DR. WERNER HUBER.
HEAD OF DRIVER ASSISTANCE AND PERCEPTION.
BMW GROUP.
ON THE WAY TOWARDS AUTOMATIC DRIVING. THE AUTOMOBILE WORLD CHANGES.

Automated Driving is a customer request.

Sheer driving pleasure will also mean to relieve the driver. Time spent in the vehicle can be used productively.

HAD is the chance, to make the next big step towards accident free driving.

Pull: Customer Benefits

New players are entering the market

Google and Uber run the „Driverless Car“ as Game Changer for urban mobility („Automated Ridesharing“).

Push: New Players

Actors from other markets with deep knowledge in robotics and artificial intelligence.
AUTONOMOUS DRIVING HELPS TO ENSURE OUR POSITION AS TECHNOLOGY LEADER.
TODAY: THE NEW BMW 7 SERIES DRIVER ASSISTANCE PROVIDES COMFORT AND SAFETY AT THE HIGHEST LEVEL.

Active side collision protection

Steering and lane control assistant

Remote Control Parking

Night Vision

Crossing traffic warning rear / front

Lane departure warning

Lane change warning

Lateral parking aid

Active cruise control with Stop&Go

Speed limit and No Pass information

BMW Selective Beam

Rear collision prevention

Active Park Distance Control

Parking assistant

3D View

Top View

Speed Limit Assist
Active Side Collision Protection avoids lateral hazards. In the event of an imminent collision, the system guides the vehicle away from the parallel converging car.
The **Steering and Lane Control Assistant** actively assists in steering the vehicle towards the centre of a lane, relieving the driver from a monotonous driving task.
Remote Control Parking allows the driver to comfortably initiate the automated parking procedure from outside the vehicle when the car must be parked in a narrow space or garage.
FUTURE: CHANGE OF RESPONSIBILITY FROM DRIVER TO VEHICLE. DEGREES OF AUTOMATION.

<table>
<thead>
<tr>
<th>Human</th>
<th>Transition of responsibility</th>
<th>Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>No active assistance system</td>
<td>Early warning systems such as cruise control/ speed assistant</td>
<td>Machine</td>
</tr>
<tr>
<td>0 – Driver Only</td>
<td>1 – Assistance</td>
<td>2 – Semi-Automation</td>
</tr>
<tr>
<td>3 – High-Automation</td>
<td>4 – Full-Automation</td>
<td>5 – Autonomous</td>
</tr>
</tbody>
</table>

**Regulated by law and introduced into the market.**

- **Today:**
  - Awareness for take over
  - Take over request (“Eyes-off”)

- **Not regulated by law and under research.**
  - General awareness
  - No take over request (“Mind-off”)

**Degrees of Automation:**

- **0 – Driver Only:** No active assistance system
- **1 – Assistance:** Early warning systems such as cruise control/ speed assistant
- **2 – Semi-Automation:** Traffic control (e.g. congestion assistant)
- **3 – High-Automation:** Awareness for take over
- **4 – Full-Automation:** No take over request (“Mind-off”)
- **5 – Autonomous:** General awareness
FIRST IDEAS BEING IMPLEMENTED TEN YEARS AGO

- BMW Track Trainer (2006).
- Emergency stop assistant (2009).
- Highly automated driving on the motorway (Gen1: 2011; Gen2: 2014)
- Highly automated driving at the limits of vehicle dynamics (2014).
- Fully automated remote valet parking (2015).
MANY TECHNOLOGIES TO BE MASTERED ON THE WAY TO HAD. VEHICLE HAS TO ACHIEVE A SAFE STATE AT ANY TIME.
ARTIFICIAL INTELLIGENCE METHODS ARE CRUCIAL ELEMENTS.

Data Analytics in Cloud Platform for Digital Services

Learning maps, crowd data analysis…

Algorithms for Situation Recognition and Motion Planning

Computer vision/audition, sensor fusion, pattern recognition,…
First step: highly automated driving on motorways.

Motorway: Manageable complexity, structurally separated opposite lanes.

Human driver: “Still part of the game”, doesn’t need to monitor the system, secondary tasks allowed, **BUT** he has to respond appropriately to a request.

**Step 1**
- Traffic Jam Assistant
  - 0 to 60 km/h in traffic situations.
  - Following mode: Slower cars ahead.

**Step 2**
- Highway Pilot
  - 0 to 130 km/h in mixed traffic.
  - Entry to exit.
  - Managing all motorway use cases: construction areas, tunnels, obstacles...
  - Comfortable and cooperative driving behaviour, keeping to all traffic rules.
ANOTHER INTERPRETATION OF AUTOMATED DRIVING:
“BMW TAKES OVER AT YOUR REQUEST” (LAS VEGAS, CES 2015).
NEW MOBILITY SERVICES.

Step 1
- Autonomous Driving to/from customer

Step 2
- Autonomous Relocation during Night

Step 3
- Fully Automated Driving/Ridesharing
CONCLUSION.

- Automated driving serves the driver, as it could significantly shape an accident-free and sustainable individual mobility.
- Artificial Intelligence and Robotics drive the future automotive development for vehicle automation.
- Strategic partnerships and co-operations becomes a crucial element.
- On the way towards automatic driving many technologies will be introduced to enhance the active safety of cars (during manual operation).
- Remaining challenges comprise cost-efficient industrialization as well as technological, social and legal aspects.
- A joint collaboration of all key players is necessary. BMW is active in all relevant working groups.
THANK YOU FOR YOUR ATTENTION.
DR. WERNER HUBER.
HEAD OF DRIVER ASSISTANCE AND PERCEPTION.