Bosch – Technology to Enhance Quality of Life

- 375,000¹ Bosch associates across the globe. Including its sales and service partners, Bosch is represented in some 150¹ countries.

- Approximately 56,000¹ researchers and developers work at Bosch: at 118² locations worldwide, in a single network.

- Bosch is one of the world’s leading international providers of technology and services.

- Over the past five years, Bosch has invested more than 24 billion euros in research and development.

- Our objective: to develop innovative, useful, and exciting products and solutions to enhance quality of life – technology that is “Invented for life.”

¹ As of 12.15 ² R&D locations with >50 associates, as of 12.15
Bosch – A Global Network
Four Business Sectors

Mobility Solutions
Industrial Technology
Energy and Building Technology
Consumer Goods
BOSCH Mobility Solutions
Bosch Chassis Systems Control
Product Portfolio

<table>
<thead>
<tr>
<th>Active safety</th>
<th>ABS</th>
<th>ESP®</th>
<th>Regenerative braking systems</th>
<th>Inertial measurement unit</th>
<th>Steering-angle sensor</th>
<th>Wheel-speed sensor</th>
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</thead>
<tbody>
<tr>
<td>Actuation</td>
<td>Brake discs</td>
<td>Brake master cylinder TMC8</td>
<td>NOAH brake booster</td>
<td>Tie rod, through bolt brake booster</td>
<td>iBooster</td>
<td>Brake discs</td>
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<td>Driver assistance</td>
<td>Mid-range radar</td>
<td>Long-range radar</td>
<td>Ultrasonic systems</td>
<td>Rear/surround view camera</td>
<td>Night vision camera</td>
<td>Multi purpose camera</td>
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<tr>
<td>Passive safety</td>
<td>Airbag control unit</td>
<td>Integrated safety unit</td>
<td>Peripheral acceleration sensor</td>
<td>Peripheral pressure sensor</td>
<td>Pressure tube sensor</td>
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Bosch Driver Assistance Portfolio

- Predictive Emergency Braking
- Evasion Assistance
- Lane Assistance
- Predictive Pedestrian Protection
- Turn and Crossing Assistance
- Travel Assistance
- Driver Monitoring
- Light and Sight Assistance
- Park and Maneuver Assistance

- Long-Range Radar
- Mid-Range Radar
- Multi Purpose Camera
- Stereo Video Camera
- Infrared Night Vision Camera
- Ultrasonic Sensors
- Near Range Camera
- Head Unit, Digital Maps
- Car-to-X, Connected Vehicle
- Instrument Cluster Heads-up Display
Development Steps – Automated Driving

Degree of automation

- Single sensor
- Sensor-data fusion
- Sensor-data fusion + map

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**ACC/lane keeping support**
- Only longitudinal or lateral control

**Integrated cruise assist**
- Partially automated longitudinal and lateral guidance in driving lane
- Speed range 0-130 kph

**Highway assist**
- Partly automatic longitudinal and lateral guidance
- Lane change after driver confirmation
- Supervision of surrounding traffic (next lane, ahead, behind)

**Highway pilot**
- Highly automated longitudinal and lateral guidance with lane changing
- Reliable environment recognition, including in complex driving situations
- No permanent supervision by driver

**Auto pilot**
- Door-to-door commuting (e.g. to work) in urban traffic
- Strictest safety requirements
- No supervision by driver
A Total Transformation of the Vehicle and…
Of the Way Policy, Regulations and Standards are Shaped

“This is a remarkable time to be involved in vehicle safety. In many ways, the car hasn’t changed as much in the entire last century as it’s about to change in the next few years.”

- NHTSA Administrator Dr. Mark Rosekind
New Challenges: Multiple Agencies and Stakeholders
Vehicle Safety and the Future of Mobility
Recent Headlines in Washington, DC

Safety Debate Has Grown to Encompass Cyber Issues

POLITICO
Morning Cybersecurity
A daily briefing on politics and cybersecurity

— IS 'JACKWARE' THE NEXT BIG THING? As car companies race toward the ubiquity of autonomous vehicles, they should beware of a new kind of threat: jackware. The theoretical form of ransomware could lock up an entire car or a vital piece equipment until a fee is paid, said Stephen Cobb, a senior security researcher at ESET, in a recent blog post. Cobb explains that jackware could take control of a car via several common security gaps in connected vehicles. “Unfortunately, based on past form, I don’t have great faith in the world’s ability to stop jackware being developed and deployed,” Cobb said, citing last year’s recall of 1.4 million Fiat Chrysler cars over digital security concerns.

KPMG
70% of automotive consumers are concerned about the potential for vehicle hacks in the next five years.

THE HILL
Senator pushes for cyber protections in vehicles
TRENDING: GOP convention | Hillary Clinton | Donald Trump
NEWS | POLICY | REGULATION | BLOGS | BUSINESS | CAMPAIGN | OPINION
What is Motivating the Government and Industry?

Motor Vehicle Fatalities Increased 7.2% in the U.S.
Fatalities in Road Traffic 2013
Share of Vulnerable Road Users (VRU)

Sources:
1) Numbers for 2012, IRTAD
2) Ministry of Road Transport and Highways, Government of India 2013 Road Accident Report
3) WHO report 2011, reported road traffic fatalities from 2009
5) Traffic Accidents China, Annual yearbook 2013
6) Royal Thai Police, Traffic Accident National Highways 2005, extrapolated data (biased) based on 2005, known numbers from 2006: 12691 fatalities
What is Motivating the Government and Industry?
DOT Leadership Has Called for a New Vision

America’s transportation system is a fossil in 2045.

In Asia, electric buses travel endlessly without refueling because they receive their power wirelessly.

In Europe, driverless cars zoom around the highways, and because the technology is so safe, car crashes are as much a part of the past as horse-and-buggy accidents.

Millennials — Shaped by Technology
There are 73 million Millennials aged 18 to 34. They are the first to have access to the internet during their formative years and will be an important engine of our future economy.

Millennials are driving less. By the end of the 2000s, they drove over 20% fewer miles than at the start of the decade.
“One area that needs immediate, tangible action is cybersecurity. Failure to tackle the cybersecurity challenge would threaten the technology-driven safety transformation we all want to achieve. ...opportunities in this realm for proactive steps. In fact, such steps are essential. Regulation and enforcement alone will not be sufficient to address these risks – cybersecurity threats simply move too fast for regulation to be the only answer.”
Deutsche Bank Global Conference, January 13, 2016

“We lost 35,200 lives on our roads last year. We are in a bad place. This is a bad situation, and we should be desperate for new tools that will help us save lives. If we wait for perfect, we’ll be waiting for a very, very long time. How many lives might we be losing while we wait? Ones that could otherwise be saved by a thoughtful but determined approach to bring lifesaving technologies to the road.”
Automated Vehicle Symposium, July 20, 2016
U.S. New Car Assessment Program (NCAP)
Crash Avoidance to be Added as a Separate Category

NCAP Today

safercar.gov

NCAP Tomorrow

Overall Vehicle Score

Crash Tests

Crash Avoidance

Pedestrian
To Regulate or Not to Regulate?
New Mechanisms for Interacting with the Industry

U.S. DOT and IIHS announce historic commitment of 20 automakers to make automatic emergency braking standard on new vehicles

NHTSA Automated Vehicle Operational Guidance Public Meetings
April 8, 2016; April 27, 2016

Seventeen automakers reach agreement with US government to cooperate on safety issues in the future

NHTSA Vehicle Cybersecurity Roundtable
January 19, 2016
AV Guidance: Targeted at Industry and the States

Recommendations will be critical in shaping future efforts

DOT/NHTSA Efforts: In Six Months . . .

- Develop deployment guidance
- Create model state policy
- Identify new tools
- Structure current tools

Source: Presentation by NHTSA Administrator Dr Mark Rosekind, March 22, 2016
"If cars don’t have a driver that means that anyone can drive them no matter what age... even people as old as 70 or 80 can!"
  - Kobe, 6

"The car has a ‘thing’ in it that can tell the future and stop if you are going to have a car crash."
  - Kitty, 6