



Adapt*!*Ve

*Automated Driving Applications and
Technologies for Intelligent Vehicles*

*Working on research, legal and deployment issues in Europe for Automated
Vehicles*

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AUTOMATED VEHICLES SYMPOSIUM

HYATT REGENCY

SAN FRANCISCO AIRPORT

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- Towards automated vehicles (Intro)
 - Research activities in Europe
 - Challenges
 - Deployment issues
- The AdaptIVe Research project
 - Background
 - Conception
 - Application domain
 - Features
 - Work in progress
 - Function classification and legal aspects in Response 4 work

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J Research Activity



2008

2010

2013

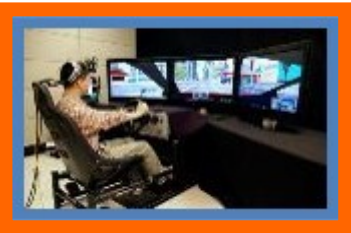
2016

Input sources

- Sensors: radar (short/long range), camera (mono-, stereo-), laser scanner, ultrasonic, INU
- Digital maps
- Wireless communication (V2I, V2V)

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Challenges



Real-time environment perception

- **reliability** of sensing has to be **quantified**;
- reliability has to be **improved** for real life conditions (e.g. adverse weather conditions + complex traffic scenarios);
- Data fusion- perception algorithms

Automation control strategies

- Up to now focus on longitudinal control; **Lateral control** systems are predominantly advisory

Human factors

- Complex use cases like **overtaking, lane merging and crossroad** entering/exiting need more investigation
- Driver becomes a **supervisor** of a system instead of a **manual controller** of the vehicle
- In partial and high automation, a capable driver is still required to **resume manual control**
- Profound insight is needed into the **determinants** of the quality of the **interaction of the driver with the automated vehicle**
- Most knowledge in relation to driver behavior is based on **driving simulator studies and not real traffic conditions.**

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Deployment issues



- Vienna convention terms “driver” and “control” allow for open interpretations (CARS Stanford study)
 - A recent amendment has been made this year by the U.N. Working Party on Road Traffic Safety which would allow a vehicle to indeed drive itself, as long as the system "can be overridden or switched off by the driver".

- Legal framework evaluation efforts by EU projects:

CityMobil2

VIRA

NETWORKING
IN AUTOMATION

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Automated Driving

Many different stakeholders...this process is difficult and time consuming

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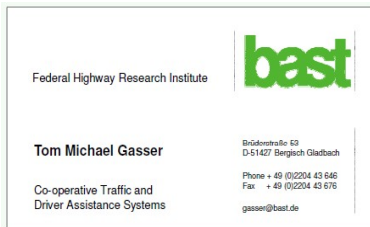
Background



- Code of Practice for Driver Assistance Systems



- Partial automation incl. minimum risk maneuver in case of function problem



- BAST study on levels of automation
 - introduces speed range, automation function duration dimensions
 - discusses legal evaluation



- Integrated perception platform
- Active interventions for wide range of highway scenarios
- Aspects of shared control between the system and the driver

// The Adapt!Ve project

Conception



- active interventions
- continuous support
- transitions among automation levels (user in the loop)

...level of automation is set dynamically



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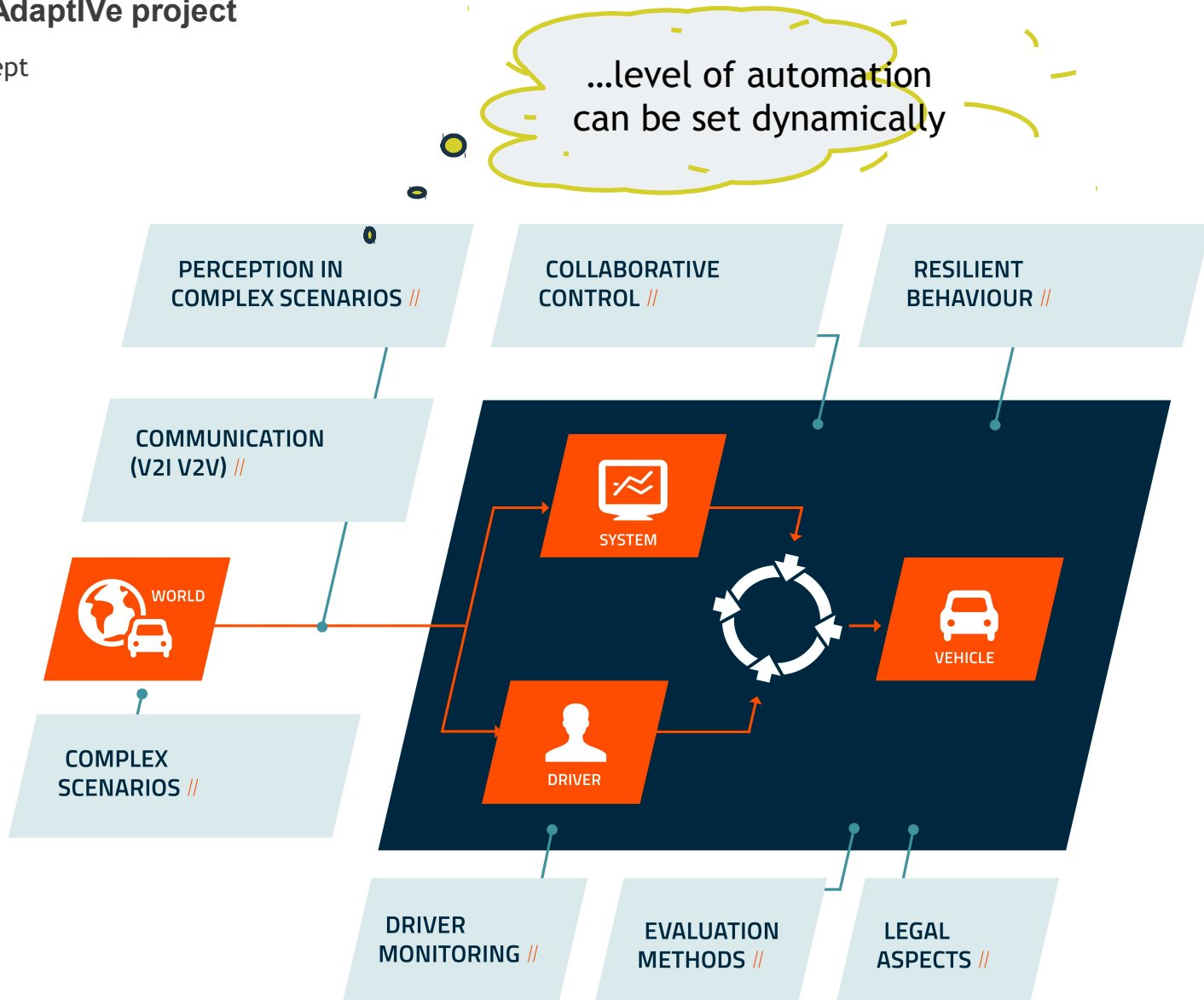


- cooperative support of neighbouring vehicles
- cooperative support of the infrastructure

...resilient to different types of system and human failure

// The Adaptive project

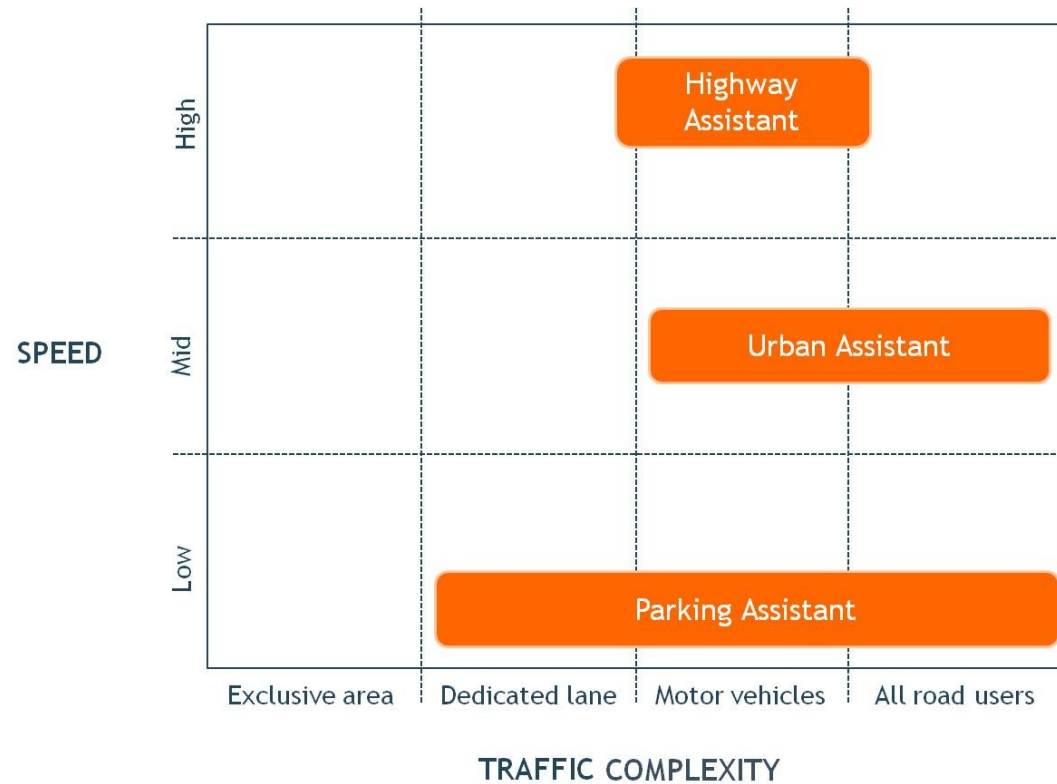
Concept



// The Adaptive project

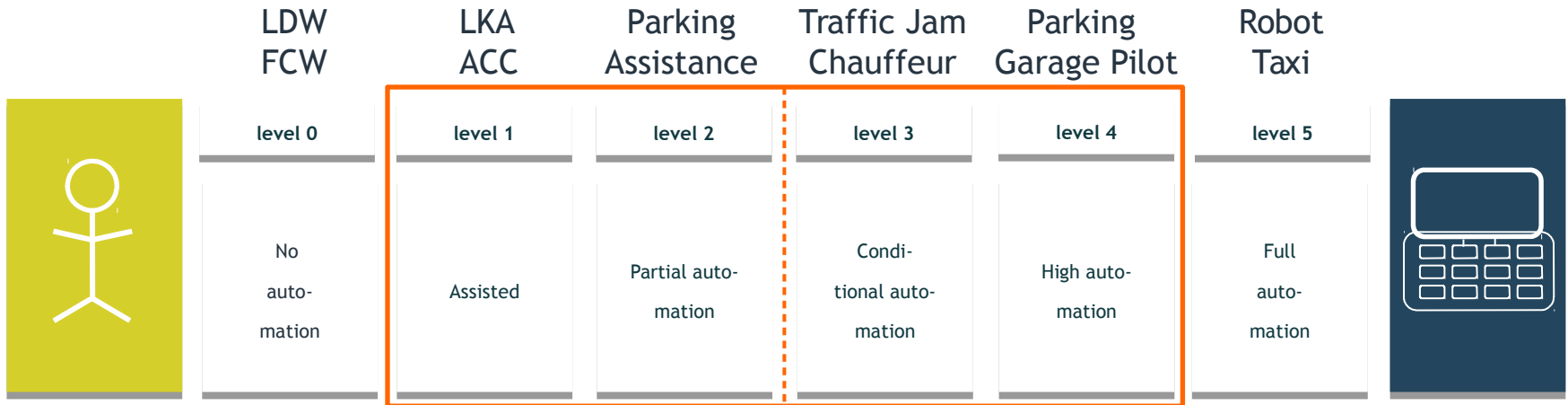
Application domain

- suited for mixed traffic
- real world complex environments
- provide adaptive support based on the driving task demand (bidirectional V2V also included)
- design “take over requests” based on system and driver state
- deployable in a short to medium time



// The AdaptIVe project

Levels of driving automation



Driver in the loop

- No significant change with respect to existing driver assistance systems

Driver out of the loop

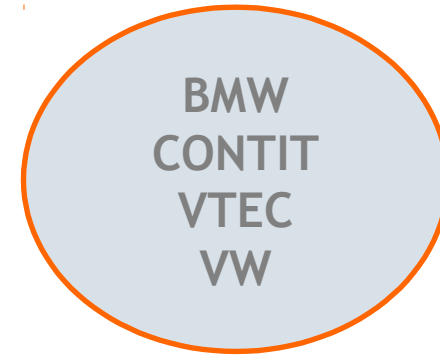
- Not in accordance with regulatory law (Vienna Convention, national road law)
- Extra risk with respect to product liability
- need for action

Source: SAE document J3016, "Taxonomy and Definitions for Terms Related to On-Road Automated Motor Vehicles", issued 2014-01-16, see also http://standards.sae.org/j3016_201401/
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// The AdaptiVe: work in progress

Functions (1/2)

- Lane Following
- Lane Change (and overtaking)
- Stop&Go Driving
- Speed / time gap adaptation at a motorway entrance ramp
- Cooperative merging with speed adaptation
- Cooperative merging with lane change
- Danger spot intervention
- Predictive automated driving
- Enter and exit of a motorway
- Cooperative response on emergency vehicle on duty

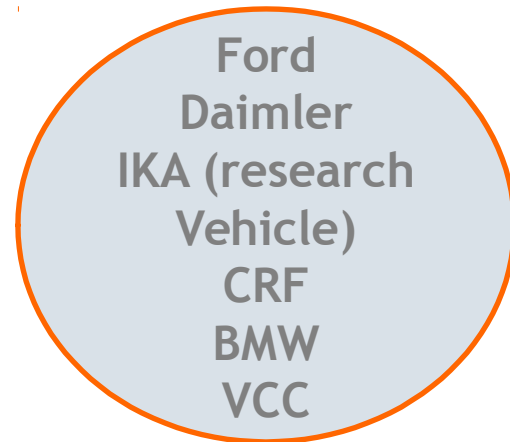


- ✓ *Lat./long. control*
- ✓ *Lane change support
(handle delays due to lane
obstruction)*
- ✓ *V2I, V2V included*
- ✓ *Driver take-over situations*

// The AdaptiVe: work in progress

Functions (2/2)

- Park Assistant - Pholova app
- Construction Site Manoeuvre (simulation)
- Automated Parking Garage Pilot
- City Cruise
- Supervised City Control
- City Chauffeur
- Partially Automated Urban Driving

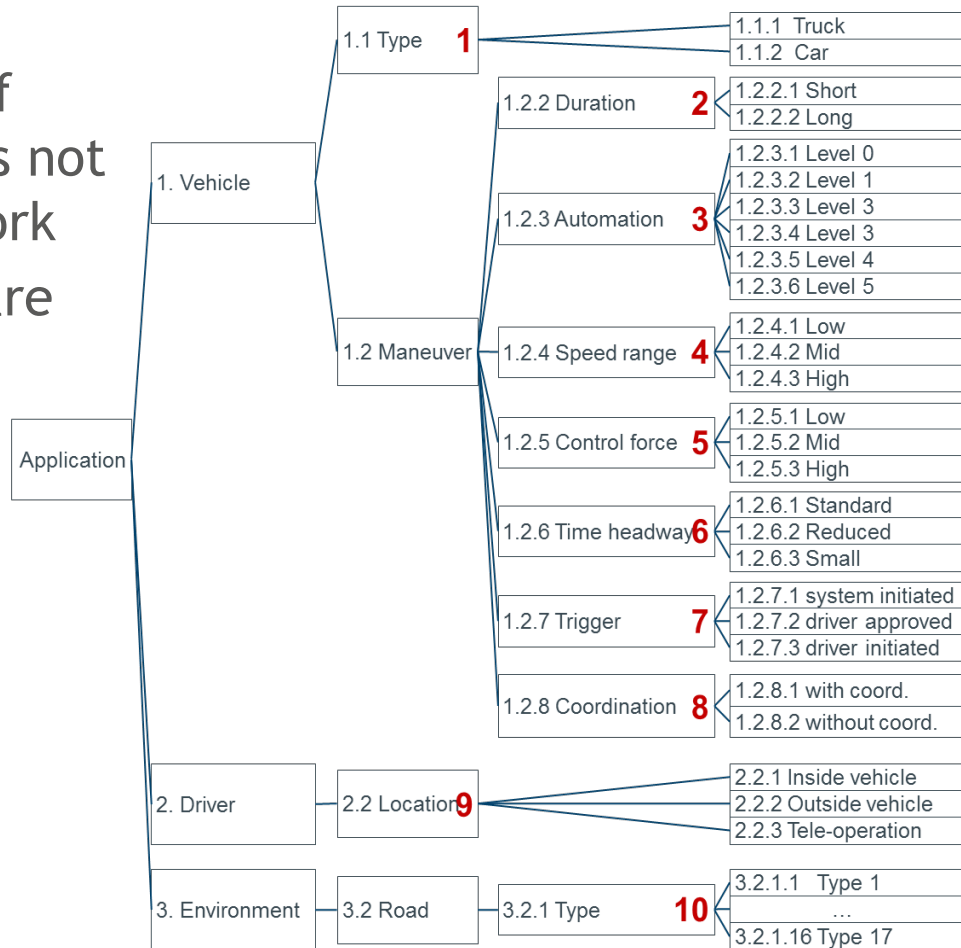


- ✓ *Lat./long. control*
- ✓ *Low speed scenarios for parking apps with the driver both inside/outside the vehicle*
- ✓ *Complex urban scenarios incl. roundabout, traffic lights and intersections: lane change support, V2I for specific use cases*

// Response 4 : work in progress

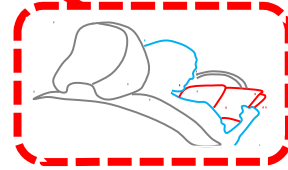
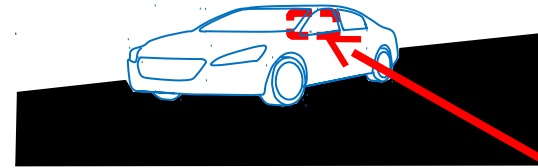
Functions' classification

- Classification by level of automation and speed is not sufficient for further work
- **in new vehicle models** Additional parameters are needed
- Collect and structure parameters, limit to essentially needed ones



// Response 4: work in progress

Next steps

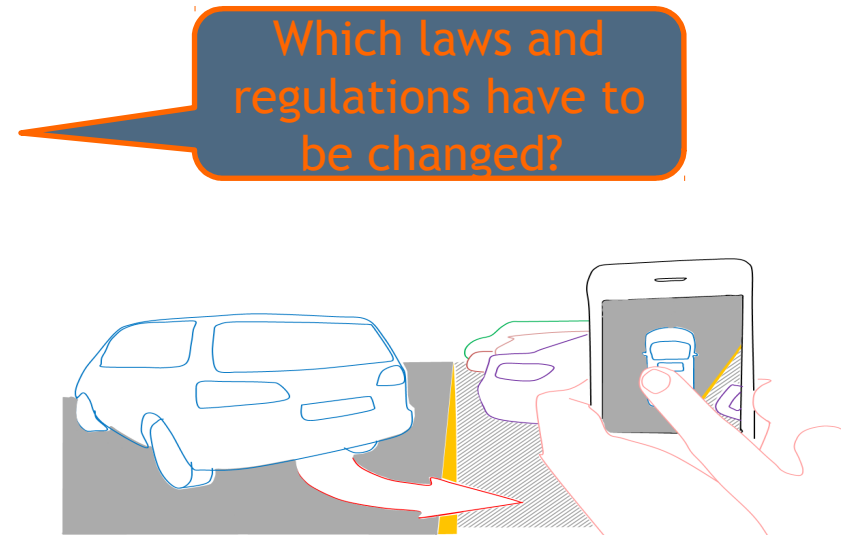


- Verify selection of classification parameters
 - from legal perspective
 - from functional safety perspective
 - from human factors perspective
 - Verify applicability with Adaptive functions
- **Result:**
Final set of parameters for further work in Response 4

// Response 4: work in progress

Legal aspects

- Cover relevant legal areas for industry
- Assess national laws for main target markets (Europe and overseas)
- Need for harmonization
- Built on function classification



Vienna Convention	National Regulatory Law	Homologation -> UNECE	Liability		Data privacy and data security
			Product liability/ tort law	Criminal liability	Ownership, Use, Tampering



Co-funded by
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Thank you.

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