AdaptIVe: Automated driving applications and technologies for intelligent vehicles
## Facts

<table>
<thead>
<tr>
<th>Budget:</th>
<th>EUR 25 Million</th>
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<tbody>
<tr>
<td>European Commission:</td>
<td>EUR 14.3 Million</td>
</tr>
<tr>
<td>Duration:</td>
<td>42 months (January 2014 - June 2017)</td>
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<tr>
<td>Coordinator:</td>
<td>Aria Etemad, Volkswagen Group Research</td>
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<tr>
<td>8 Countries:</td>
<td>France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom</td>
</tr>
</tbody>
</table>
// 30 partners
Motivation for automated driving functions

- **Zero emission**
  - Reduction of fuel consumption & CO₂ emission
  - Optimization of traffic flow

- **Demographic change**
  - Support unconfident drivers
  - Enhance mobility for elderly people

- **Vision zero**
  - Potential for more driver support by avoiding human driving errors

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// Potentials of automated driving

Drivers are supported in demanding or repetitive tasks.

Vehicles dynamically adapt the level of automation according to the current situation.

Vehicles react more effectively to external threats.

Vehicles are resilient to different types of system and human failure.
AdaptIVe: Objectives

1. Perception in Complex Scenarios
2. Collaborative Control
3. Resilient Behaviour
4. Communication (V2I V2V)
5. Complex Scenarios
6. Driver Monitoring
7. Evaluation Methods
8. Legal Aspects
AdaptIVe: Structure

Subproject 1: Integrated project (IP) management

Subproject 2: Response 4
Legal framework

Subproject 3: Human-Vehicle Integration
Collaborative automation

Subproject 4: Automation in close-distance scenarios

Subproject 5: Automation in urban scenarios

Subproject 6: Automation in highway scenarios

Subproject 7: Evaluation framework for automated driving applications
// Demonstrators and Functions

e.g. automated parking, parking assistance, ...
e.g. intersections and traffic lights, urban roundabouts, ...
e.g. cooperative merging, predicted driving, danger spot intervention, ...

stop & go, minimum risk manoeuvre
Levels of driving automation acc. to VDA and SAE

**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 of 1968, national road law) ➔ 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/
Automation in highway scenarios: Innovation

- Extensions to the existing **V2V communication** protocols based on ITS G5 will be specified to **enable dialog and negotiations** before and during lane change or filter-in manoeuvres.
- Fault-tolerant and resilient **system architecture** for highly automated driving functions
Automation in highway scenarios: Innovation

- Improve **energy efficiency** using information of traffic control systems, digital maps and vehicle sensors, **Predictive automated driving style**
- Driver **take-over situations** e.g. from “partial automated” to “driver only” or “conditional automated” to “driver only” demonstrated and evaluated
- Particular manoeuvres like the minimum risk manoeuvres **transparently indicated** to other traffic participants
Automation in highway scenarios: Functions

- Level 0: No automation
- Level 1: Assisted
- Level 2: Partial automation
- Level 3: Conditional automation
- Level 4: High automation
- Level 5: Full automation

Functions:
- Minimum risk manoeuvre
- Enter and exit highway
- Cooperative response to emergency vehicles
  - Following lane and vehicle
  - Lane change and overtaking manoeuvre
  - Stop & go driving
  - Speed and time-gap adaptation
  - Cooperative merging
  - Danger spot intervention
  - Predictive automated driving

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Use cases are used by SP3 for studies regarding Human-Vehicle-Integration.
Use Case: Cooperative merging with lane change

- Vehicle on motorway entrance ramp sends V2V feedback.
- Lane change possible feedback visible for driver.
- Actuator shall change lane.
- Conducts lane change.
- Lane change done.

Environment, vehicle, automation, steering wheel, gas pedal, brake pedal, display, lever/button, driver.
Extension of V2V-protocols

- An extension is required for the development of cooperative automated driving functions
- It has to cover phases of sensing, planning, acting and error handling
- The protocol extension will be used for the discussion with standardisation organizations

Proposal for cooperative merging:

- Environmental model
- Trigger
- Maneuver planner
- Evaluation
- Validation
- Accept
- Conf.
- Acting
- Vehicle on highway
- Vehicle on entrance lane
Architecture: Overview
Architecture: Overview
//Timeline

**Timeline**

Duration 42 months, January 2014 - June 2017

today
Thank you.

Jens Langenberg

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