VOLKSWAGEN
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Automated Driving Applications and Technologies for Intelligent Vehicles

Jens Langenberg

AdaptIVe: Automated driving applications and technologies for intelligent vehicles

Graz
30 September 2015

// Facts

Budget:	EUR 25 Million
European Commission:	EUR 14,3 Million
Duration:	42 months (January 2014 – June 2017)
Coordinator:	Aria Etemad, Volkswagen Group Research
8 Countries:	France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom

Co-funded by the European Union under the 7th Framework Programme

Supported by EUCAR EUROPEAN COUNCIL FOR AUTOMOTIVE R&D

// 29 partners


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// Motivation for automated driving functions

Zero emission	Reduction of fuel consumption & CO_2 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	

// Potentials for automated driving

Drivers are supported in demanding or repetitive tasks.
Travel comfort increases.

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.

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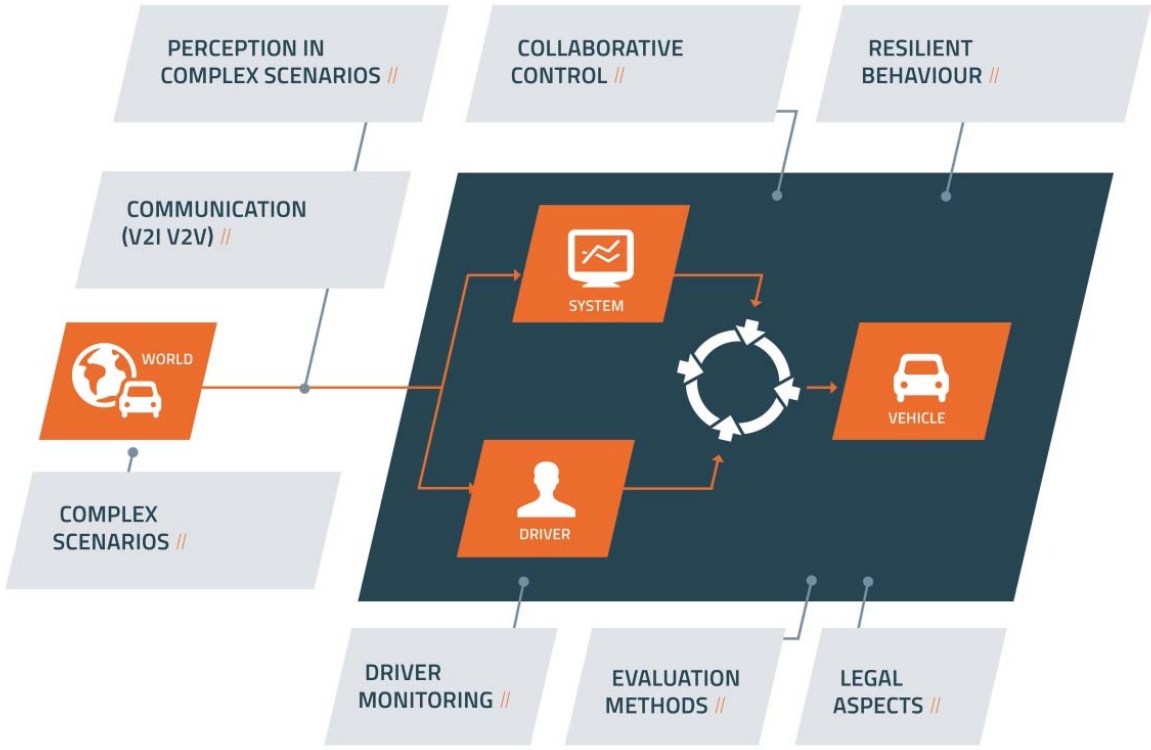
// Objectives



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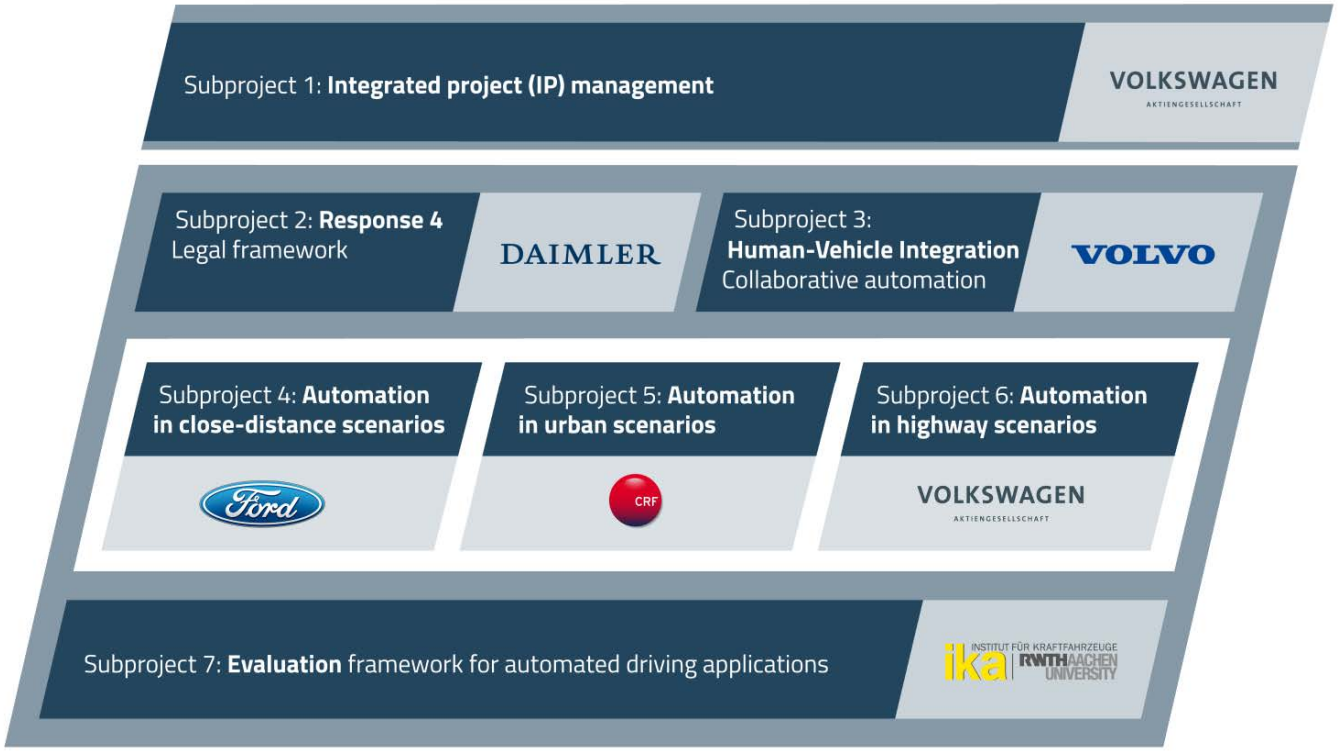
// Structure



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// 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, …

minimum risk manoeuvre

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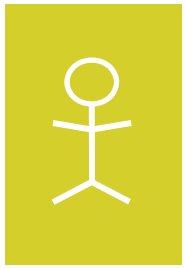
Levels of driving automation acc. to SAE and VDA

	LDW FCW	LKA ACC	Parking Assistance	Traffic Jam Chauffeur	Parking Garage Pilot	Robot Taxi	
	**level 0**	**level 1**	**level 2**	**level 3**	**level 4**	**level 5**	
	No auto-mation	Assisted	Partial auto-mation	Condi-tional auto-mation	High auto-mation	Full auto-mation	

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)
- Shared responsibility for control between driver and system

➔ 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

- Improve **energy efficiency** using information of traffic control systems, digital maps and vehicle sensors, **predictive automated driving** style
- Particular manoeuvres like the minimum risk manoeuvres **transparently indicated** to other traffic participants
- Fault-tolerant and resilient **system architecture** for highly automated driving functions

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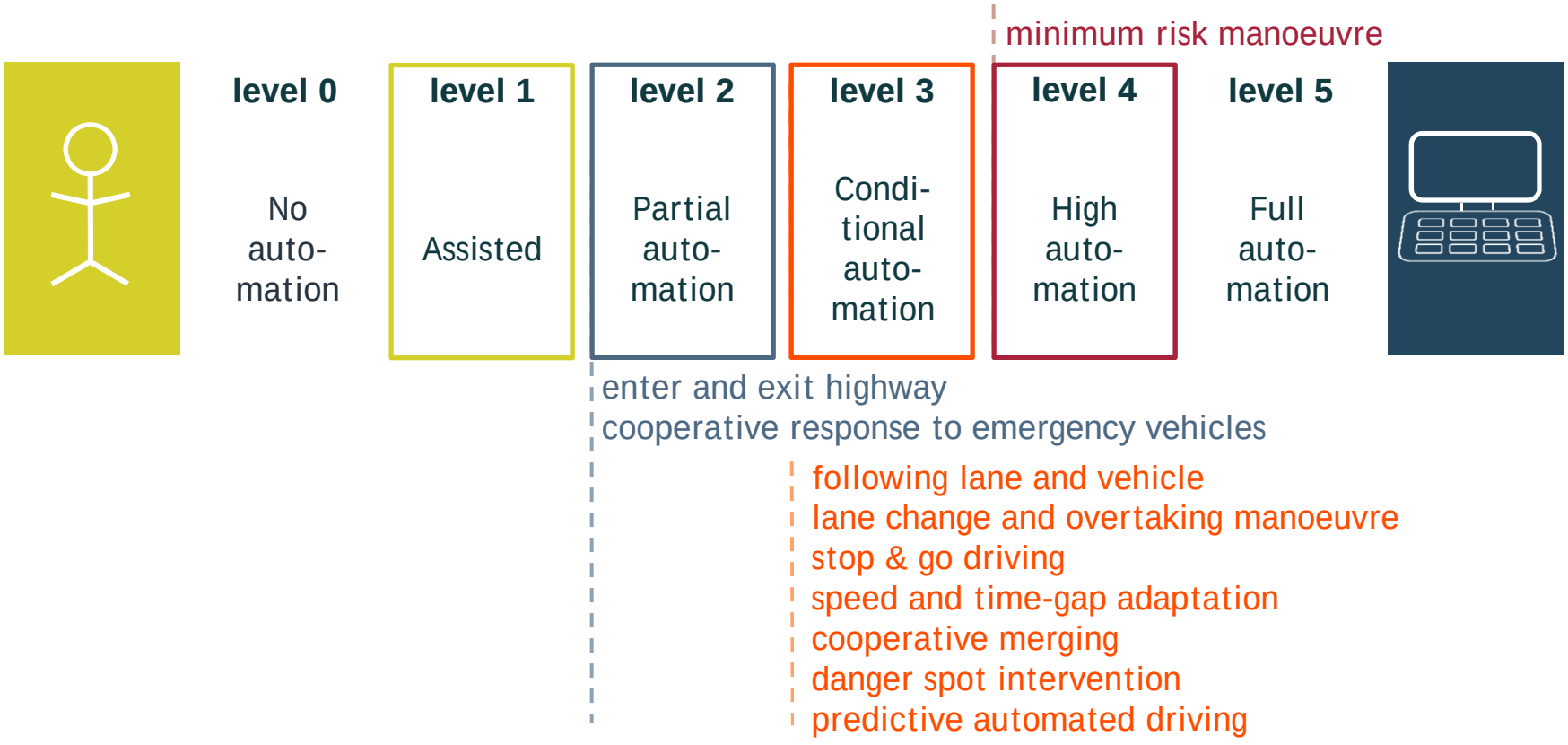
// Automation in highway scenarios: Innovation

- **V2V communication** protocols based on ITS G5 will be specified to **enable dialog and negotiations** before and during lane change or filter-in manoeuvres
- Driver **take-over situations** e.g. from “partial automated” to “driver only” or “conditional automated” to “driver only” demonstrated and evaluated

// Level 3 Highway Chauffeur

- **Conditional automated driving** up to **130 km/h** on motorways or similar roads
- From entrance to exit, on all lanes, incl. overtaking
- Driver must activate the system, but does not have to monitor the system
- Driver **can at all times override** or switch off the system
- Take over request in time, if automation gets to its system limits
- **Safety benefit** via relief of the driver: no exhausting, manual driving during long distance driving
- **Comfort benefit** via relaxing and use of selected infotainment functionalities

Functions Level 3 Highway Chauffeur



// Automation in highway scenarios: Filter-in manoeuvres

This situation is hard to solve for an automated vehicle of the first generation!

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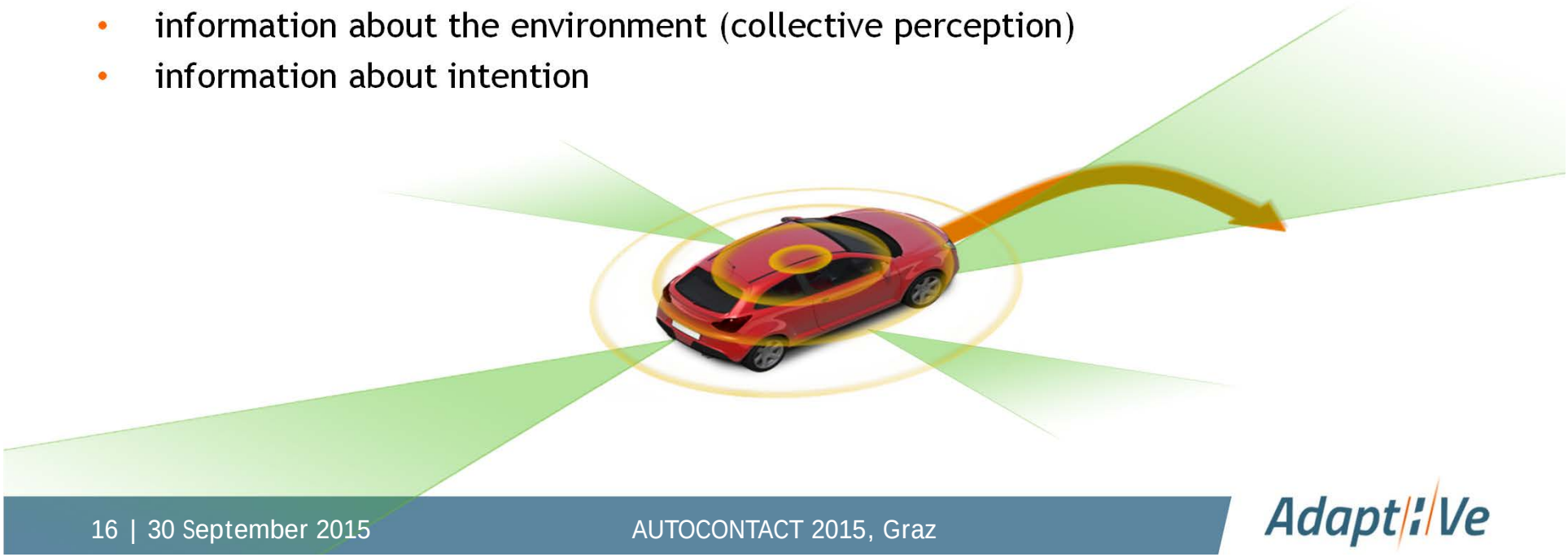
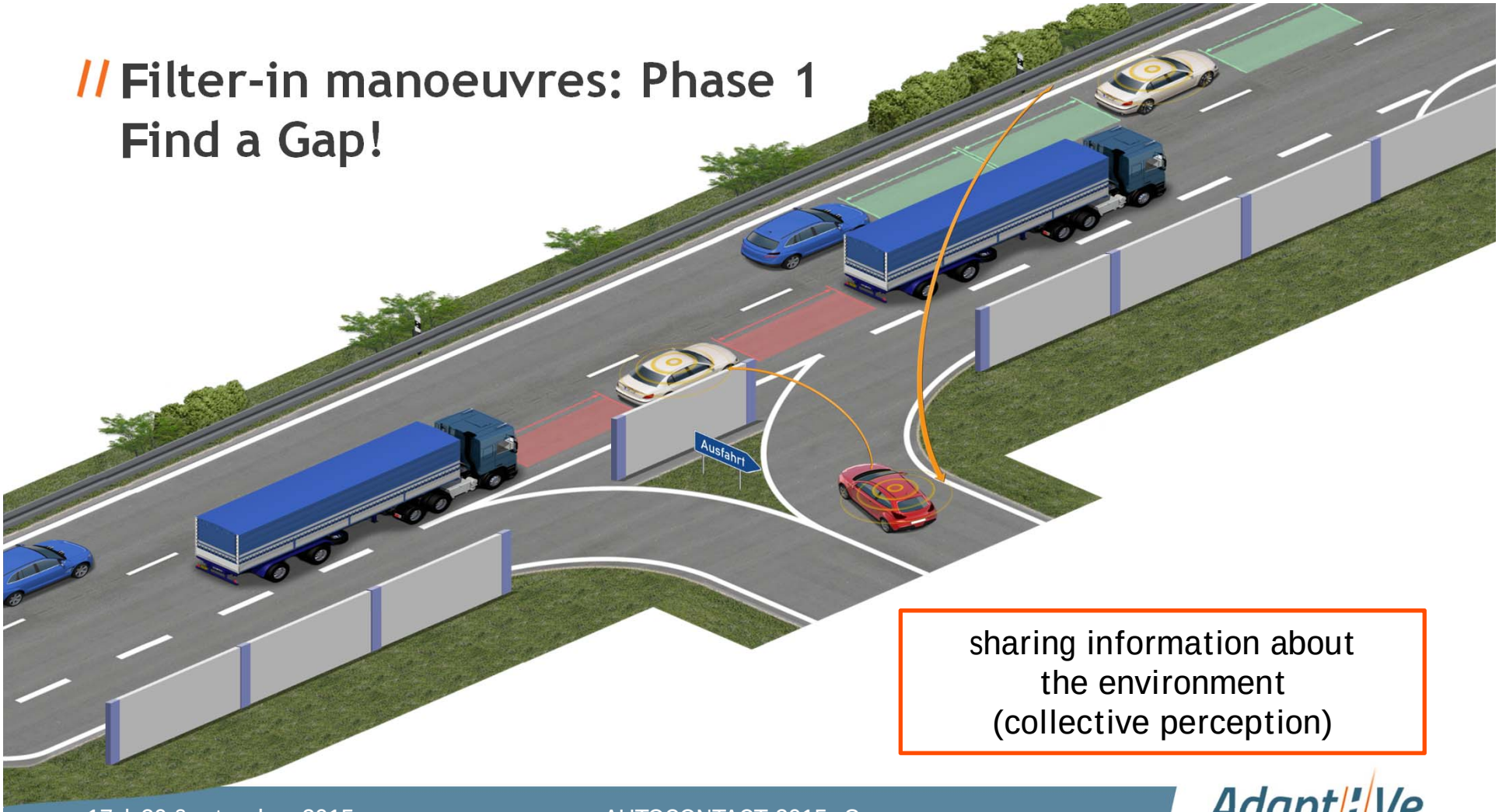
// Automation in highway scenarios: cooperative driving

Within AdaptIVe, a cooperative automated driving vehicle will send / receive and process the following information via vehicle-2-vehicle communication:

- status information
- information about the environment (collective perception)
- information about intention



// Filter-in manoeuvres: Phase 1
Find a Gap!



sharing information about
the environment
(collective perception)

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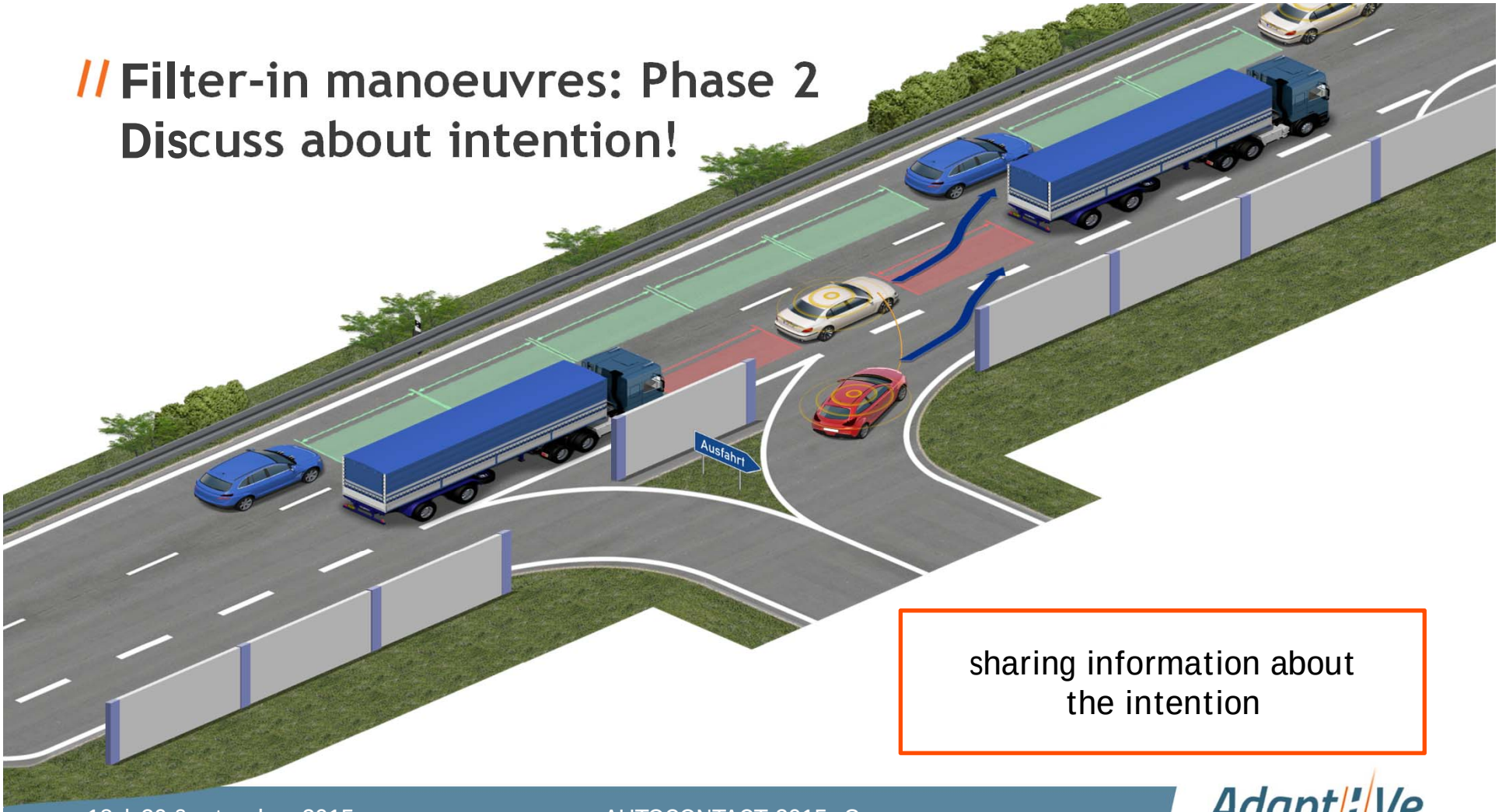
// Filter-in manoeuvres: Phase 2
Discuss about intention!



sharing information about the intention

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Filter-in manoeuvres: Phase 3
Conduct manoeuvre!

// Transitions of control between automation and driver

// Human Factors: Ironies of Automation

- Automation takes over tasks that humans find annoying or are bad at
  - But: Operator has to monitor if the system is doing the right thing
- The more reliable the automated system, the lesser the human has to intervene and correct the automation
  - But: The lesser the human has to intervene, the harder it will be

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// Tasks

- Develop **high-level use cases** for test and development throughout the project
- Collect **research issues** on the interaction of drivers with automation in vehicles that currently remain uninvestigated or unresolved
- Conduct **experiments** in different laboratory settings, including dynamic driving simulators, and, if suitable, also instrumented test vehicles
- Create **functional requirements** and decision strategies for collaborative automation in particular situations

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Time
Piloted Infotainment
Setup MMI
Browser
E-mail
Video Call
Media
TMC
09:48
Clock
Auto-Pilot active
0.0km
1690km
In 01 → back to manual.
Audi multimedia
OPEN
AUTO
AC
OFF
SYNC

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Thank you.

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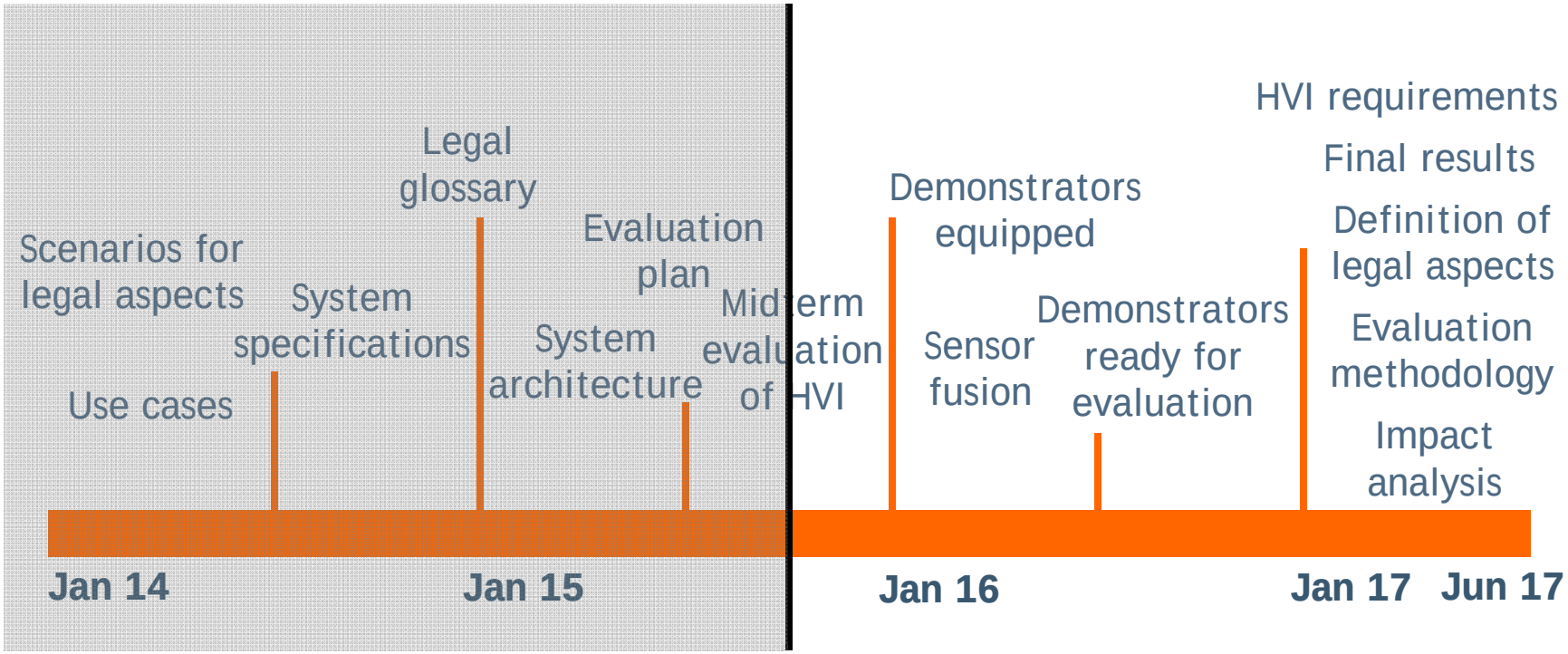
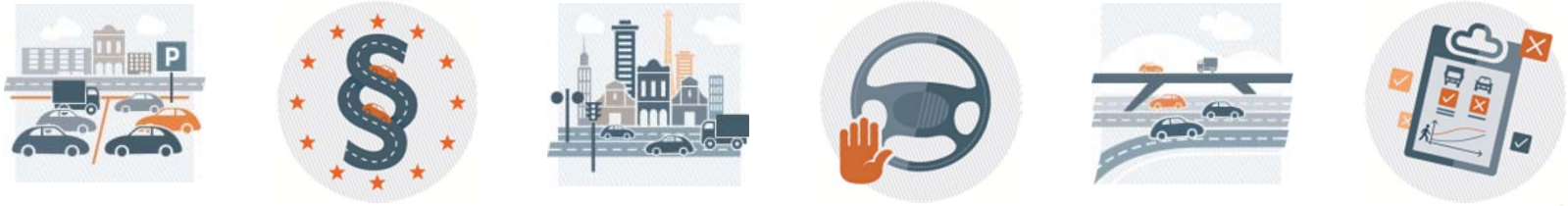
// Timeline


Scenarios for legal aspects
Use cases
System specifications
Legal glossary
System architecture
Evaluation plan
Mid-term evaluation of HVI
Demonstrators equipped
Sensor fusion
Demonstrators ready for evaluation
HVI requirements
Final results
Definition of legal aspects
Evaluation methodology
Impact analysis
Jan 14
Jan 15
Jan 16
Jan 17
Jun 17

// Objectives

- Demonstrate automated driving in **complex traffic environments** taking into account **full range of automation levels**.
- Enhance perception performance in complex scenarios by using advanced sensors. Add support by **cooperative** and **communication technologies**.
- Provide guidelines for the implementation of cooperative controls involving both drivers and automation – for **collaborative automation**.
- Define and validate specific **evaluation methodologies**. Assess the **impact** of automated driving on European road transport.
- Evaluate the **legal framework** with regards to existing implementation barriers.



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// Human Factors: Requirements

Within AdaptIVe a catalogue of Human Factors Requirements including categories of Agent State, Awareness, Arbitration and Action was established to see if automated vehicles will achieve the goal of safe transitions!

	Action	Axes	How to realize	Equipment
FR31	Easy to deactivate Automation, but also prevent unintended de-activation	long	Double actions (buttons etc.) and placed at different locations	Buttons, switches etc. Visual and audio messages.
		lat	Double actions (buttons etc.) and placed at different locations	Buttons, switches etc. Visual and audio messages.
FR32	Easy to activate Automation, but also prevent unintended activation	long	Double actions (buttons etc.) and placed at different locations	Buttons, switches etc. Visual and audio messages.
		lat	Double actions (buttons etc.) and placed at different locations	Buttons, switches etc. Visual and audio messages.
FR34	Sounds should be distinguishable from other sounds			Audio