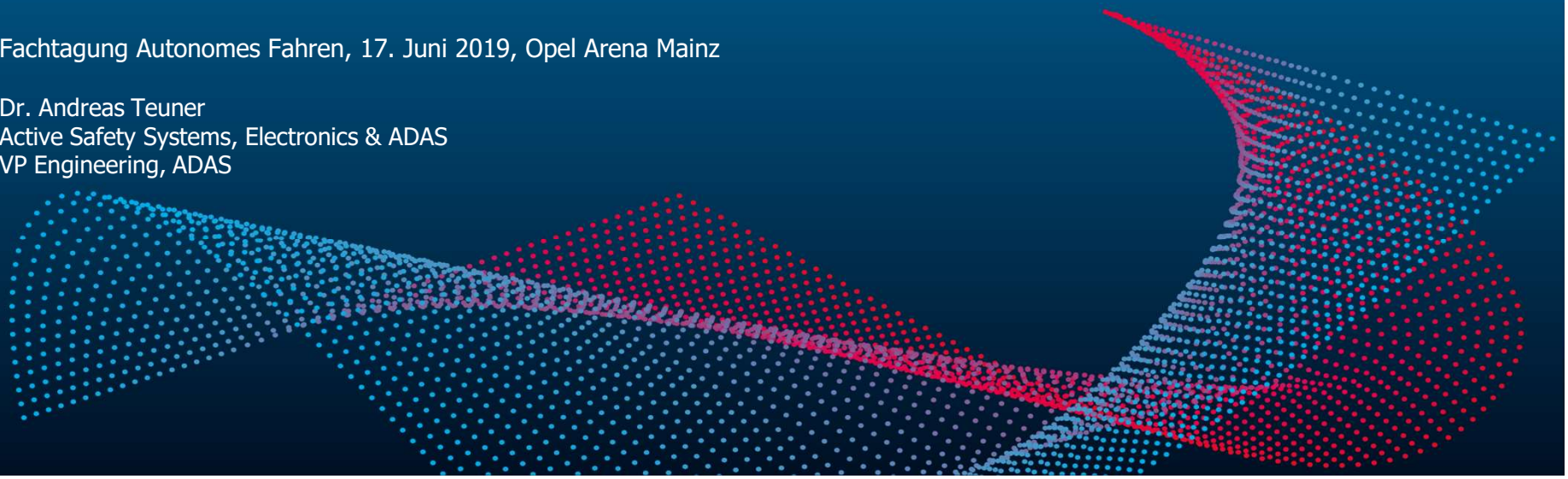
Automatisiertes Fahren: Trends, Komponenten und Herausforderungen

Fachtagung Autonomes Fahren, 17. Juni 2019, Opel Arena Mainz

Dr. Andreas Teuner
Active Safety Systems, Electronics & ADAS
VP Engineering, ADAS



Agenda

01 ZF Group

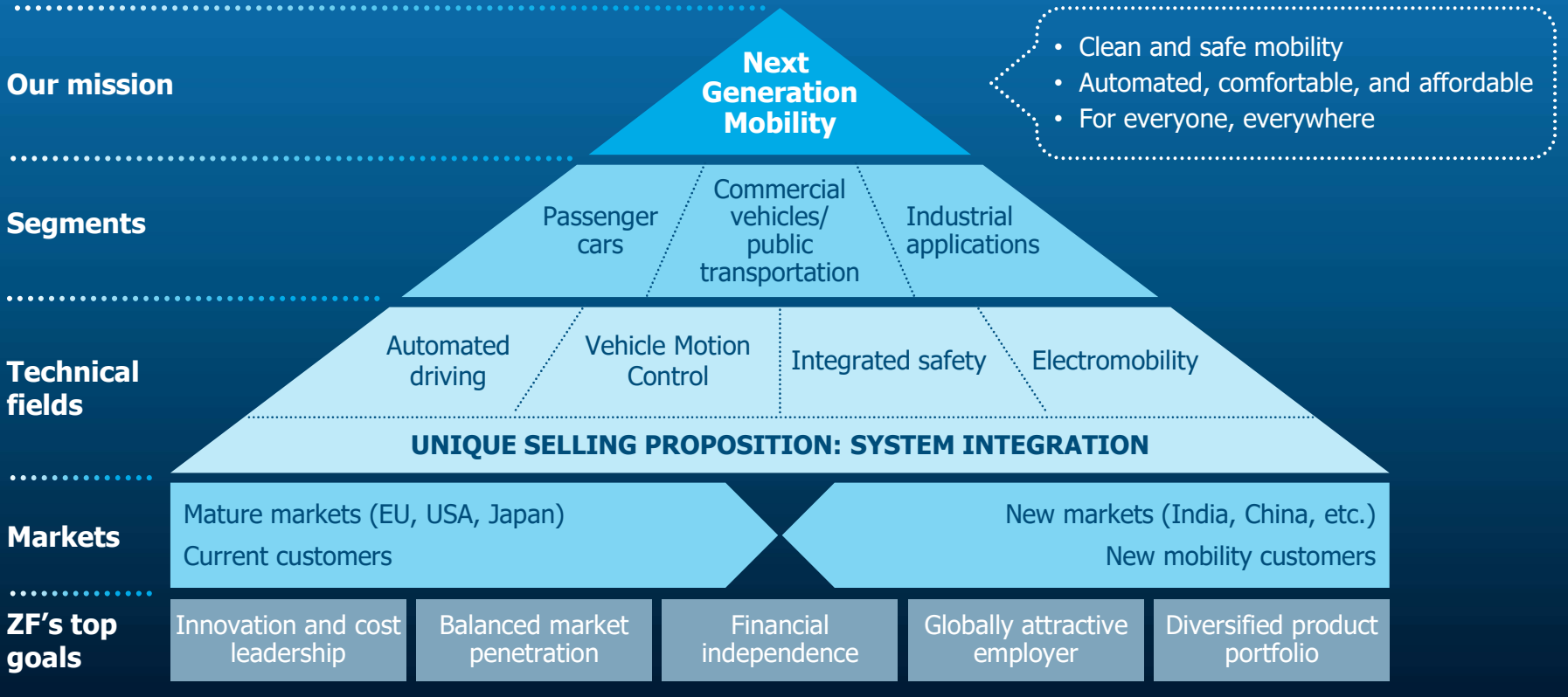
02 Komponenten

02 Mission & Vision

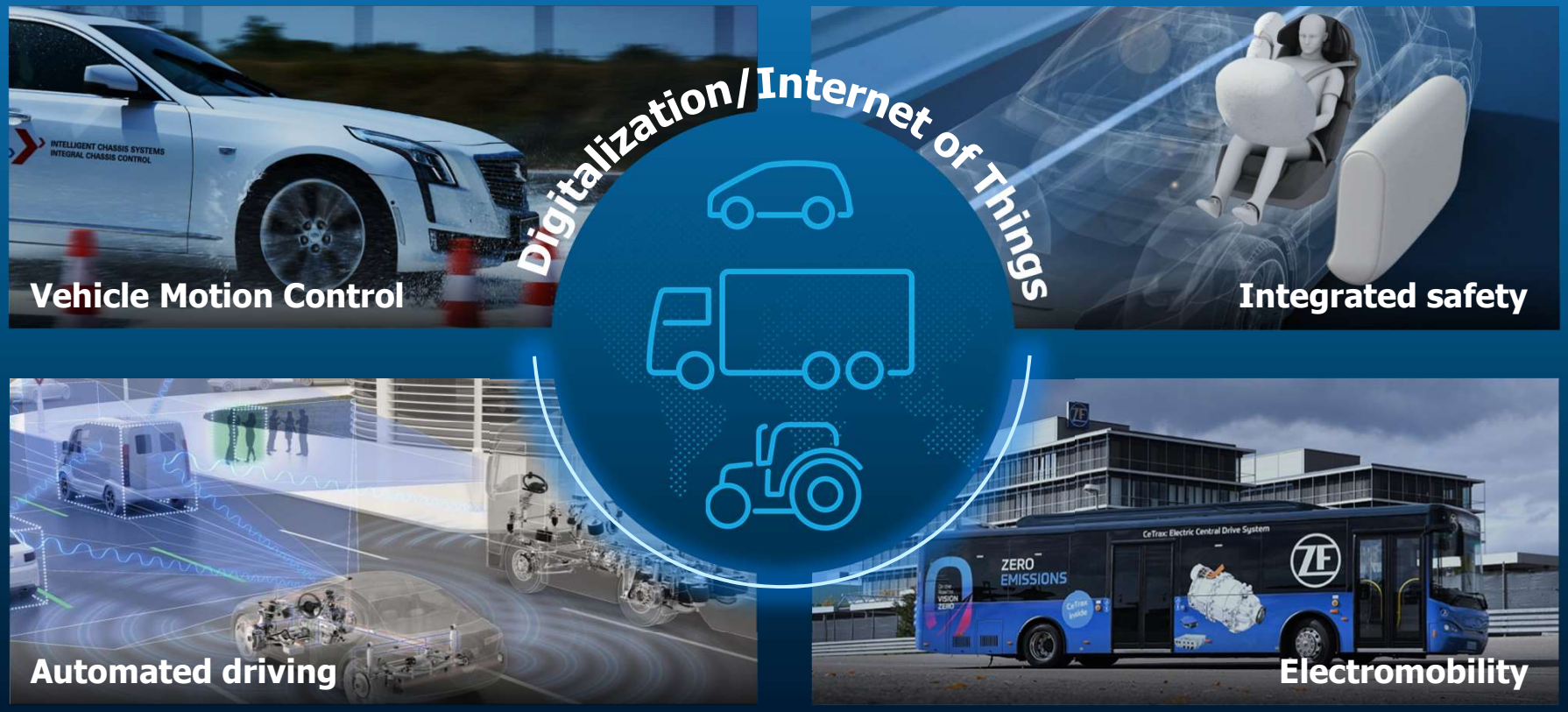
03 From ADAS to AD

01
ZF Group

ZF Strategy: "Next Generation Mobility"



ZF Shapes the Future in Four Technology Fields



Urban Mobility of the Future

Next Generation Mobility – Individual Solutions for People and Freight

Financial Overview 2018

EUR 2.1 billion
adjusted EBIT

EUR 2.5 billion
Research & Development

EUR 1.6 billion
investments in property, plant, and equipment

EUR 36.9 billion
sales

EUR 1.4 billion
reduction of gross debt

148,969
employees

Strategic Market Segments of Autonomous Driving

Passenger Car	Commercial Vehicles	People & Cargo Mover	Ride Hailing	Industry Automation
				
Traditional OEMs	**Comm. Vehicle OEMs and Fleet Owners**	**People and Cargo Purpose Built Vehicles**	**Transport as a service providers**	**Automated Operation**
Car manufacturer with business model to end customer	HCV / LCV manufacturer with business model to fleet owners Fleet owners	PBV manufacturer with business model to fleet owners, cities, mobility providers	TaaS as business model to end customers no fleet ownership low asset valuation	Automation as cost reduction factor highly diversified market

02
Components

SEE

S-Cam 3 Camera

S-Cam 4 Camera

TriCam Camera

Scalable Remote Camera

Interior Observant System

Crash Sensors

AC1000
77GHz Radar MR

NextGen Radar
77GHz MR Radar

Imaging Radar
77GHz SR Radar

360° Surround
View Radar
Systems

Radar Innovation
Technology

3D Solid-State Lidar

THINK

Safety Domain ECU
Gen 1 & 2

Image Processing Module
With Central Fusion

Nividia ProAI

ADAS & Automated Driving Functions

Braking and
Steering ECUs

Powertrain
Control Units

ACT

Integrated Brake Control (IBC)

Electrically Powered Steering Belt Drive (EPS BD)

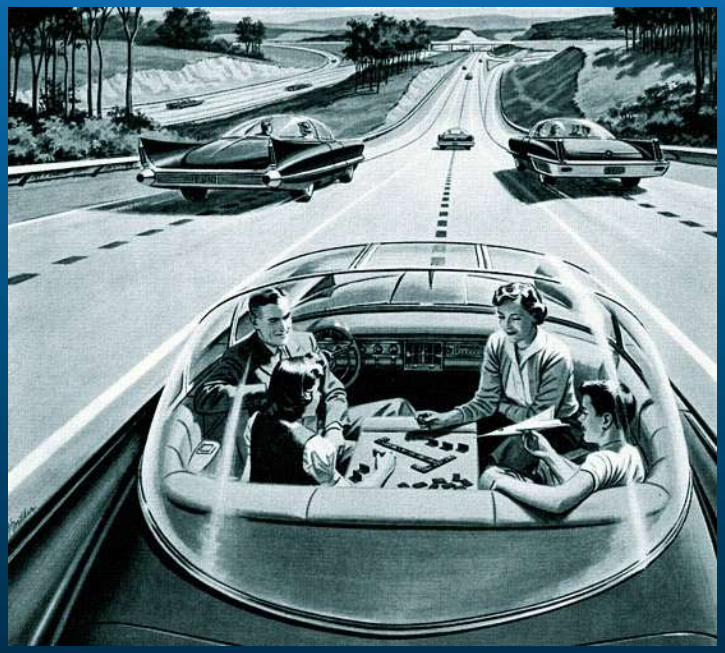
Active Buckle Lifter/ACR

Shock Absorbers

Transmission

03
Mission & Vision

Automated Driving - Motivation



Source: *"Power companies build for your new electric living".*
The Victoria Advocate. 24 March 1957.

Safety – "Vision Zero"
Improve road safety by reducing driver errors.

Efficiency
Optimized driving strategy and routes.

Comfort
More relaxation for drivers.

Extended Mobility
No limitation for seniors, disabled or teenagers.

Vision, Mission and Focus Area of the Automated Driving Team

ZERO ACCIDENTS — On the Road to VISION ZERO — ZERO EMISSIONS

Source: http://firstselectionbd.com/fsweb/index.php/vision-mission

Mission:

- **Develop production-ready automated driving functions and associated algorithms** that can be bundled with components or even supplied standalone.
- **Define future architecture** and **product requirements** for automated driving functions and associated components.
- **Building on existing components** in or near to mass production.

Focus Area:

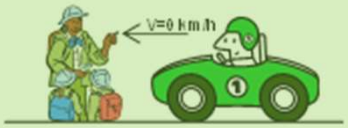
- **Function development**
  - System Engineering and Functional Safety.
  - Algorithm Development.
  - Vehicle Prototyping and Customer Engagement.

Ancient vision of the future…

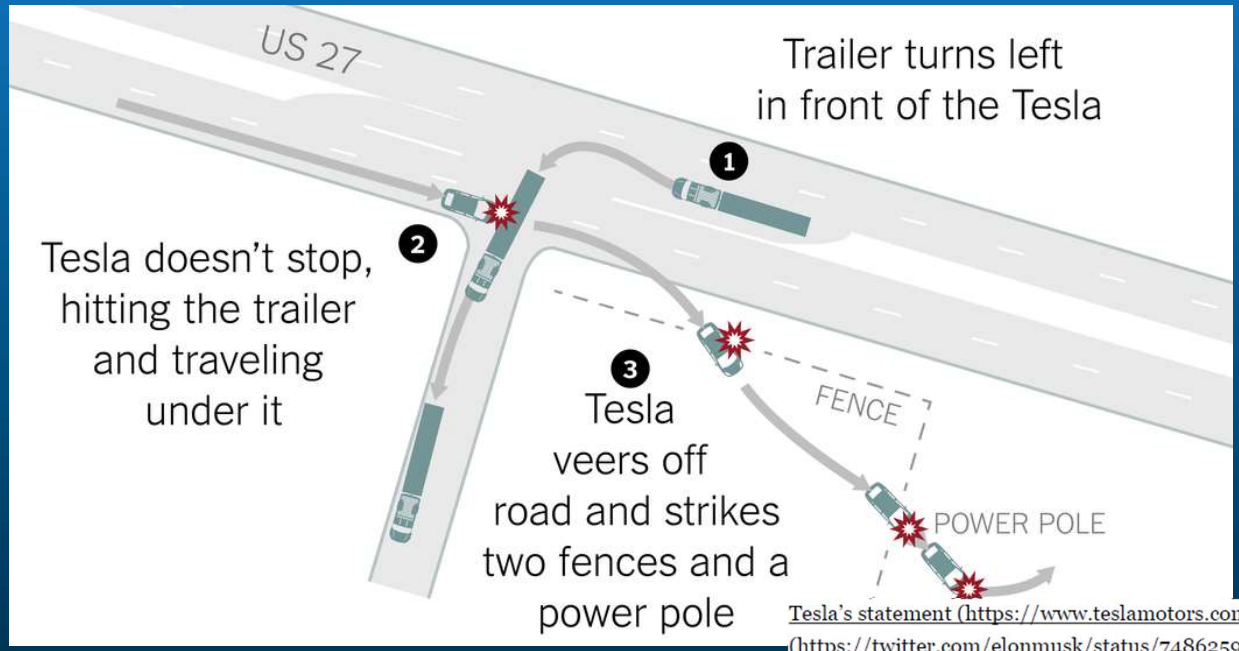
But this happened in between…

one example of
Missing Safety
can prohibit
success of a new
technology

Nominal Performance

	Critical situation	No critical situation
System Intervention	True Positive 	False Positive 
No system Intervention	False Negative 	True Negative 

Nominal Performance



source: www.nytimes.com/interactive/2016/07/01/business/inside-tesla-accident.html

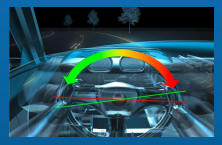
Tesla's statement (https://www.teslamotors.com/blog/tragic-loss) and a tweet from Elon Musk (https://twitter.com/elonmusk/status/748625979271045121) provide some insight as to why the Autopilot system failed to stop for the trailer. The autopilot relies on cameras and radar to detect and avoid obstacles, and the cameras weren't able to effectively differentiate "the white side of the tractor trailer against a brightly lit sky." The radar should not have had any problems detecting the trailer, but according to Musk (https://twitter.com/elonmusk/status/748625979271045121), "radar tunes out what looks like an overhead road sign to avoid false braking events."

source: https://spectrum.ieee.org/cars-that-think/transportation/self-driving/fatal-tesla-autopilot-crash-reminds-us-that-robots-arent-perfect

04

From ADAS to AD

From ADAS to Automated Driving

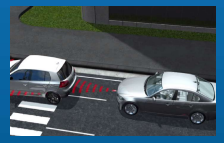


Lane Keeping Assist

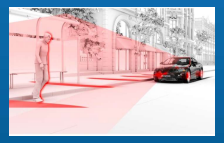
Traffic Sign Assist

Adaptive Cruise Control

Blind Spot Detection

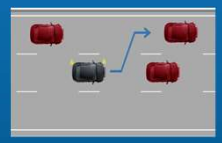


Collision Mitigation Braking



Emergency Brake Assist

Emergency Steering Assist

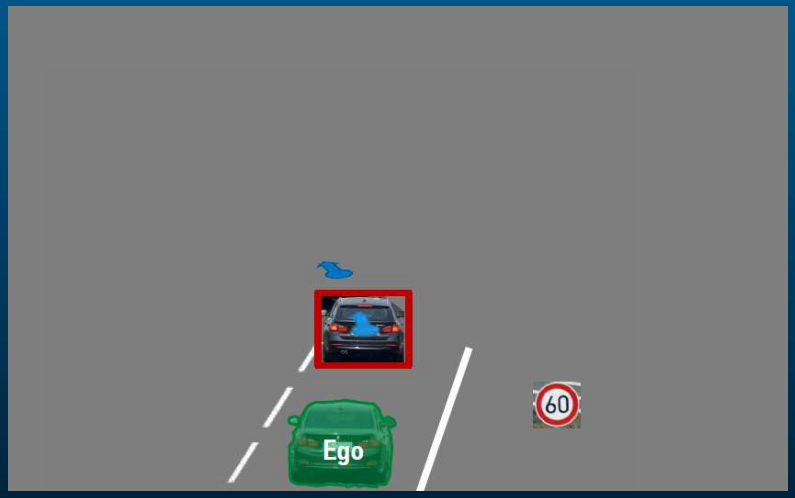


Lane Change Assist

ADAS functions **only perceive** the **part** of environment **of interest.**

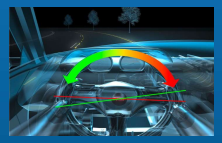
Essential information for **automated driving** are **not even observed**, filtered out or treated in **function-specific** way.

- Sensor(s): Full range radar, camera
- Environment Model: Moving points; lane markings, traffic signs, object fusion (radar/camera)
- Control: Dynamic objects



Environment Model, Hariolf Gentner, BMW, 27.02.2014

The True Situation – Challenge for AD Functions

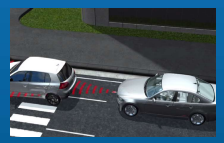


Lane Keeping Assist

Traffic Sign Assist

Adaptive Cruise Control

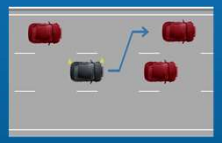
Blind Spot Detection



Collision Mitigation Braking

Emergency Brake Assist

Emergency Steering Assist



Lane Change Assist

Key **building block** is the **perception** of the **whole environment** independent of the function.

This leads from decentralized and separated ADAS functions to **one function** with **centralized architecture** from function and system point of view.

Foto: http://www.nordbayerischer-kurier.de/sites/default/files/styles/facebook/public/23.4wit.013.baustelle_a_70.jpg.jpg?itok=ypZ9tl5t

Evolution or Revolution?

Monitored Driving			Non-monitored Driving		
Level 0 (Driver Only)	Level 1 (Assisted)	Level 2 (Partial Automation)	Level 3 (Conditional Automation)	Level 4 (High Automation)	Level 5 (Full Automation)
Eyes-ON	Eyes-ON	Eyes-ON	Eyes temp. OFF	Eyes-OFF	Eyes-OFF
Hands-ON	Hands-ON	Hands temp. OFF	Hands temp. OFF	Hands-OFF	Hands-OFF

Available Mass Market Functions

ADAS sensors:
- Forward/rear/side looking radar
- Forward/rear looking camera
- Ultrasonic / Lidar

e.g.: Speed Limit Alert
Forward Collision Alert
Lane Departure Warning
Blind Spot Warning

ADAS compatible actuators:
- Electronic Power Steering
- Electronic Slip Control

Adaptive Cruise Control
Emergency Brake Assist
Lane Keeping Assist

Evolution

ADAS sensors with computational ECU (Domain ECU)

Highway Support (Single-Lane & Multi-Lane)

Redundant sensing & actuation

Behavioral function

Highway & Urban Chauffeur & Pilot

?

Costs?
Legal issues?
Security?

Key Challenges for Automated Driving

5 Key topics to answer

Automated Driving

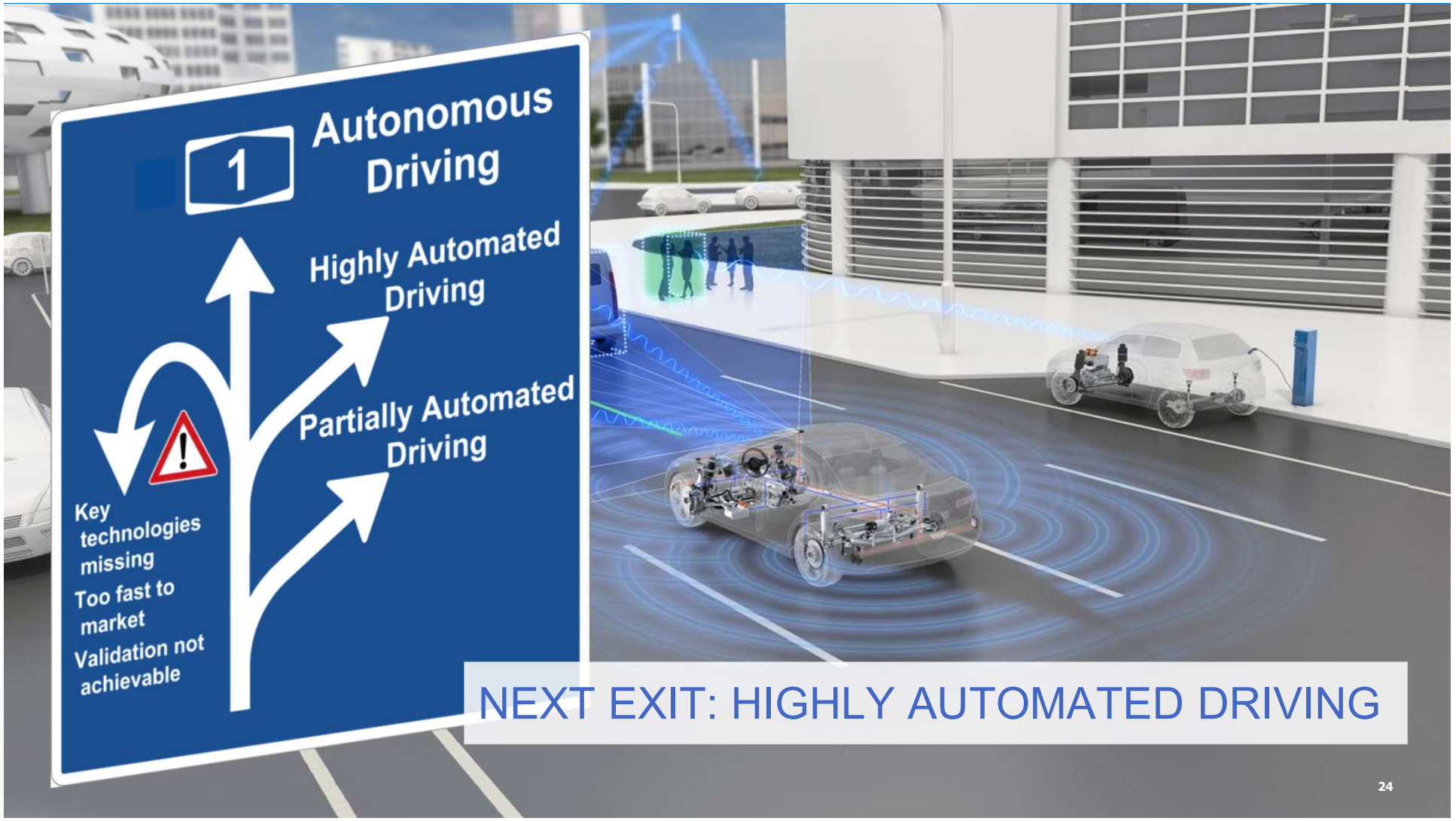
System and Function Architecture
Need for centralized architectures.

Verification and Validation Strategies
Methodology and data management solutions missing.

Human-Robot-Interaction
Intense interaction between driver and automated vehicle.

Sensor Technologies
Key technologies are missing.

Algorithm and Function Processing Units
Immense processing power needed.



NEXT EXIT: HIGHLY AUTOMATED DRIVING