Innovation Days Connected Drive meets Efficient Dynamics.

Driver assistance systems of the future.

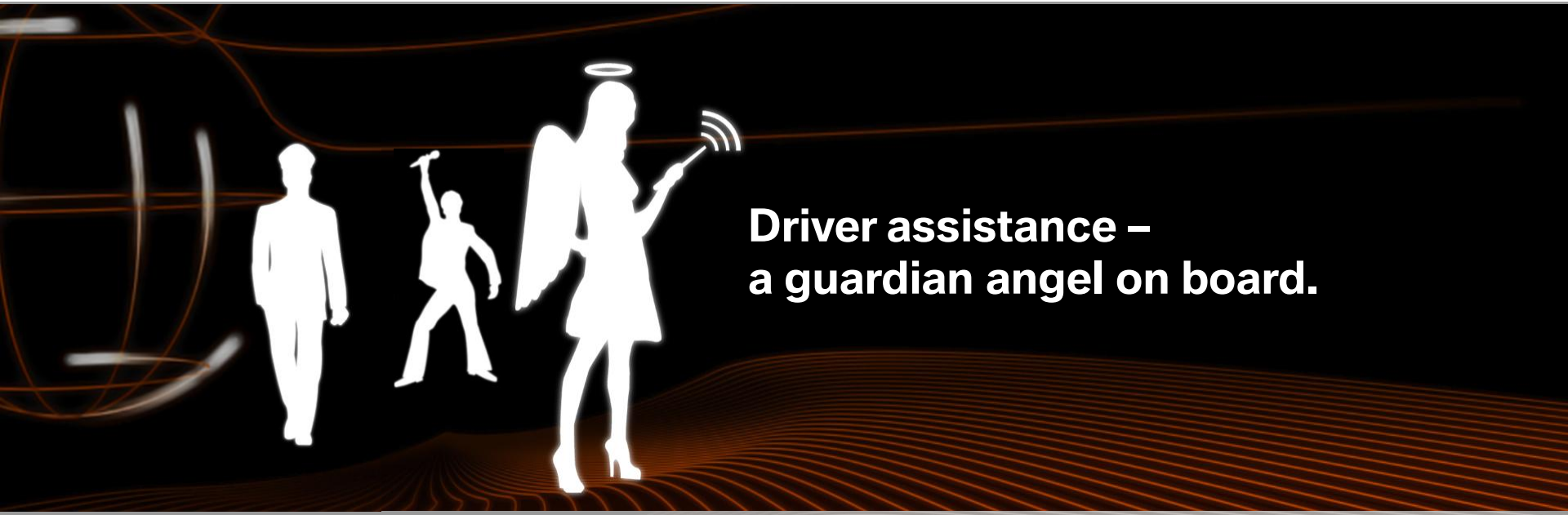
BMW Group

Connected Drive meets Efficient Dynamics.

Topics.

Presentation:	Driving prototypes:
- Active PDC and Remote Controlled Parking - Camera- and transponder-based pedestrian protection - Lateral Collision Avoidance and Active Hazard Braking -Traffic Jam and Queuing Assistant - Emergency Stop Assistant	

Driver assistance systems of the future.
A guardian angel on board.

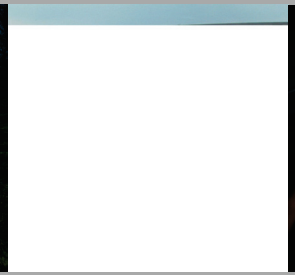


Driver assistance systems of the future.

More safety due to reliable information and better view.

Navigation

Adaptive Headlights



Speed Limit Info

Night Vision with pedestrian detection

Proactive driving assistant

Pedestrian recognition

Driver assistance systems of the future.

More safety due to active systems.

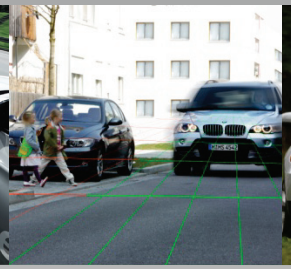
Adaptive Brake Assistant, Dynamic Brake Control

Collision warning with brake function

Camera-based pedestrian protection

Active Hazard Braking

Lateral Collision Avoidance



Transponder-based pedestrian protection (AMULETT)

Emergency Stop Assistant

Driver assistance systems of the future.

More convenience for parking.

Park Distance Control

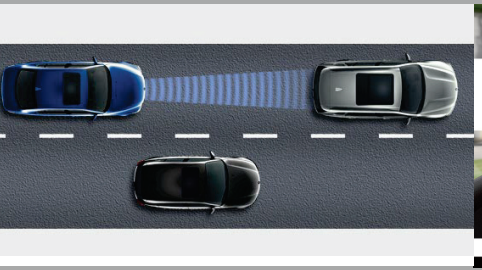
Parking Assistant

Active Park Distance Control

Remote Controlled Parking

Driver assistance systems of the future.

More convenience for driving.



Active Cruise Control

Active Cruise Control with Stop & Go Function

Narrow-Passage Assistant

Traffic Jam and Queuing Assistant

Driver assistance systems of the future.
Context.

Human factor.

- Combining human and technical powers
- “Driver in the loop”
- More sovereignty
- Delegation of tasks

Technological factor.

- Redundancy
- Sensor data fusion
- Costs
- Integration, energy consumption, weight

Legal factor.

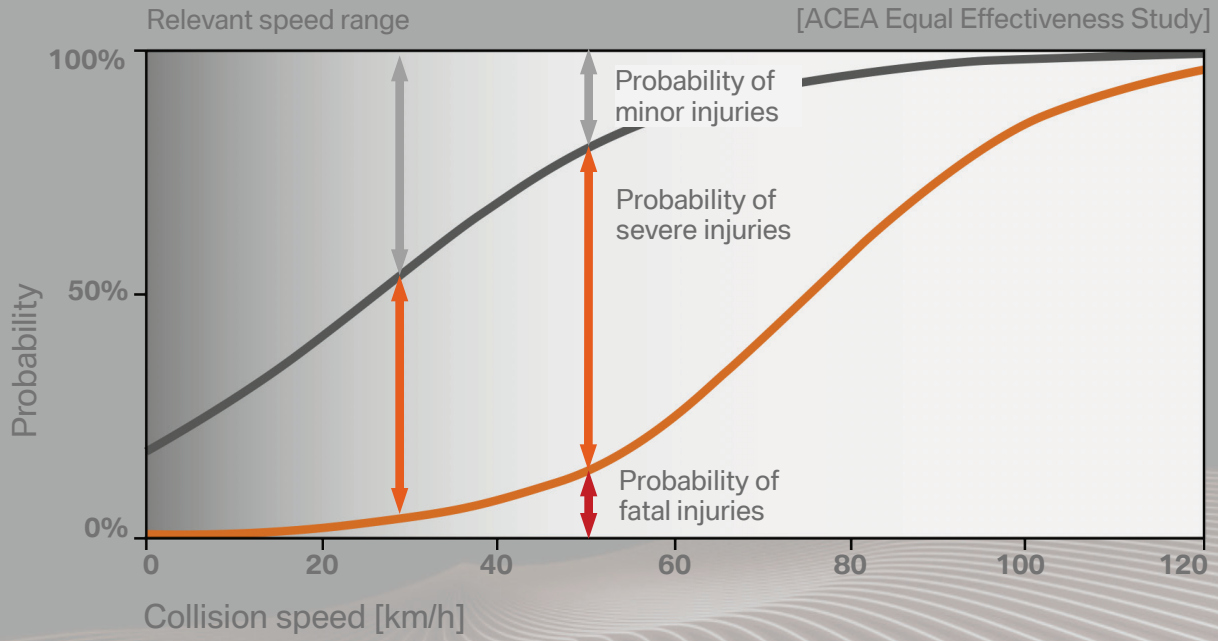
- Vienna Convention on road traffic (1968)
- Homologation
- Liability

Driver assistance systems of the future.

Driver assistance for more safety and more comfort.

Camera-based pedestrian protection.
Goals and customer benefit.

Reduction of the severity of an impact



- Increased protection for pedestrians in accidents
- Reduction of the severity of pedestrian injuries by reducing the impact energy in the event of a collision
- At best: avoidance of pedestrian-vehicle collision
- Part of an overall function “Predictive Safety”

Camera-based pedestrian protection.
Functionality.

Identification

Detection

Assessment

uncritical

preventable

unavoidable

Reaction

Camera-based recognition of the traffic situation

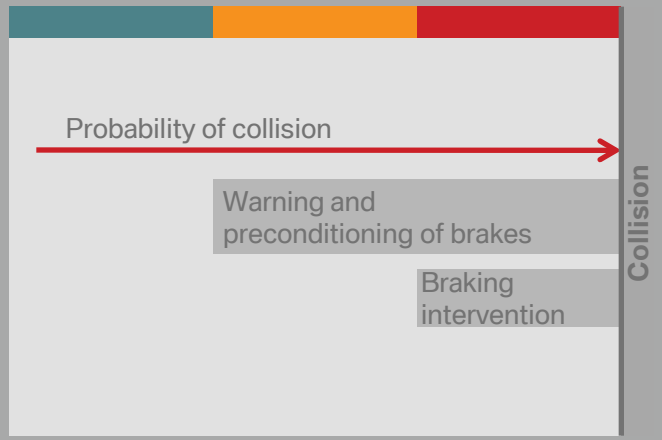
Detection of pedestrians in front of the vehicle

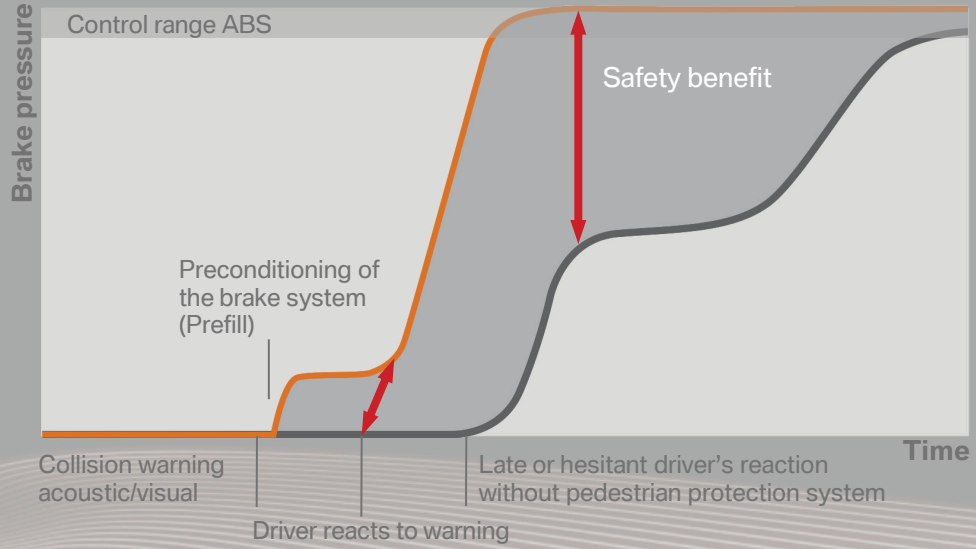
Evaluation of situations concerning the risk of accident

Different stages of system reaction

Camera-based pedestrian protection.
System reaction.

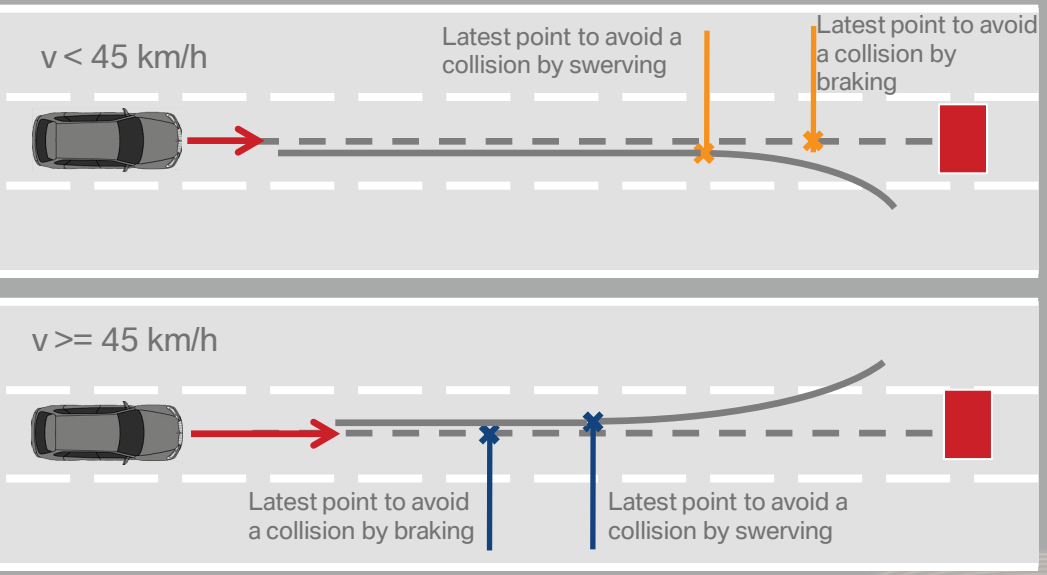
Interaction of driver and vehicle allows maximum speed reduction

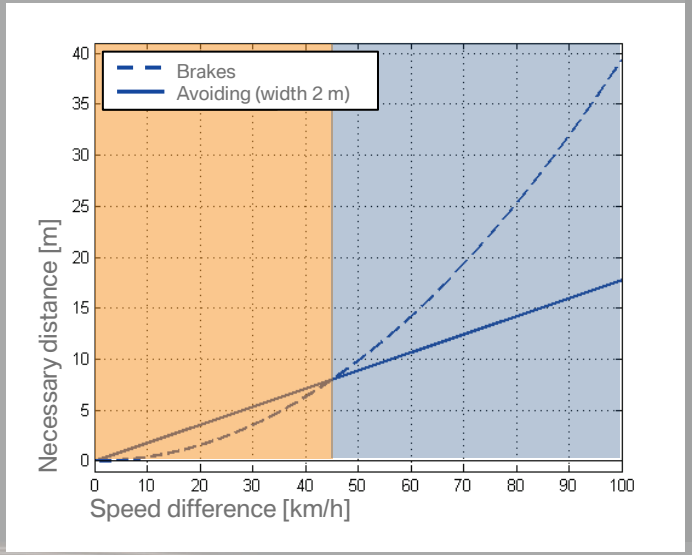




Two-stage warning strategy:
1. Warning the driver by means of visual and acoustic signals and preconditioning of braking system
2. Automatic braking if the driver does not react

Active Hazard Braking.
Challenge.





Necessary distance for braking and avoiding changes above or under approx. 45 km/h.
➔ Conflict of interest in system design

Active Hazard Braking.
Implementation.

Algorithms

Interpretation of traffic situations the driver has to react to

Continuous observation of the driver's reaction

Identification of time of intervention depending on the driver's reaction

Functions

Collision warning

Different versions

- Acoustic warning
- Haptic warning

Autonomous emergency braking manoeuvre

- Consideration of the vehicle's surroundings (avoiding possibilities)
- Consideration of moving and standing objects
- No braking respectively stopping braking when the driver reacts

Benefit to customers:

Accident avoidance also at higher speed differences due to stronger and earlier deceleration possible.
AND: No warning in normal driving situations, e.g. when the driver prepares to overtake.

Lateral Collision Avoidance.
Motivation.

Collision avoidance with vehicles on adjacent lanes

– Recognise unintentional collateral approach to other vehicles

– Warning of cars on adjacent lanes, which do not stay in their lane

Lateral Collision Avoidance.
Sensor concept.

Ultrasonic sound sensors

With the aid of ultrasonic sound sensors both sides of the vehicle are observed

- horizontal angle of beam: ±32°
- vertical angle of beam: ±9°
- range: up to 4 metres (depending on speed)

Lateral Collision Avoidance.
Function.

- Observation of both sides of the vehicle during the whole journey.
- Haptic feedback via steering wheel (directional steering momentum) when distance below safety clearance (if there is enough space on the other side)
- Additional warning in the Head-Up Display
- Steering momentum occurs only if there is enough space in the vehicle’s own lane

Transponder-based pedestrian protection.

Research projects AMULETT and Ko-TAG.

Complex

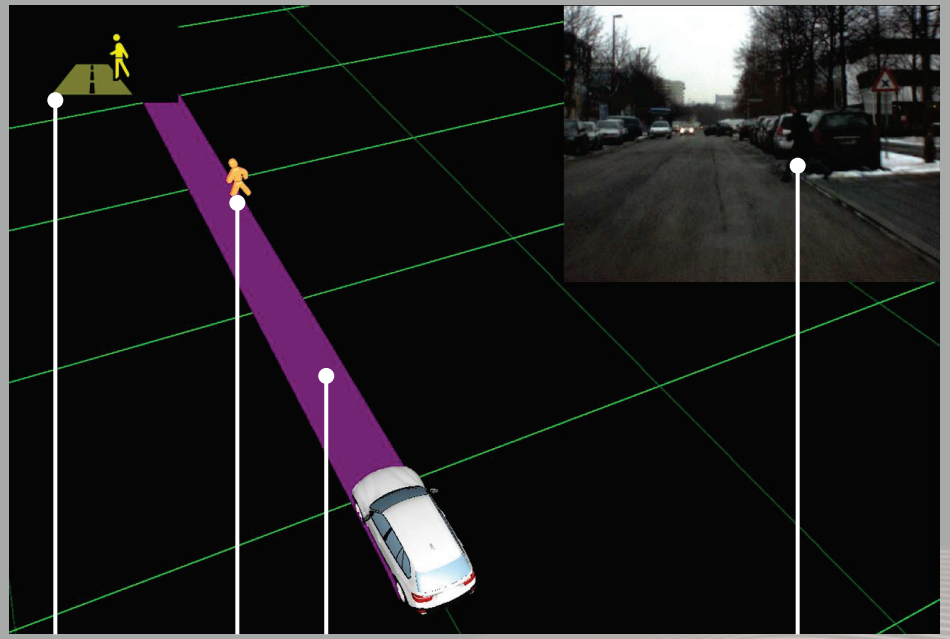
Difficult to observe

Highly dynamic

Approach:
Pedestrians wear a transponder, which can be located by vehicles also when not visible.

Goal:
Safety increase particularly for vulnerable road users.

Research projects AMULETT and Ko-TAG.
Cooperative sensor technology.



Results of positioning:
– type of road user
– distance to vehicle
– angle to vehicle

Situation evaluation and system reaction:
– driver warning
– braking manoeuvre
– emergency stop

Research projects AMULETT and Ko-TAG.

Preventive pedestrian protection system.

Warning in the Head-Up Display

Emergency stop

Research projects AMULETT and Ko-TAG.

Cooperative sensor technology.

Transponder

Multi-antenna system

Car's sensors and trigger system

Emergency Stop Assistant.
Targets.

Driver is incapacitated

Vehicle takes over control

Vehicle carries out all guidance tasks safely

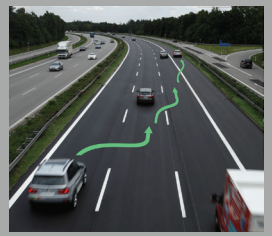
Vehicle ensures fast medical first aid for passengers

SmartSenior

Smart-phone

Sensors for vital data

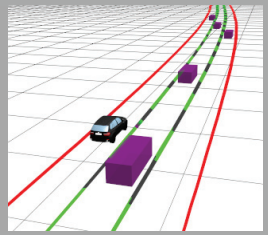
Emergency Stop Assistant.
Driving strategy.



Target

Coordination

Driving situation



Controlling the velocity and keeping the distance

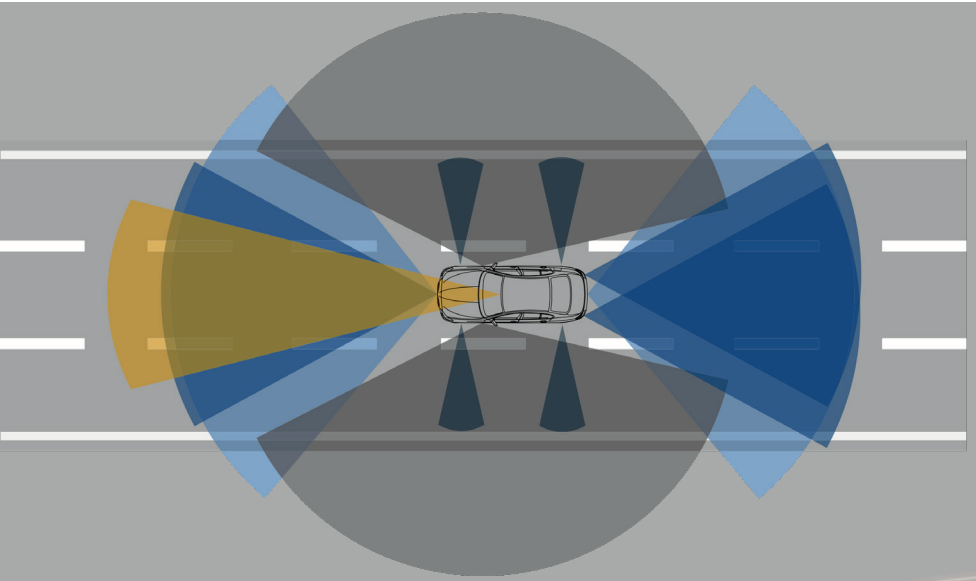
Lane keeping

Lane changing

Lane keeping and braking down to a full stop

Emergency Stop Assistant.

Vehicle environment detection – object recognition.



Laser scanner
Laser scanner
Video camera
Radar sensors
Ultrasonic sound sensors

Increasing reliability and availability of object recognition by bringing together various redundant sensor technologies.

Emergency Stop Assistant.

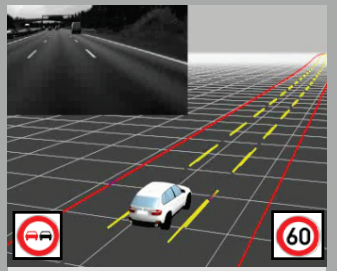
Vehicle environment detection – localisation.

Camera-based lane detection

+

Extremely accurate GPS system

+



Digital map exact to the last centimetre

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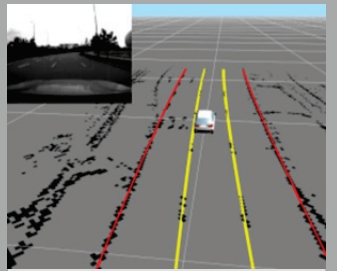
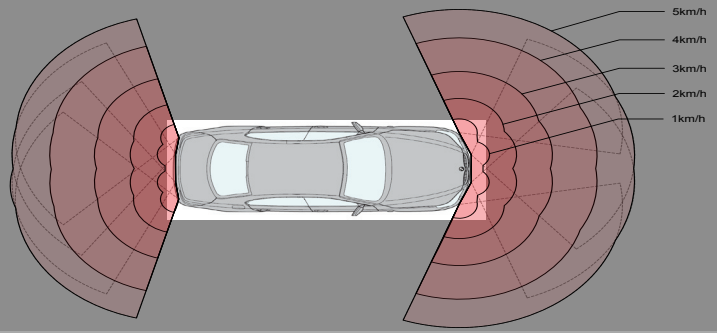


Laser-scanner-based lane and object detection

Increasing reliability and availability of localisation down to the last centimetre by bringing together various redundant sensor technologies.

Active PDC (Park Distance Control).

Brake support on parking and in manoeuvring situations.



Description:

- Convenient brake support which adapts to situations in low speed range (< 8 km/h)
- Three-stage concept: velocity limit: 5 km/h, deceleration to 1 km/h based on obstacle detection, full stop for collision avoidance
- The driver can overrule the emergency braking manoeuvre at all times and remains in full charge of the vehicle

Benefits:

- More convenience due to appropriate adaptive braking in poor-visibility parking and manoeuvring situations
- Preventing the risk of annoying dents or scratches on the vehicle

Remote Controlled Parking.
Garage parking.

Target
Development of a parking assistance function for forward perpendicular or garage parking.

Description
- Driver stands outside the vehicle
- The parking manoeuvre is activated via the car key
- Automatic forward parking manoeuvre into the garage
- Automatic backward parking manoeuvre out of the garage
- Vehicle aligns itself centrally between and parallel to the walls on either side

Benefit
Sparing the driver any awkward gymnastics or the risk of damage to the doors when getting into or out of the car .

Traffic Jam and Queuing Assistant.
Technology.

ACC Stop & Go maintains the desired distance to the vehicle in front and brings the vehicle to a full stop in heavy traffic.

Active, continuous steering assistance to keep in your lane additionally to the ACC Stop & Go for traffic jam and queuing situations.

Available for velocities ranging from 0 km/h right through to 130 km/h.

Signals in the instrument cluster and the Head-Up Display.

Simultaneous use of radar, camera and GPS.

Traffic Jam and Queuing Assistant.

The driver is at all times responsible for driving the car.

The driver can deactivate or override the system at any time, for example for a lane change, turning or leaving the motorway.

Thus it is part of the driving task to keep the hands on the wheel at all times. If the driver's hands come away from the wheel, the driver is given a clear alert to take over.

If a corner is too tight or the system reaches its limits due to insufficient road markings, the driver is prompted to take over full driving duties once again and the system deactivates itself.

Driver assistance systems of the future.

Control circuit driver – vehicle – environment.

“The best of both worlds”

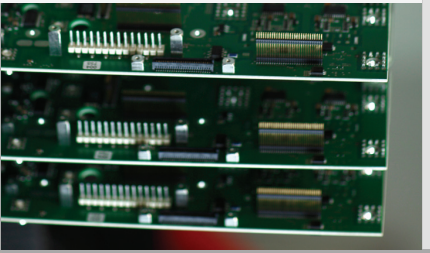
Human strengths	Strengths of technical systems
Flexibility to respond to the situation as required	No susceptibility to fatigue, stress or distraction
Rapid decision-making, even in highly complex situations	Objective measuring and assessment of physical values such as distance and relative speed
Forward-thinking responses	Fast pre-programmed reactions with high level of precision
Rapid interpretation of situations	Precise and reliable repetition of predefined processes
Strongly developed ability to improvise	
Instantaneous ethical assessment of situations	

Driver assistance systems of the future.

Driver – vehicle – environment. Interaction instead of competition.

Driver

Driver Assistance System



Information intake

Information processing / situation detection

Decision on actions

Actions

Control elements

Signal processing / fusion / situation detection

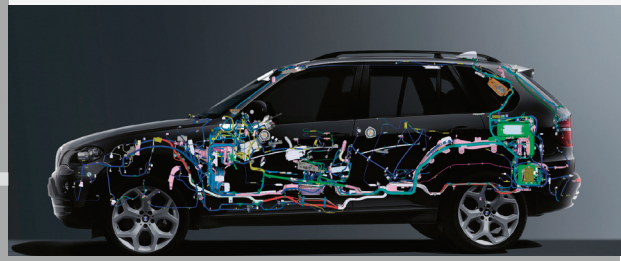
Displays

Sensors

(coordinated) function(s)

Actuators

Vehicle



Environment

Innovation Days Connected Drive meets Efficient Dynamics.

Thank you for your attention.