



Assistenzsysteme und automatisiertes Fahren

Übersicht, Status und Ausblick

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Motivation ADAS / AD



- **Safe driving** emergency braking, blind spot warning, evasive steering
- **Driver relief and comfort functions**
e.g. parking, stop & go, traffic flow
- **Connectivity**
e.g. smart phone apps, real time traffic information
- **Unmanned driving & driver substitution**
material transport, mobility as a service e.g. Uber



Vision

- Zero fatal accidents
- Travelling with autopilot and enjoy "business class comfort"

Market Drivers



end customers

Buying Arguments & Fleet Cost

Safety & comfort features, lowest fleet operation cost by driver substitution (taxi, hub2hub logistics)



car makers

Technological Leadership & Market Differentiation

Demonstrate front runner technologies, best in class at safety, connectivity services



law

Active Safety Legislation

New General Safety Regulation (GSR) mandatory for vehicle type approval from 2022+

Law in EU from Now General Safety Regulation



Brief Regulation Relevant Features Description starting July 2022



General Safety Regulation EU2019-2144



Advanced Emergency Braking vehicle to vehicle & pedestrians

- automatically detection of potential collision and activation of vehicle braking to avoid mitigation or collision



Reversing Detection

- make the driver aware of people and objects at the rear of the vehicle



Emergency Lane Keeping System

- assisting the driver in keeping a safe position of the vehicle with respect to the lane or road boundary, at least when a lane departure occurs or is about to occur



Driver Drowsiness and Attention Warning

- assessment of the driver's alertness through vehicle systems analysis and warning the driver if needed;



Intelligent Speed Assistance

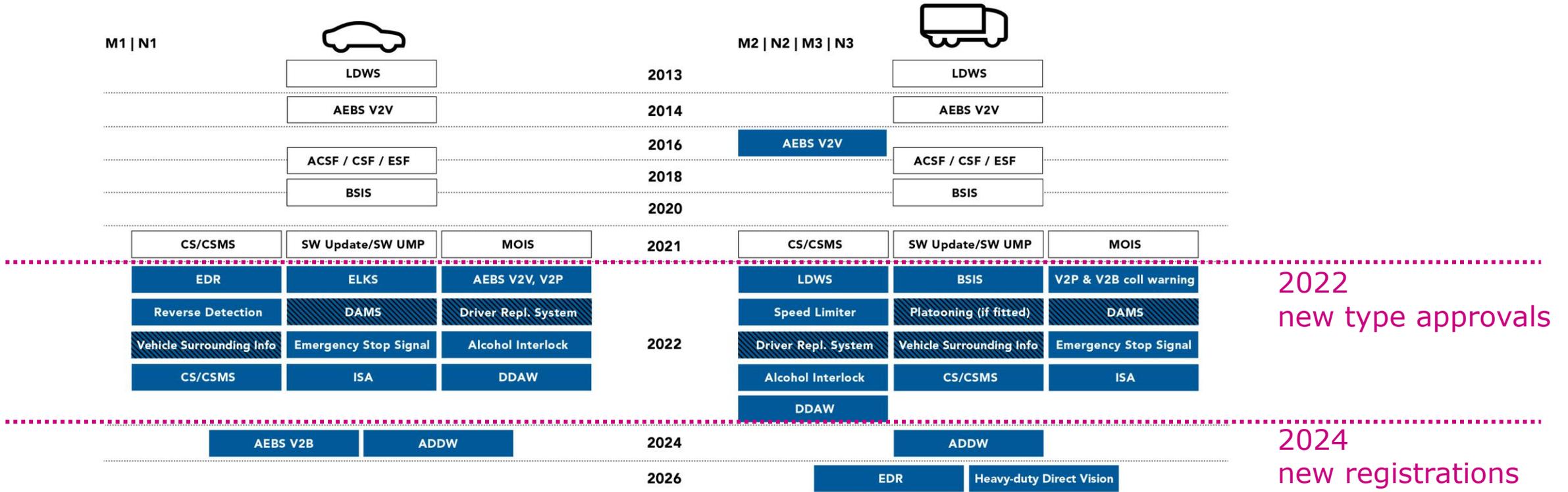
- aid the driver in maintaining the appropriate speed for the road environment by providing dedicated and appropriate feedback

- emergency stop signals
- event data recorder
- cyber attacks protection
- alcohol-interlock interface

Roadmap EU2019-2144

- „if fitted” requirements
- mandatory for new type approvals (2022) and all new registrations (2024)
- only in case of automated vehicles

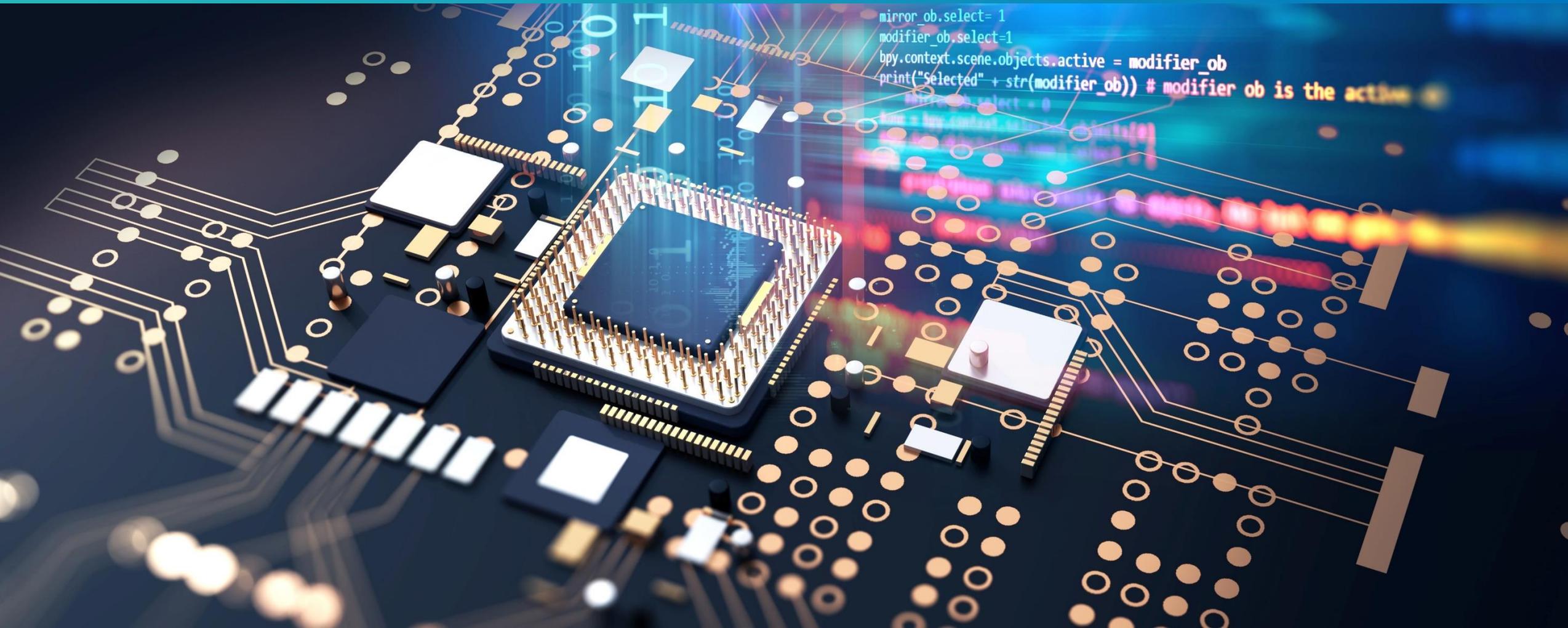
Regulatory Roadmap for ADAS features **M1-N3**



2022
new type approvals

2024
new registrations

Legend: ACSF (Automatically Commanded Steering Function), ADDW (Advanced Driver Distraction Warning), AEBS (Advanced Emergency Braking System), BSIS (Blind Spot Information System), CS (Cyber Security), CSF (Corrective Steering Function), CSMS (Cyber Security Management System), DAMS (Driver Availability Monitoring System), DDAM (Driver Drowsiness and Attention Warning), EDR (Event Data Recorder), ELKS (Emergency Lane Keeping Systems), ESF (Emergency Steering Function, ISA (Intelligent Speed Assist), LDWS (Lane Departure Warning System), V2B (Vehicle to Bi-cyclist), V2P (Vehicle to Pedestrian), V2V (Vehicle to Vehicle)

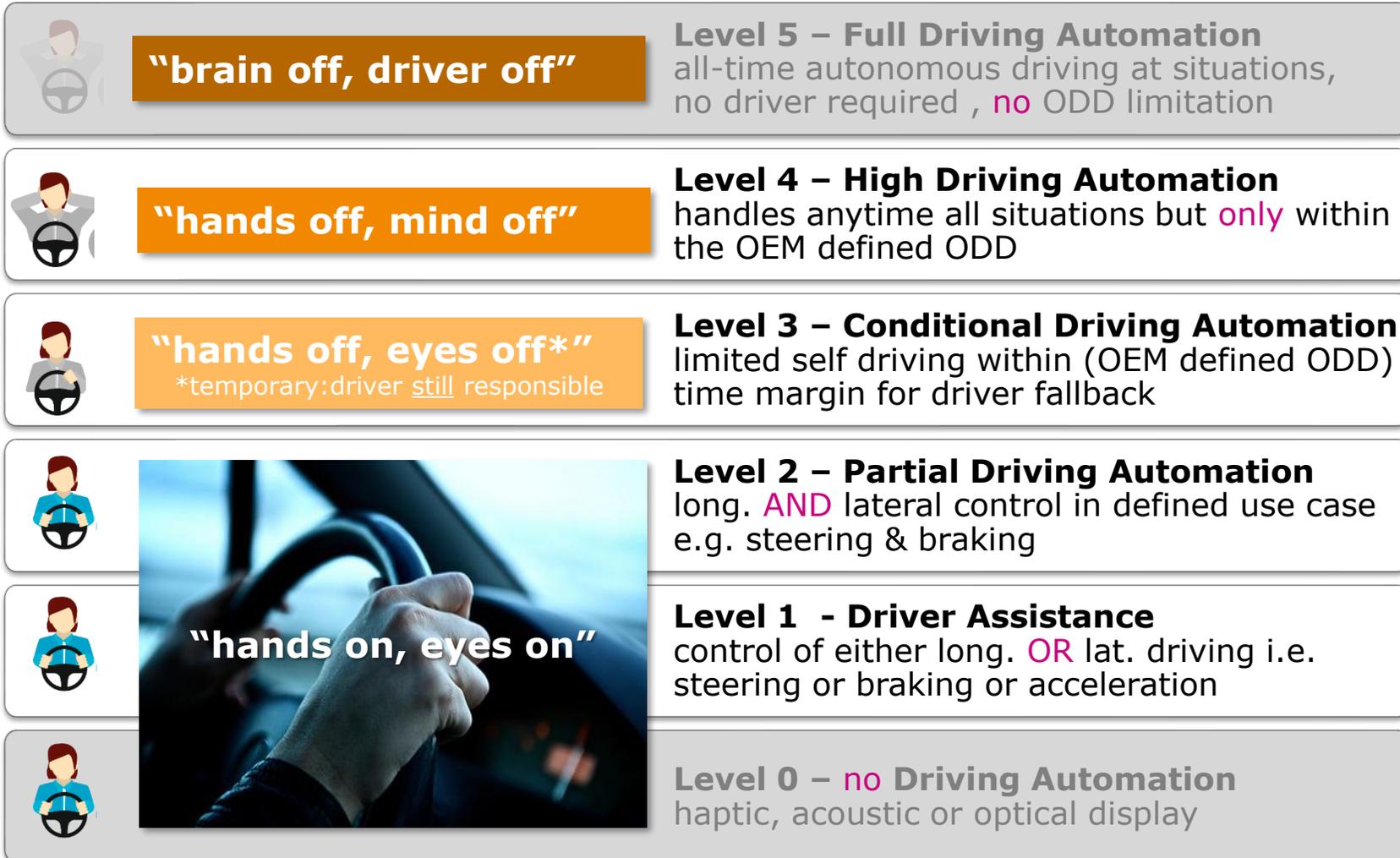


5 SAE Levels of Driving Automation

Who is When Responsible?

 "HAF"
hoch automatisiertes Fahren
**Automated
(Autonomous)
Driving**

A
D



 "FAS"
Fahrerassistenzsysteme
Assisted Driving
(advanced driver assistance system)

A
D
A
S

car makers liability area
police fines, car break downs, system errors, ...

driver is all time responsible
e.g. false negatives, system failures, end of ODD, bad light conditions, ...

Levels definition according **SAE J3016** | **ODD**=Operational Design Domain | **OEM** = car maker (original equipment manufacturer)



Practical Examples (ACC) Fallback Scenario

ODD: operational design domain / HWP: highway pilot / ACC: adaptive cruise control

immediate stop of control by ACC

driver must take over **immediately**



ACC out of ODD

- sensor fail
- traffic or environment conditions outside
- ignored hands on



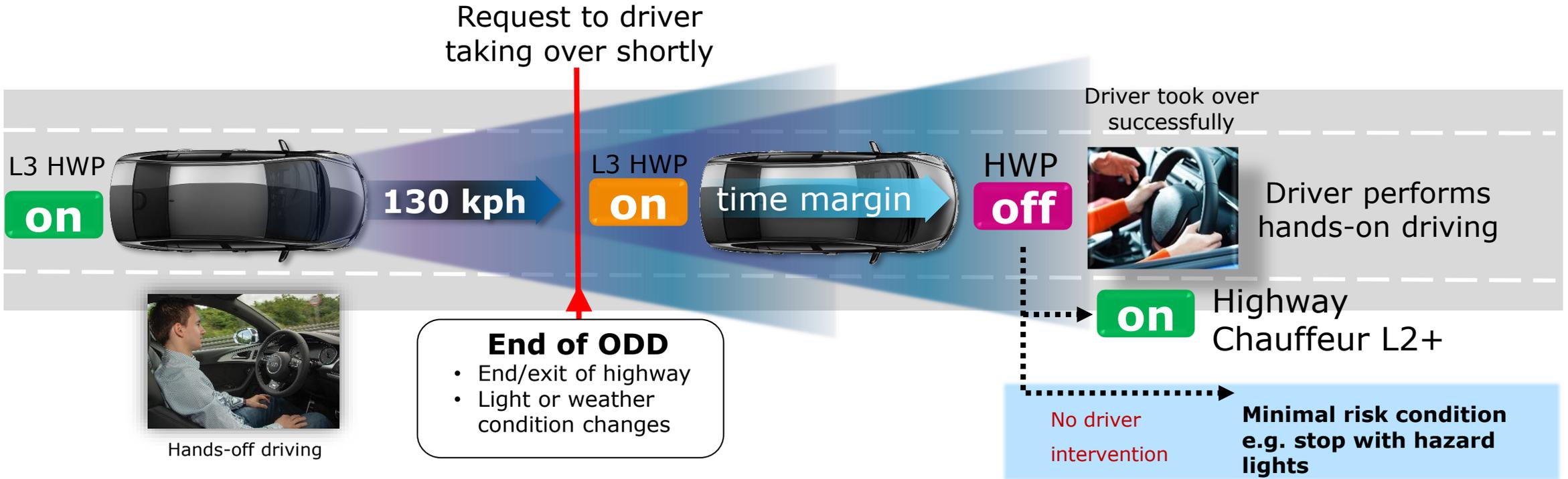
Driver always responsible

e.g. insufficient sensor capability for bicyclist or red traffic light detection → driver must intervene

L3

Practical Examples (Highway Pilot) Fallback Scenario

ODD: operational design domain / HWP: highway pilot / ACC: adaptive cruise control



Hands-off driving

End of ODD

- End/exit of highway
- Light or weather condition changes



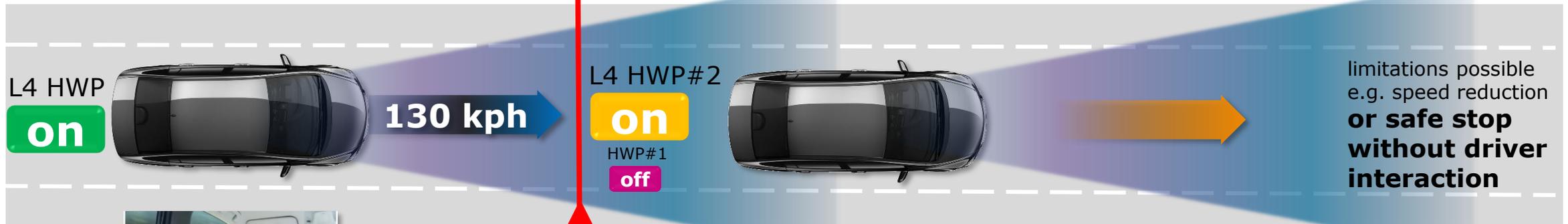
Driver responsible for e.g. vehicle failures like flat tire but not in case of ADAS failures or insufficient environment detection like sensor blackout due to severe weather conditions

L4

Practical Examples (Highway Pilot) Fallback Scenario

ODD: operational design domain / HWP: highway pilot / ACC: adaptive cruise control

failure redundant L4 system proceeds with driving task



fully automated driving

any failure
or end of ODD

- End/exit of highway
- vehicle or sensor failure

Driver is never responsible (within ODD)



flat



police stop



snow



heavy rain



power fail



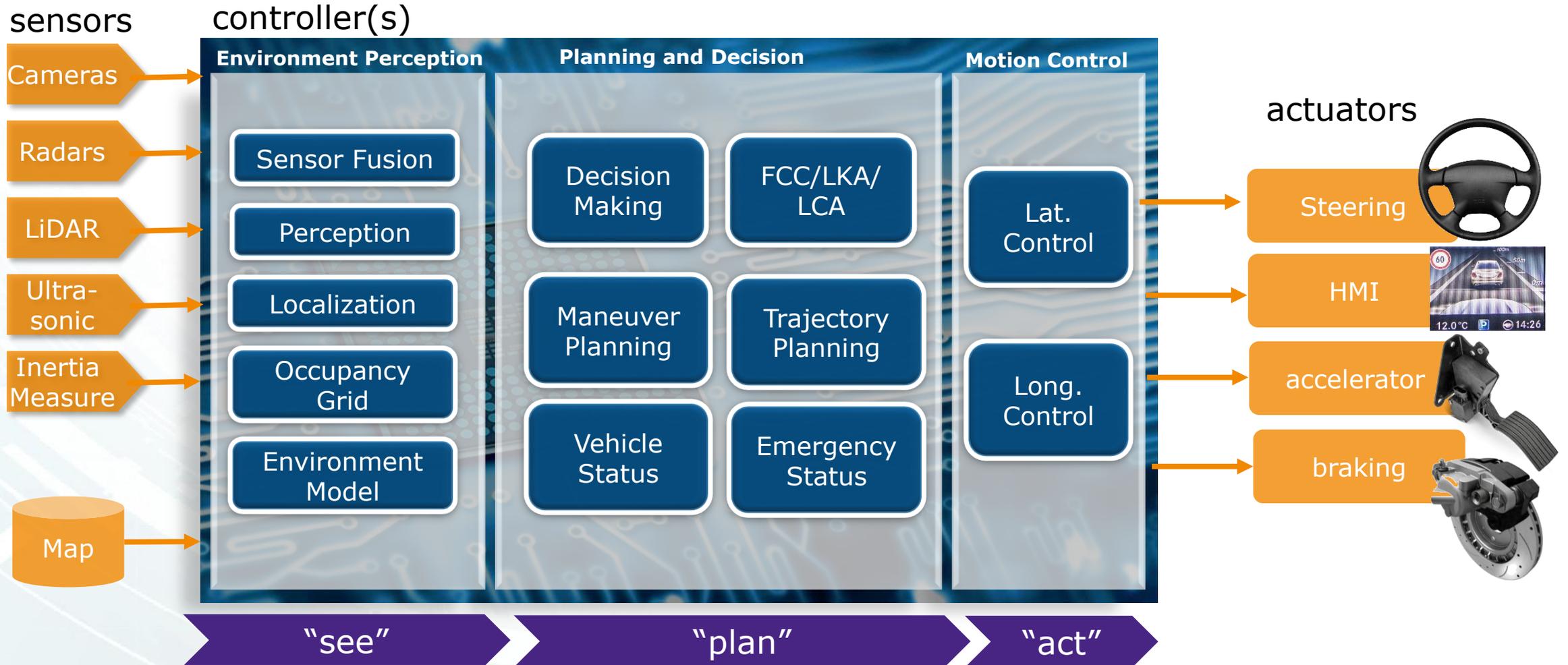
animal crossing



signs

ADAS Controller

Generic Software Architecture



Operation Examples: Active Safety ADAS



Collision avoidance
vehicles, pedestrians, bicyclist



Lane keeping aid
>65 kph



Run-off road mitigation
65-140 kph



**Cross traffic alert
with auto brake**



**Blind Spot Information
System (BLIS)**



Video Source: <https://www.volvocars.com/intl/v/car-safety/driver-assistance>

Typical ADAS Sensors & Features



Radar

Source: Continental



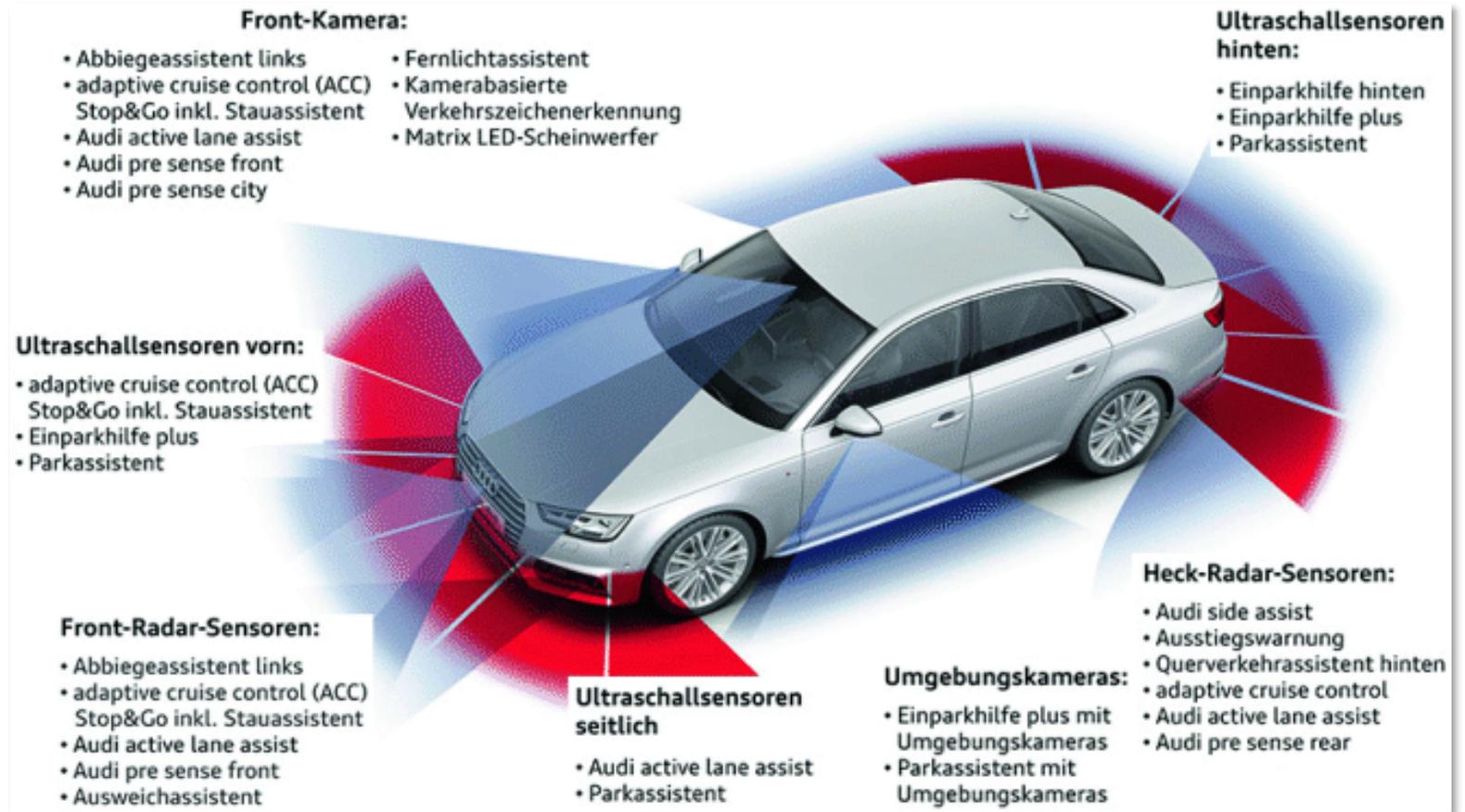
Camera

Source: Magna



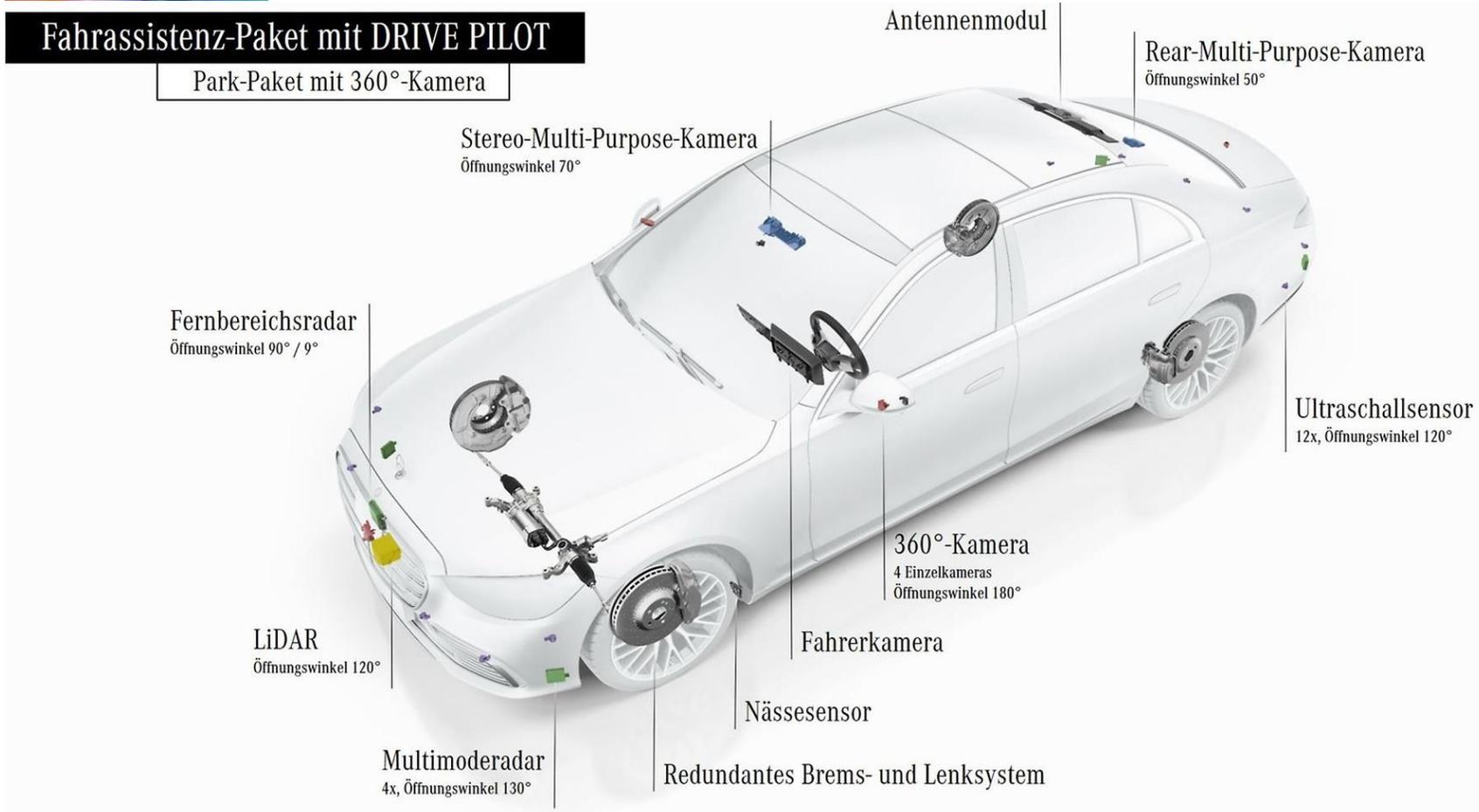
ab Level 3:
Laser (LiDAR)

Source: Bosch



Quelle: ATZ/MTZ Fahrwerkhandbuch 2017, Springer

AD Level 3 Sensoren

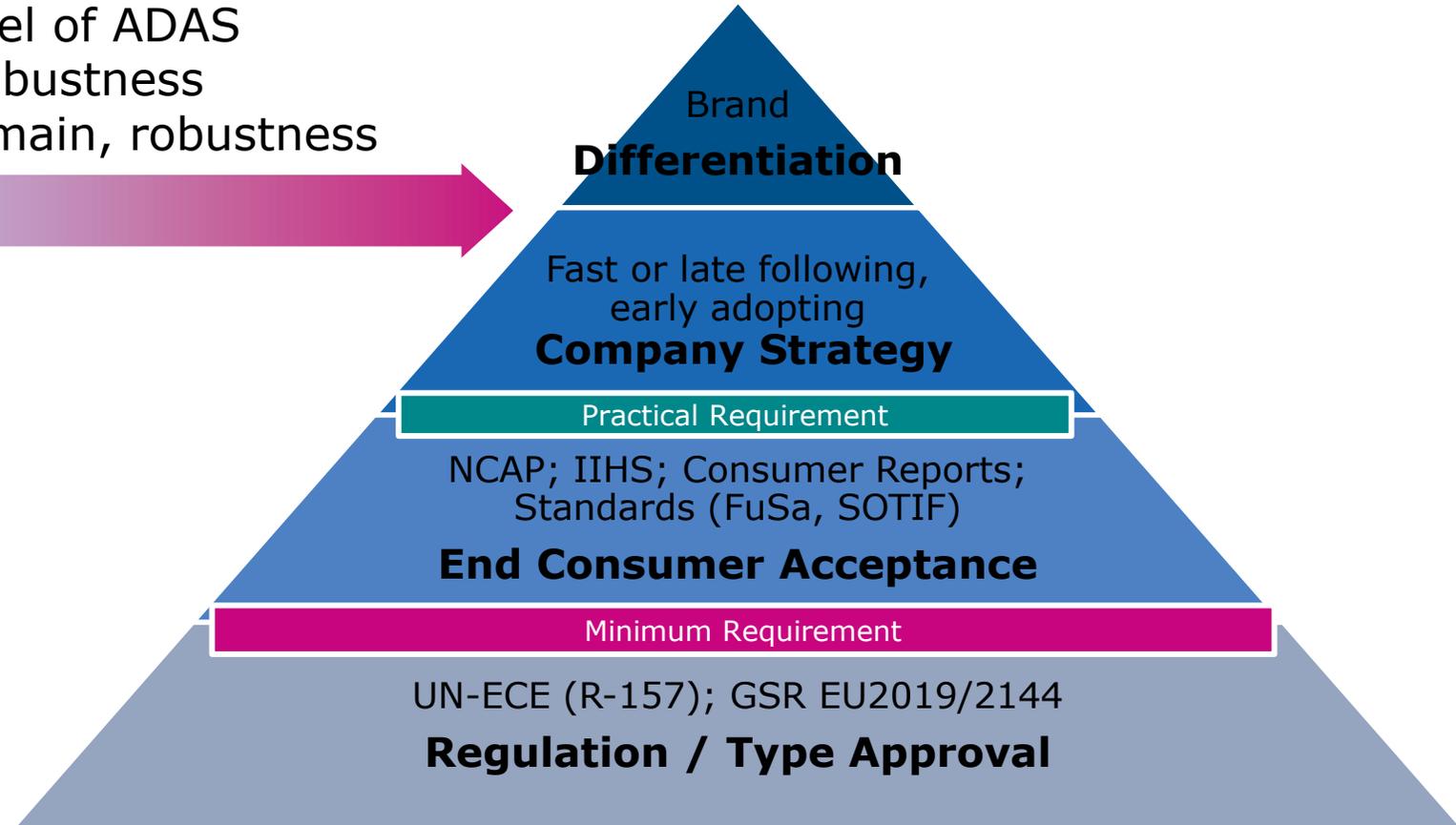


Staupilot für Autobahnen bis 60km/h

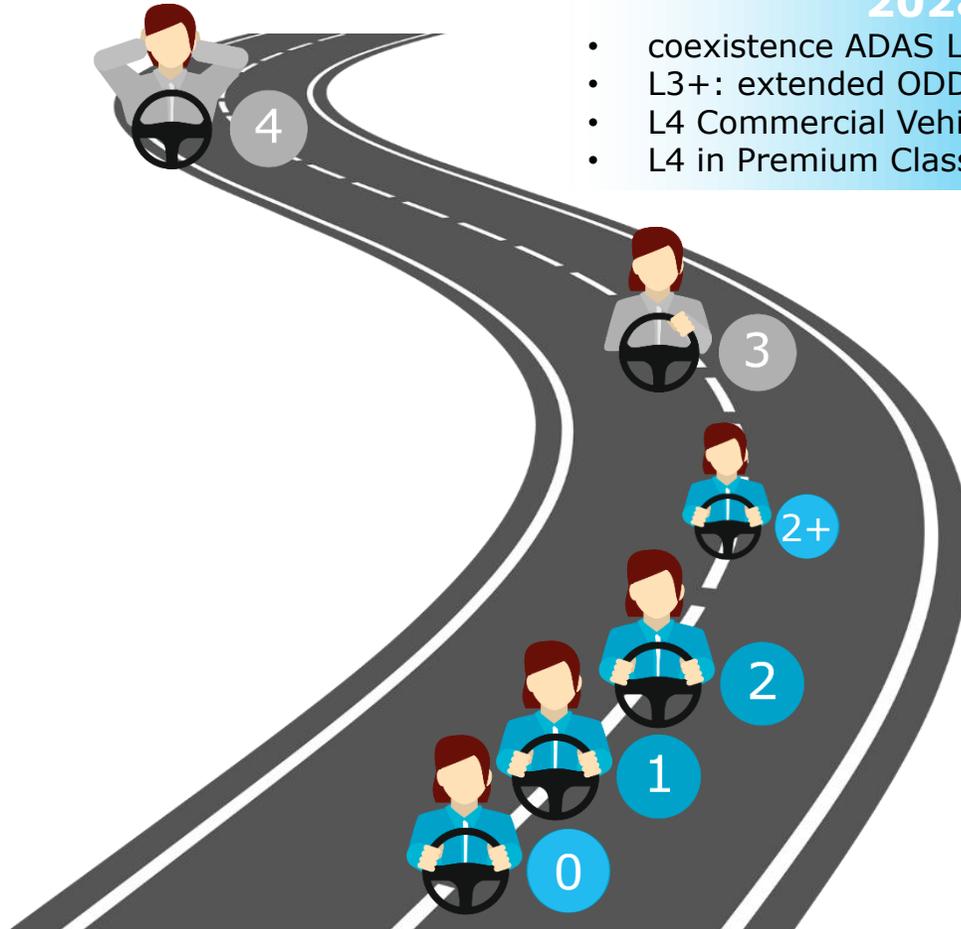
Quelle: <https://group.mercedes-benz.com>

Why Different? ADAS Design Range for Car Makers

- ✓ Type, number, SAE Level of ADAS
- ✓ Performance quality, robustness
- ✓ Operational Design Domain, robustness



Roadmap



2028, 2029

- coexistence ADAS L0-L2 & AD features, over-the-air update & upgrade
- L3+: extended ODD, refinement
- L4 Commercial Vehicle (truck) on public roads e.g. highway
- L4 in Premium Class (limited ODD e.g. valet parking)

2024, 2025

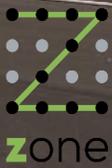
- **L0 GSR 2** - Active safety for all registrations → **100% in EU**
- **L0, L1, L2, L2+:** higher market penetration & refinement
- **L3 Premium Class:** extension of ODD e.g. ALKS 130km/h
- **L4 confined areas** commercial vehicles

2022, 2023

- ✓ **L0: GSR 1** - active safety for all new type approval (GSR1)
NCAP23 – extended active safety
- ✓ **L0, L1, L2+:** 10-25 L0 to L2+ features
- ✓ **L3:** 3 Premium Class OEMs
ALKS (Traffic Jam Pilot for Highway, 60km/h)



Development of ADAS: TESTING and VALIDATION Before Market Launch



ADAS Testing and Validation

- All development phases min. 1mio.km virtual & road (AD 777)
- Typically, **1500-2000 proving ground tests every new vehicle** launch (@basic L0-L2 ADAS)
- >100.000 km real-life tests through EU27+UK



development progress

Model/Software-in-the-Loop

Hardware-in-the-Loop

Driver-in-the-Loop

Proving Ground

Real World Fleet Validation

Start of Production

ADAS Testing and Validation

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Proving Ground & Road Examples



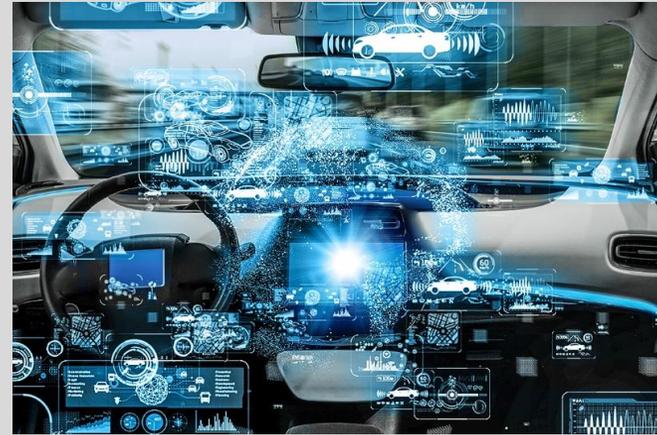
AVL Company Activities at ADAS / AD

Engineering Services



SYSTEM DESIGN, CALIBRATION AND TESTING SERVICES

Target and KPI definition, integration, performance optimization, verification and validation – from virtual to the proving ground and the real world.



TAILORED SOFTWARE AND CONTROLS DEVELOPMENT

Independent, tailored software and controls development for proof-of-concept and series production, including functional safety, cybersecurity and V2X.

Instrumentation & Test Systems



TOOLS AND METHODS FOR DEVELOPMENT AND TESTING

Scenario-based open verification and validation toolchain for ADAS/AD components, systems and features, integrated into the customer's virtual and real test environments.

Vielen Dank!



www.avl.com/adas