: With the remote controlled park assist system, vehicles park themselves as if by magic. All drivers need to do is press and hold a button on their ignition key or smartphone. This tells the vehicle to automatically maneuver itself into the parking space it has previously detected and measured using ultrasonic sensors. However, drivers retain responsibility for the parking maneuver. As soon as they release the button on their ignition key or smartphone, the system immediately stops parking.

Maneuver brake assist: At a speed of up to ten kilometers per hour, ultrasonic sensors monitor the entire area around the vehicle up to a distance of four meters. The system uses this sensor data to detect relevant and non-relevant obstacles and to calculate the path the car should travel. If there is a risk of collision, the driver is warned. If the driver fails to react, the system stops the car itself.

Park steering control: This system uses ultrasonic sensors to detect parallel or perpendicular parking spaces suitable for the vehicle in question and informs the driver. Upon activation, the system then automatically steers the car into the space. The driver remains responsible for accelerating and braking.

Rear cross-traffic alert: When reversing out of a perpendicular parking space, this radar-supported system detects vehicles, bicycles, and pedestrians that are crossing behind the car up to 50 meters away. It then gives the driver an acoustic or optical warning when there is a risk of collision.

Press photos: 1-CC-21158, 1-CC-21159, 1-CC-21160, 1-CC-21161, 1-CC-21162, 1-CC-21163, 1-CC-21164, 1-CC-21165, 1-CC-21166, 1-CC-21167, 1-CC-21168, 1-CC-21169, 1-CC-21170, 1-CC-21171, 1-CC-21172, 1-CC-21173, 1-CC-21174, 1-CC-21175, 1-CC-21176, 1-CC-21177

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