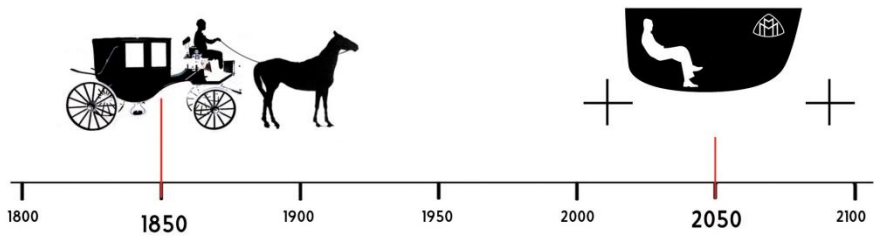


DAIMLER

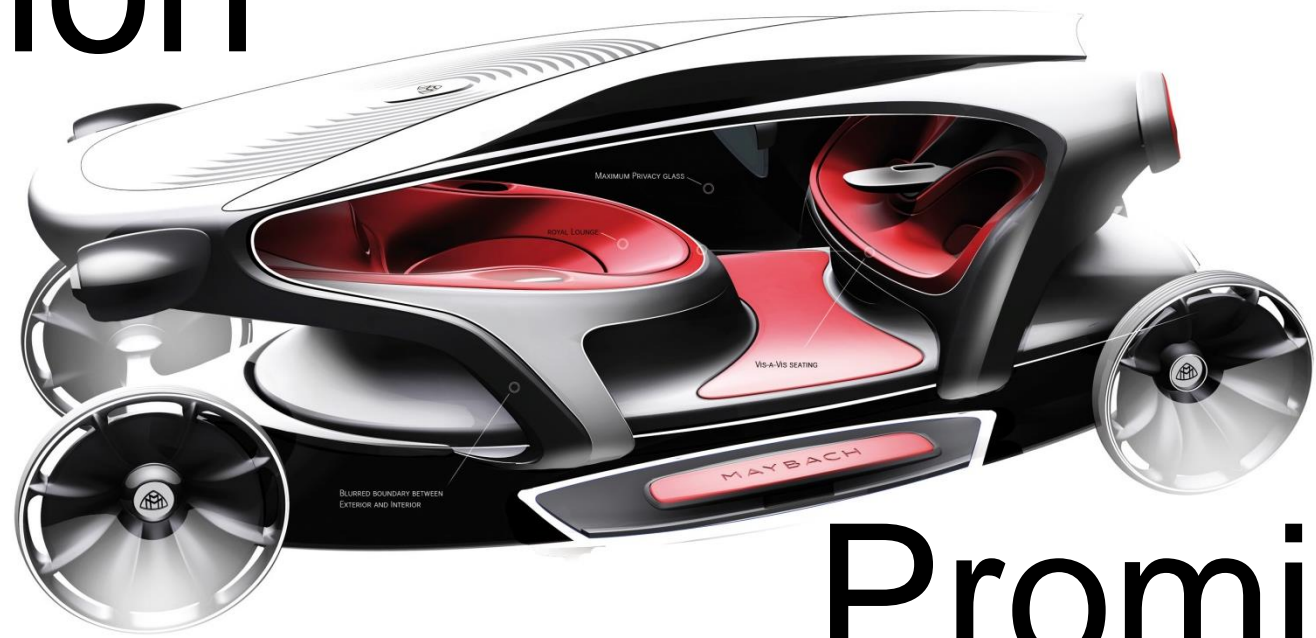
Automated Vehicles

- Vision and Promise
- State-of-the-Art
- Remaining Challenges

Eberhard Zeeb



Vision



Promise

Main Targets for Automation

Cars in private ownership

- drive comfortable and safe
- individual mobility for all
- extended use of driving time



DAIMLER

Autonomous cars allow extended individual mobility for all



DAIMLER

F 015 – Luxury in Motion



Main Targets for Automation

Cars in private ownership

- drive comfortable and safe
- individual mobility for all
- extended use of driving time



Cars for rent and share

- Bring the car to where it is needed
- Bring the car back to its station
- Use the best purpose car



DAIMLER

Autonomous cars meet the drivers wherever they are needed



DAIMLER

Our Long Term Vision of Car Sharing



Main Targets for Automation

Cars in private ownership

- drive comfortable and safe
- individual mobility for all
- extended use of driving time



Trucks to deliver goods

- extended use of driving time
- automated loading/switching
- drive safe and efficient



Cars for rent and share

- Bring the car to where it is needed
- Bring the car back to its station
- Use the best purpose car



DAIMLER

Autonomous Trucks/Vans adapt the steady flow of goods



State-of-the-Art



Series Cars Today: Mercedes-Benz Intelligent Drive

PRE-SAFE® PLUS

360° camera

Active Blind Spot Assist

Active Parking Assist

DISTRONIC PLUS
with Steering Assist

ATTENTION ASSIST

PRE-SAFE® Brake
e. g. with pedestrian detection
and urban braking function

COLLISION PREVENTION ASSIST

Active Lane Keeping Assist

BAS PLUS with Cross-Traffic Assist

Adaptive Highbeam Assist Plus

The diagram features a central white Mercedes-Benz sedan with concentric orange circles radiating from it, representing the range of various sensors. Surrounding the central image are several smaller images and text labels: a night road view with red sensor fields; a top-down view of a car with yellow sensor lines; a pedestrian running in front of a car; a car in a parking lot; a car in a city street; a car in a parking lot with cones; a car in a city street; and a car with a blue sensor overlay on a road.

Mercedes Intelligent Drive: Not only available in luxury vehicles

C-class



E-class



CLS-class



S-class



GLE-class



GLC-class

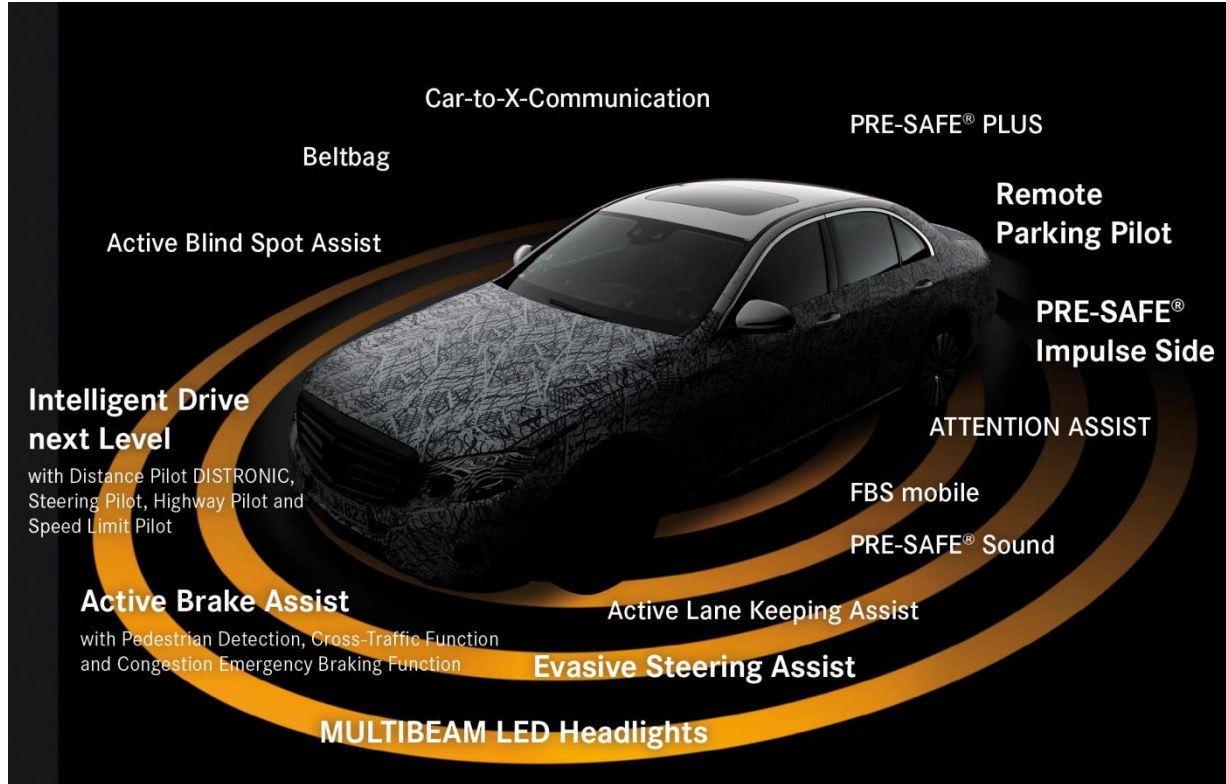


DAIMLER

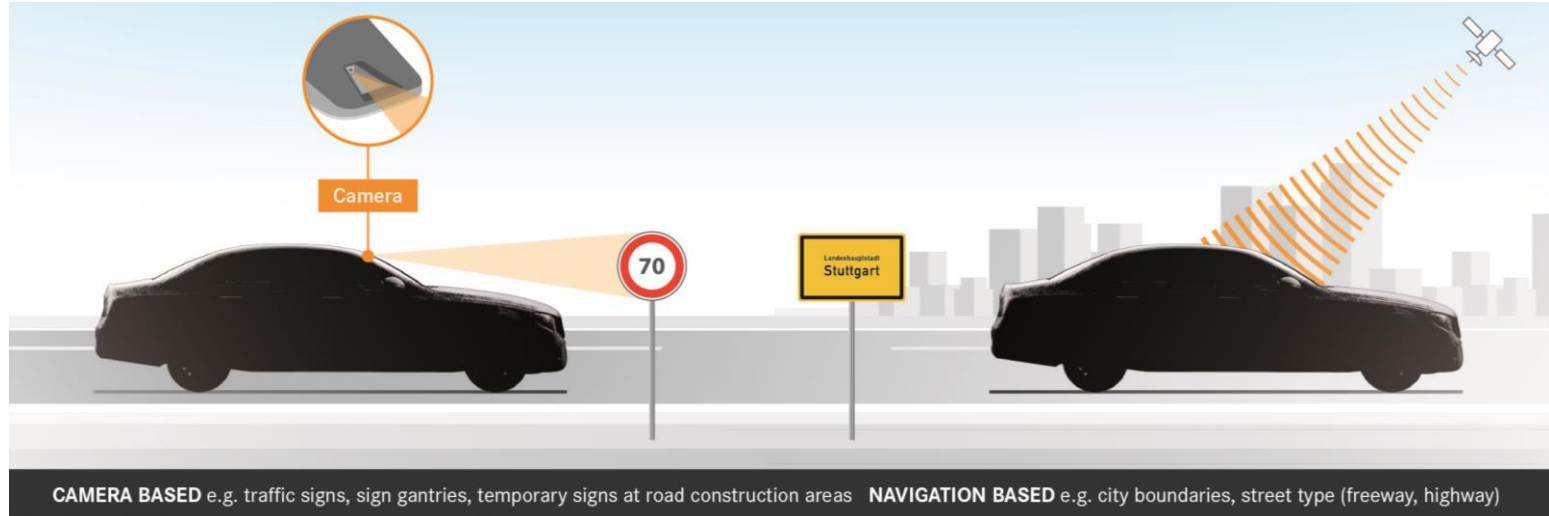
Next Step on the way to autonomous and accident free driving



Next Step on the way to autonomous and accident free driving

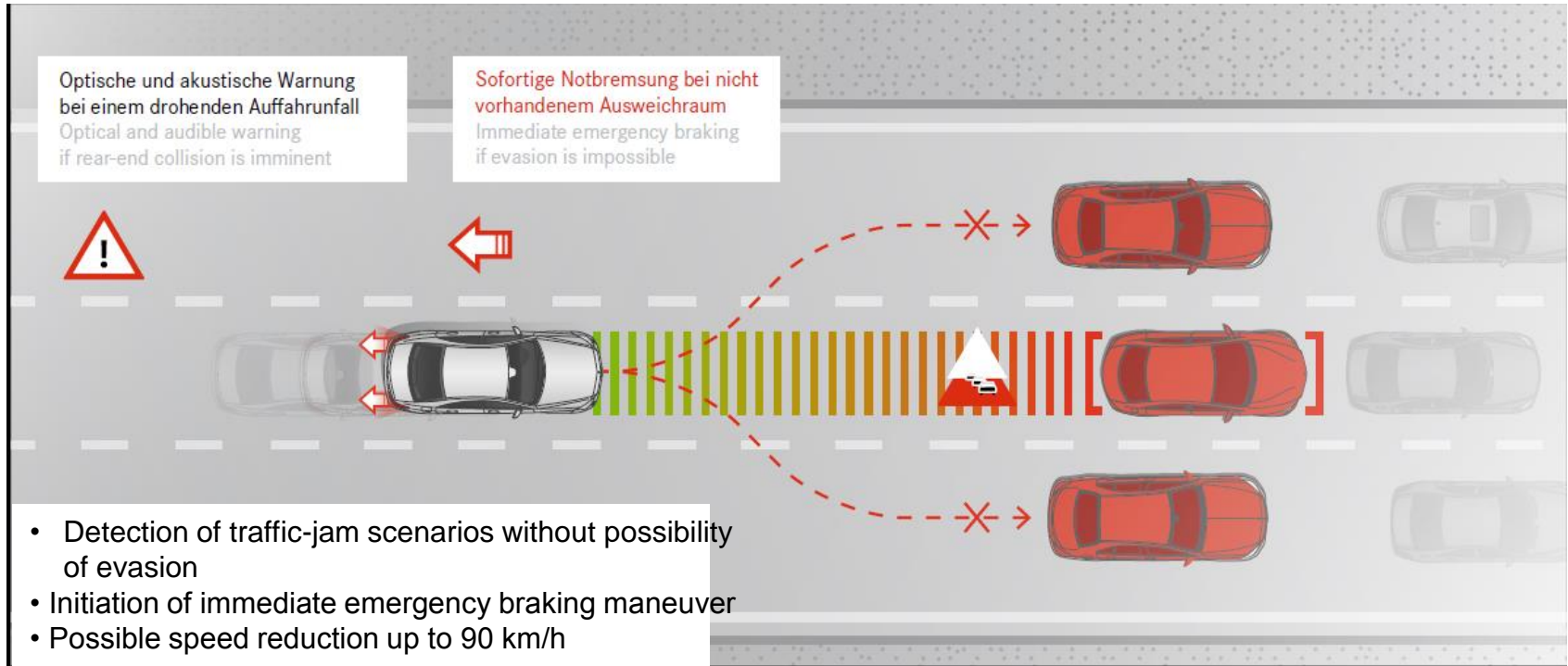


Example: Speed Limit Pilot

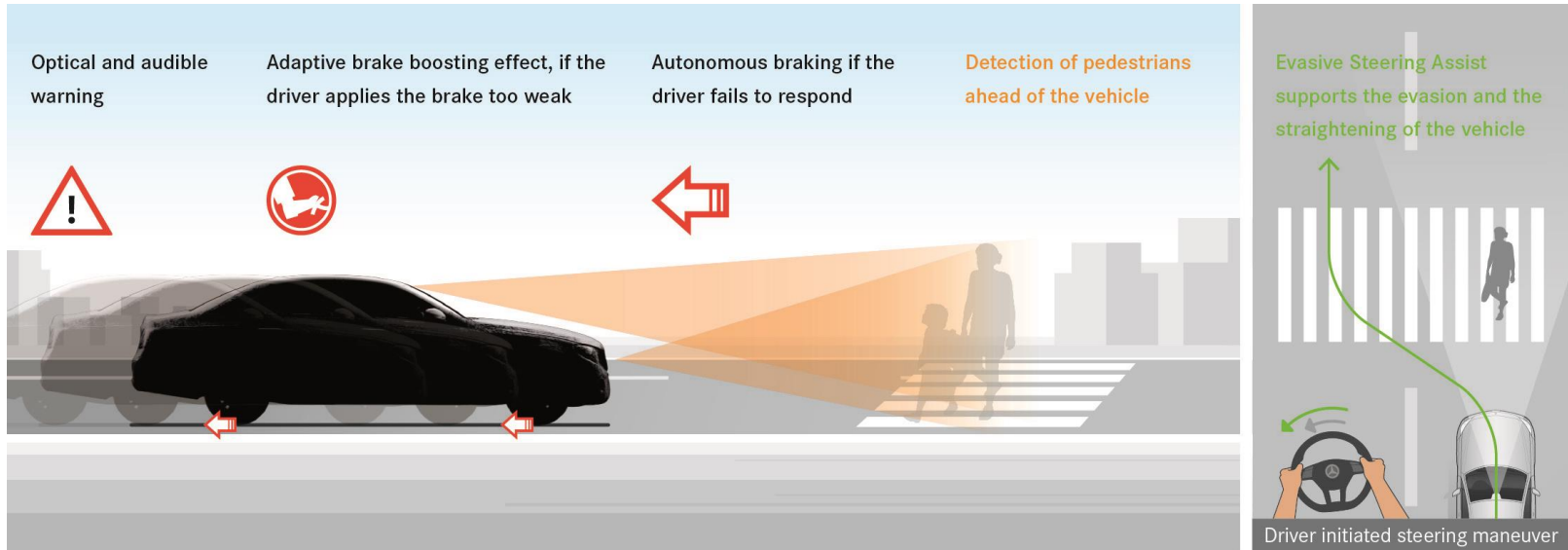




Example: Active Braking Assist with Congestion Emergency Braking

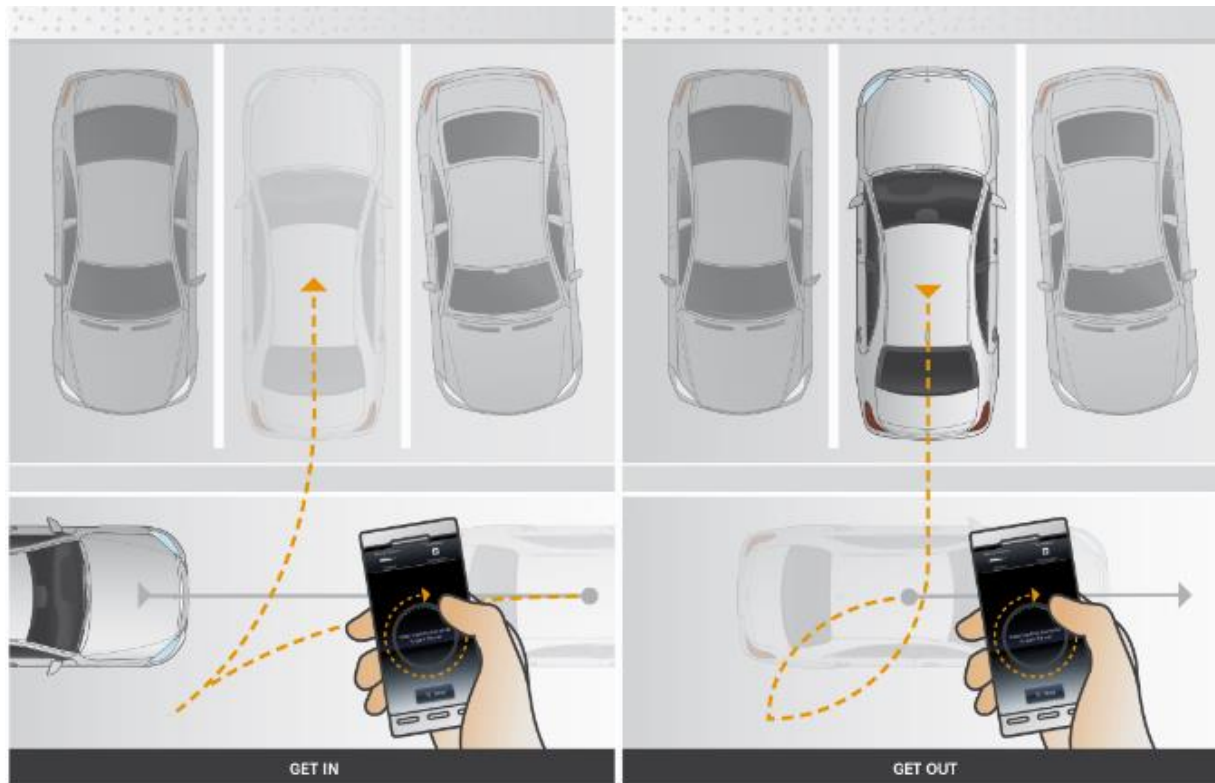


Example: Active Braking Assist and Evasive Steering Assist





Example: Remote Park Pilot



Further Steps: Change over of Responsibility from Driver to Car

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
No Automation	Assisted (Assistiert)	Partially Automated (Teilautomatisiert)	Conditionally Automated (Hochautomatisiert)	Highly Automated (Vollautomatisiert)	Fully Automated (Fahrerlos)
Drivers drives by his own		Driver has to supervise the automated function continuously. Responsibility stays at the driver No side activities allowed	System recognizes its limitations and hands over the responsibility to the driver early enough. Defined side activities allowed	System is able to manage all driving sit. autonomously. Side activities are allowed and driverless driving is possible. Driverless driving allowed	

Fail safe

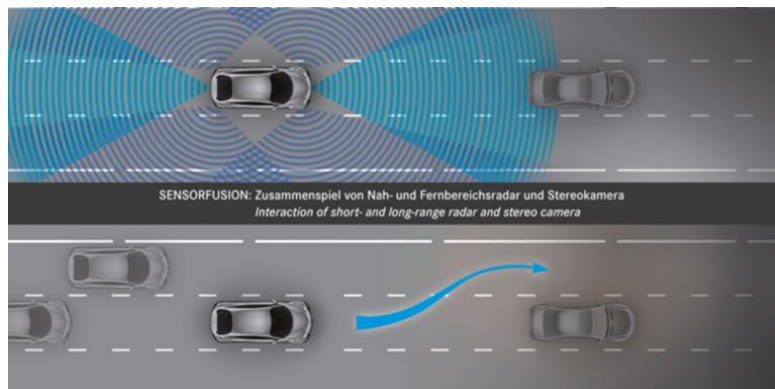
Clearly defined regulations and laws

Fail operational

regulations and laws under development

Further Steps: Autonomous Highway-Pilot

- On multi-lane roads with parallel traffic the system allows autonomous driving with driver selected cruising speed.
- All speed limits are respected, vehicle speed is adapted to traffic situations and vehicles travelling with lower speed are passed automatically
- **In Highway Pilot Mode collisions are avoided highly reliable on systems own authority (without driver interaction)**



Safety and Automation: The Major Challenge

Accidents are almost all due
to human error

Humans do much more right
when driving than they do wrong

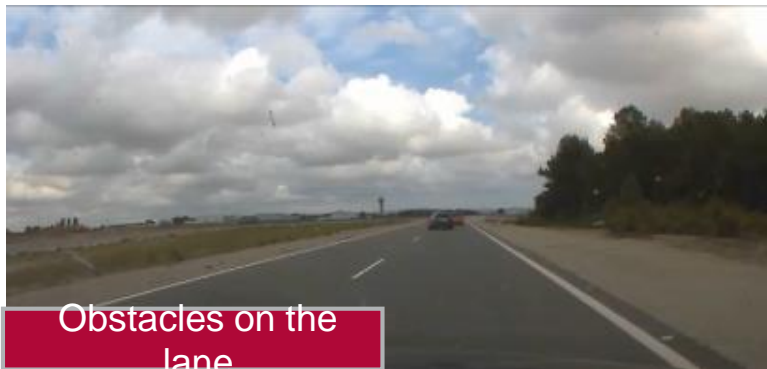
We have
with some success
automated to intervene
when people do
something wrong.

We now aim at
automating those things
that people do right.

*On the German Autobahn, every
7.5 million km we may catch an error.*

*We have to drive those 7.5 million km
and must not fail a single time.*

Level 3+: Collision Avoidance for Highly Automated Driving is Mandatory



... but it is,
depending on
weather, road, traffic conditions,
extremely challenging!

DAIMLER

Further Steps: Automated Driving on Urban and Rural Roads



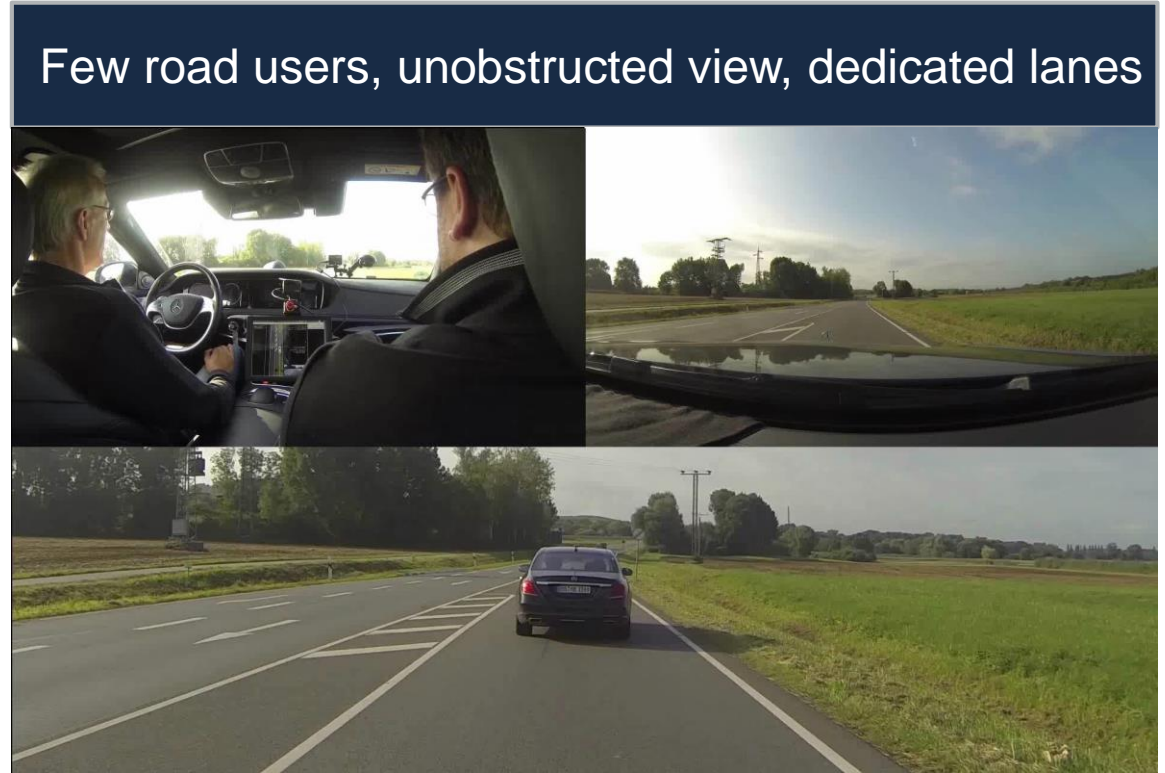
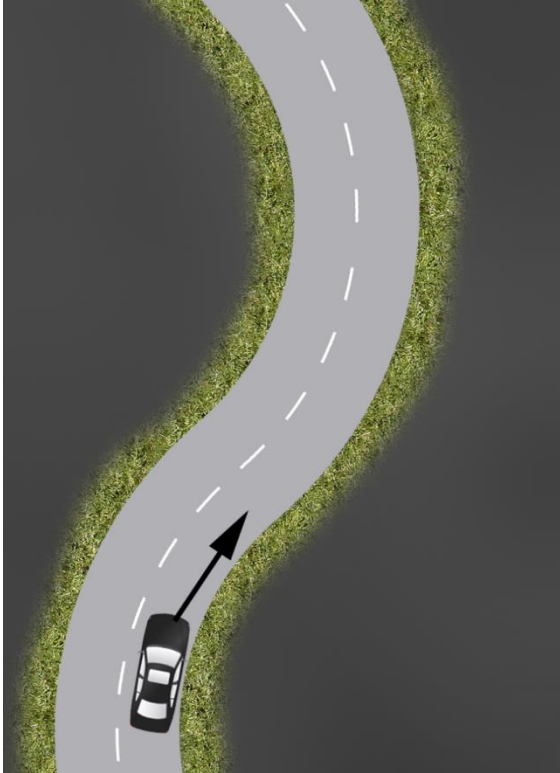
S500 Intelligent Drive: Driving autonomously on the footsteps of Bertha Benz



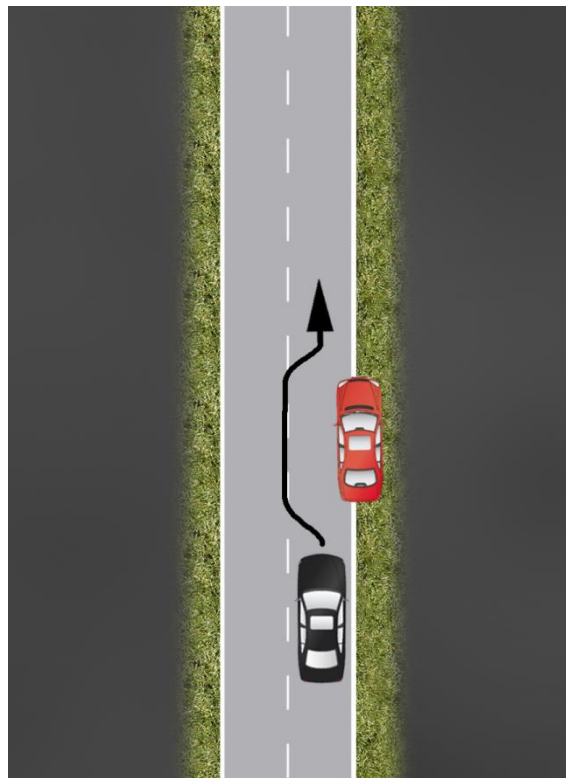
- Regular S 500 with all emergency braking systems enabled as underlying protection
- Accurate map for localization
- Additional automotive grade sensors for object detection, traffic light recognition and positioning



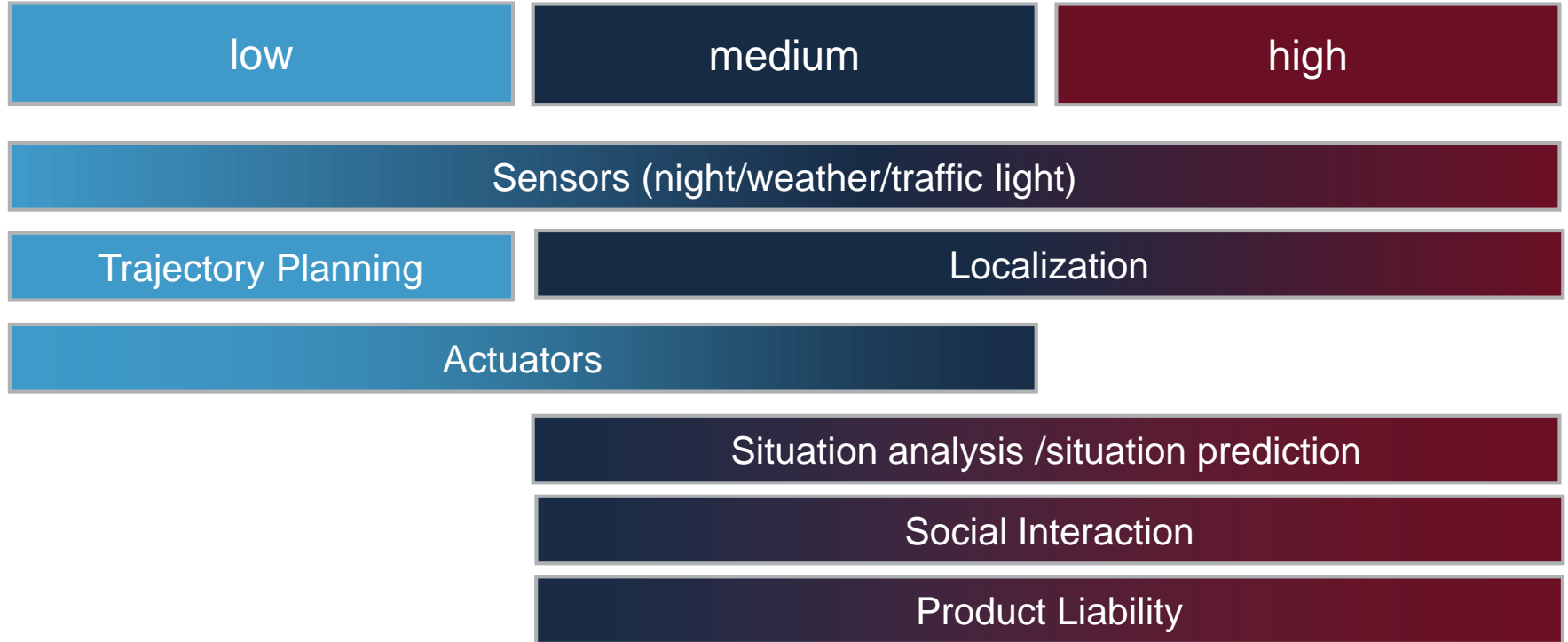
Impression of Bertha Benz Drive: Overland



Impression of Bertha Benz Drive: Inner City



Hurdles on the Way Towards Autonomous Driving



Requirements on Software Creation Process

Today: Intelligent Drive Software is developed in house

- about 2/3 is hand coded in C
 - sensor fusion software
 - situation analysis software
- about 1/3 is model coded using Simulink (using about 20 licenses in series development)
 - control software

Future Challenges for Software Creation

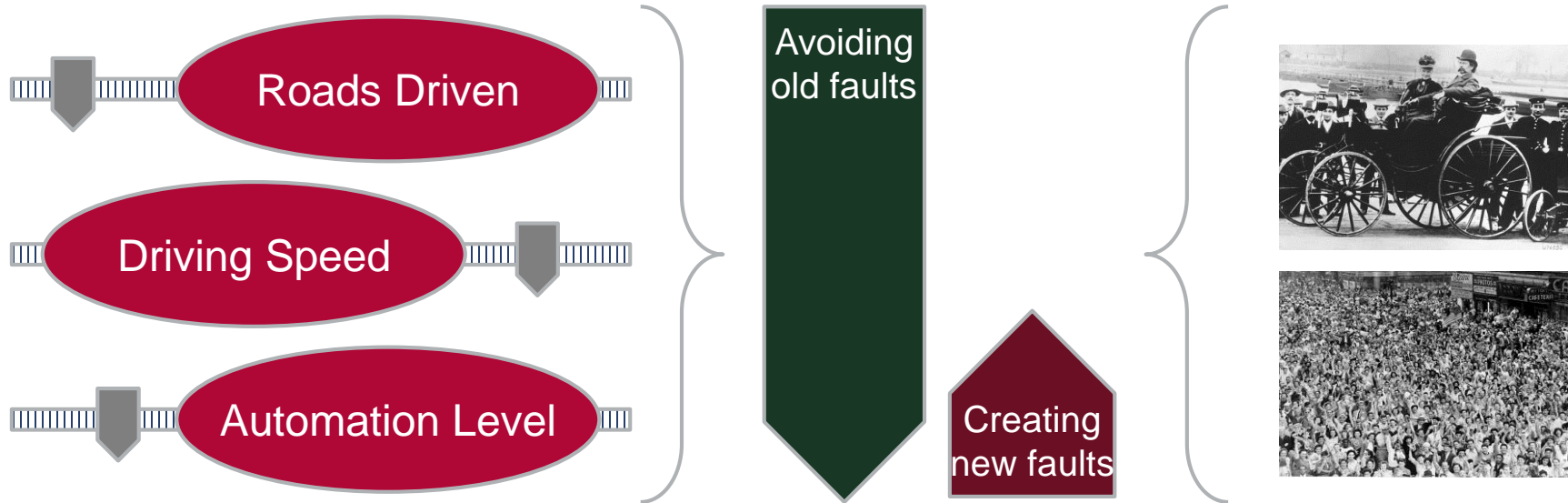
- more software modules with higher ASIL requirements, up to ASIL D
- code generator which generates automatically ASIL code
- get rid of an additional code-analysis process after automatic code generation
- efficient support for software unit test

Future Development Steps Keep „Risk Balancing“ in Mind

*One automation scenario
at a time ...*

*... with significantly
fewer risks ...*

*... for the individual
and society as a whole*



DAIMLER

F 015 – Luxury in Motion



Our Mission



Enhance comfort, safety and grade of automation step by step to reach the vision of autonomous driving soon !