

interactive



Accident avoidance by active intervention for Intelligent Vehicles

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Outlook

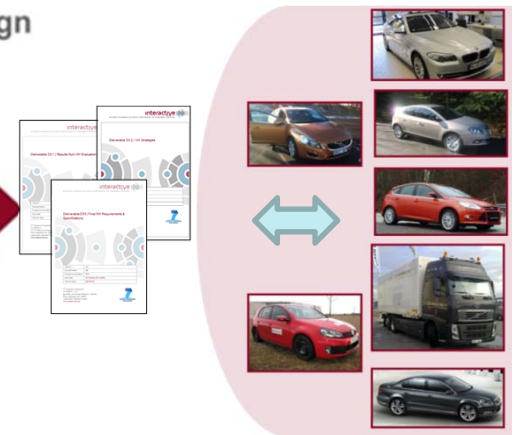
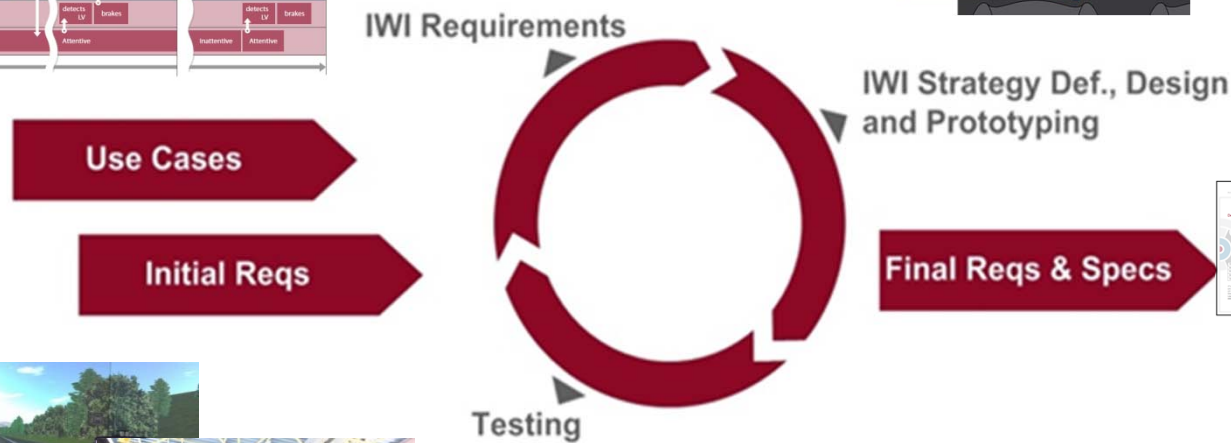
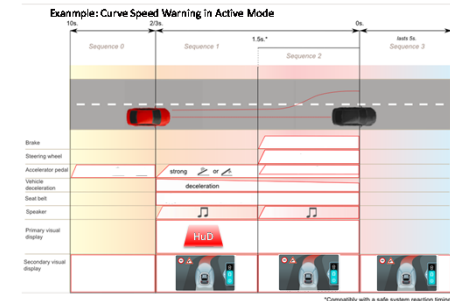
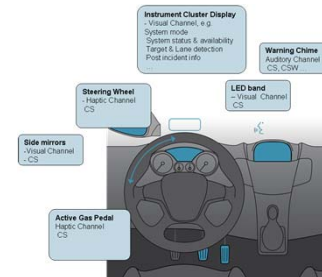
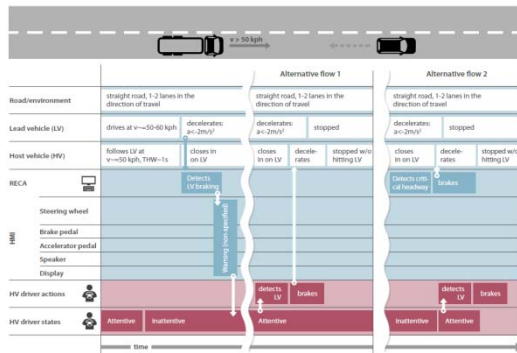
Information, Warning and Intervention strategies &
future research directions

Anna Schieben & Tobias Hesse - German Aerospace Center (DLR)
interactIVe Final Event

20th-21st November 2013

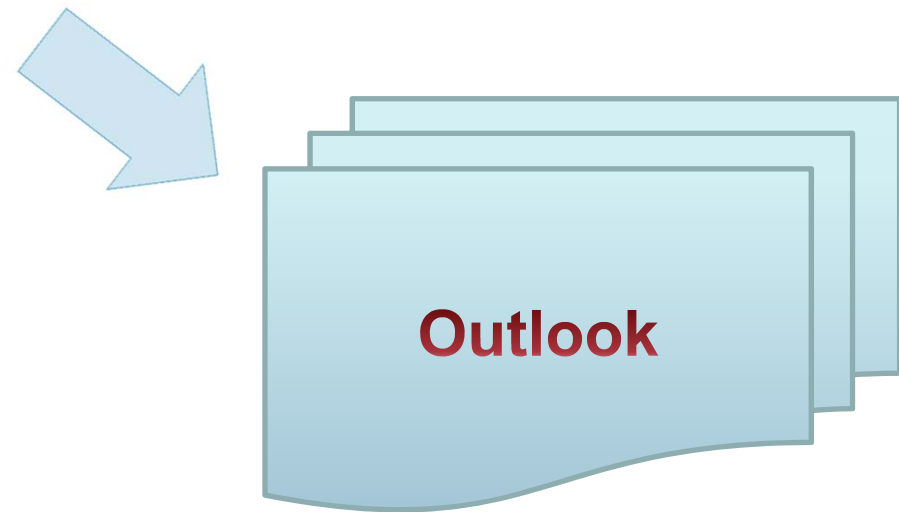
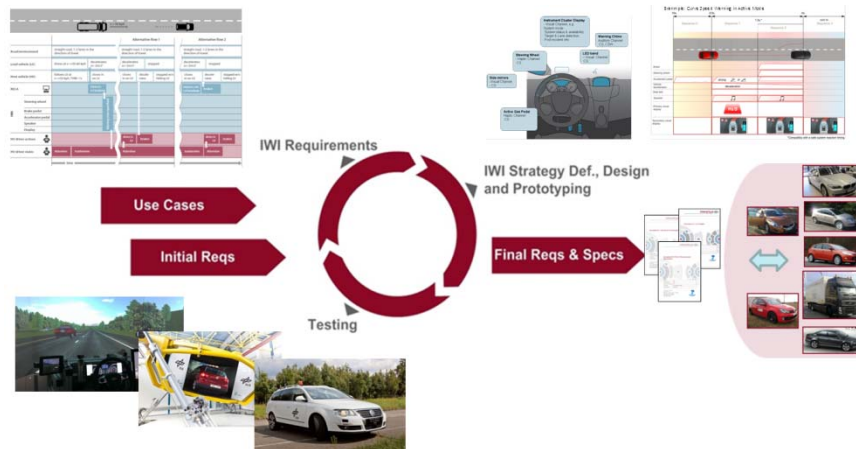
Introduction

Work process in SP 3



Introduction

Information, Warning and Intervention (IWI) strategies & Human Factors Outlook



Introduction

Functions covered by demonstrator vehicles

SECONDS

INCA

EMIC

BMW

Enhanced dynamic pass predictor

Fiat

Continuous support with focus on haptic HMI solutions

Volvo car

Collision avoidance, continuous support and SafeCruise

Ford

Collision avoidance, continuous haptic support and automated driving

Volvo truck

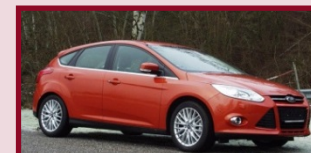
Collision avoidance and run-off road prevention by braking and steering, stability considerations for heavy vehicles

VW

Collision mitigation with focus on cost-efficient sensors and algorithm approach

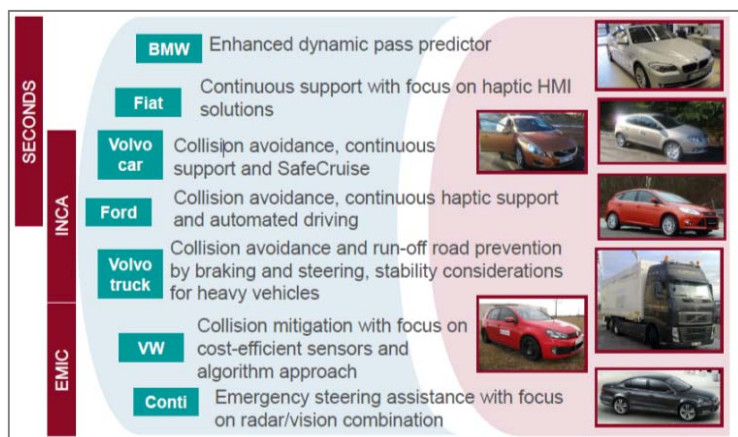
Conti

Emergency steering assistance with focus on radar/vision combination



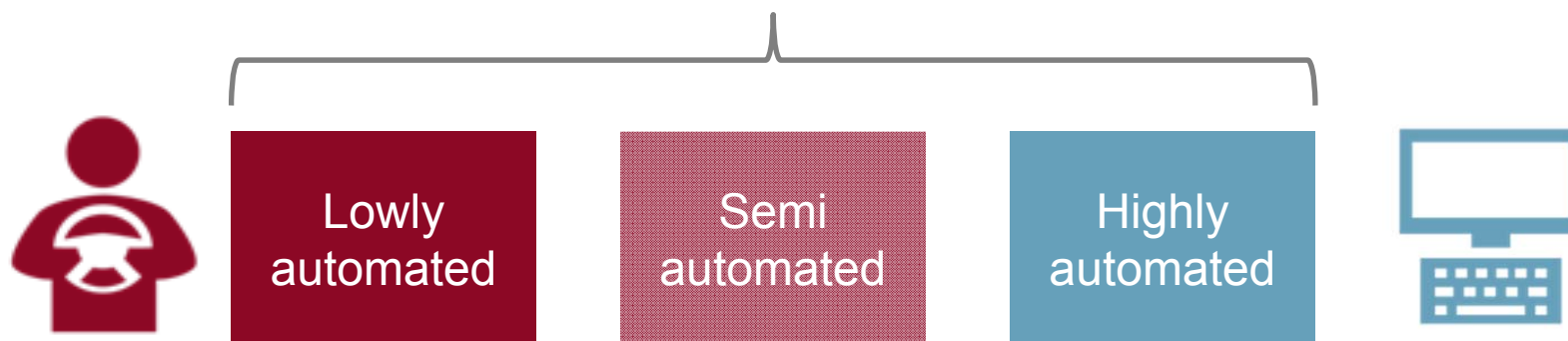
Introduction

Modes of automation covered by demonstrator vehicles



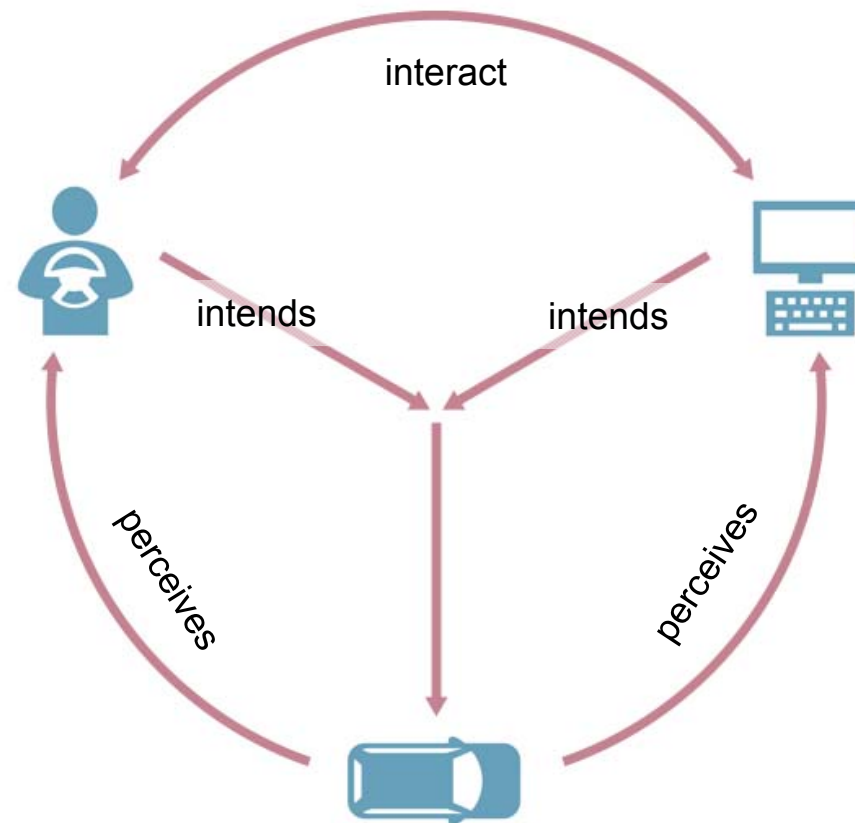
Several modes of automation addressed:

- depending on the implemented functions
- depending on the situation



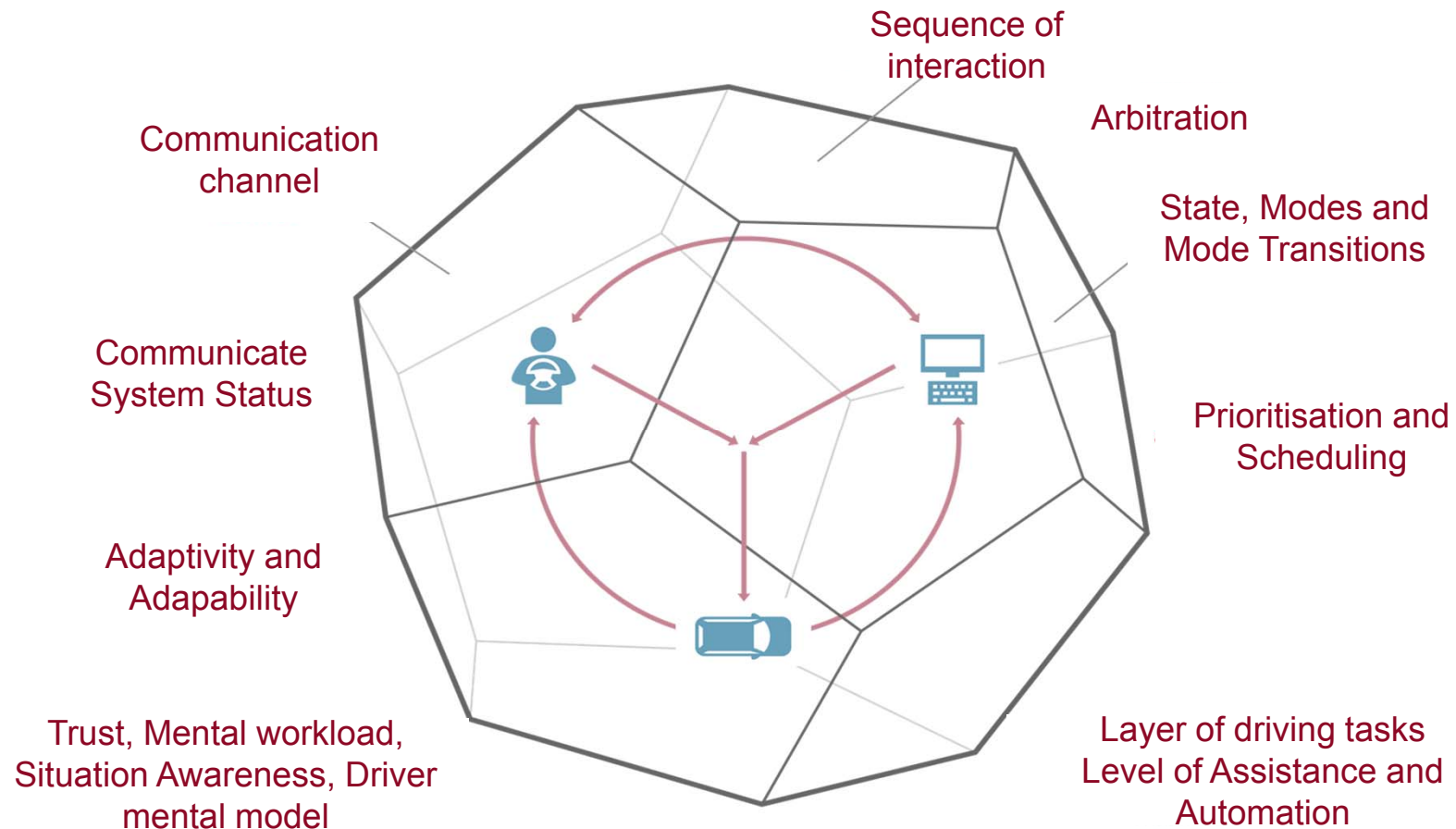
Introduction

Cooperation between driver and automation



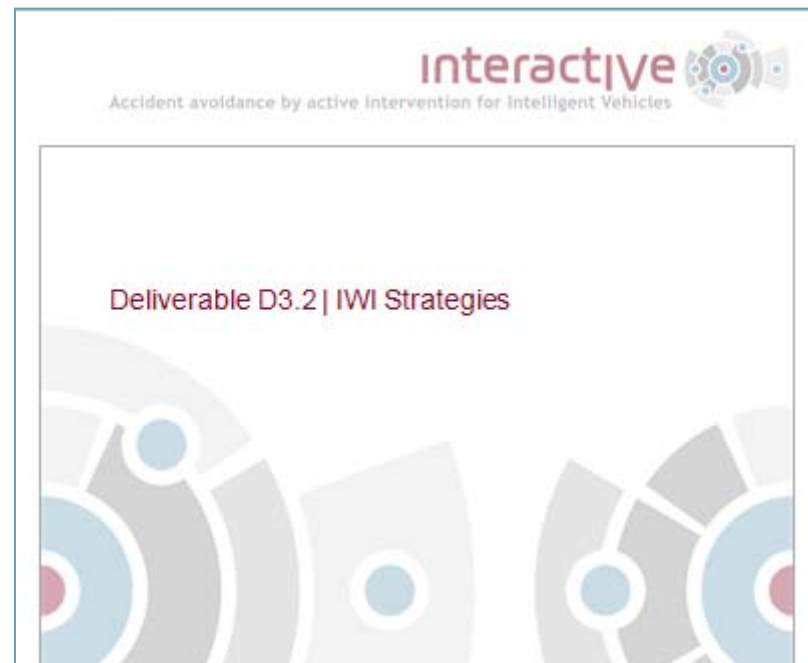
Introduction

Information, Warning and Intervention (IWI) strategies – aspects



Introduction

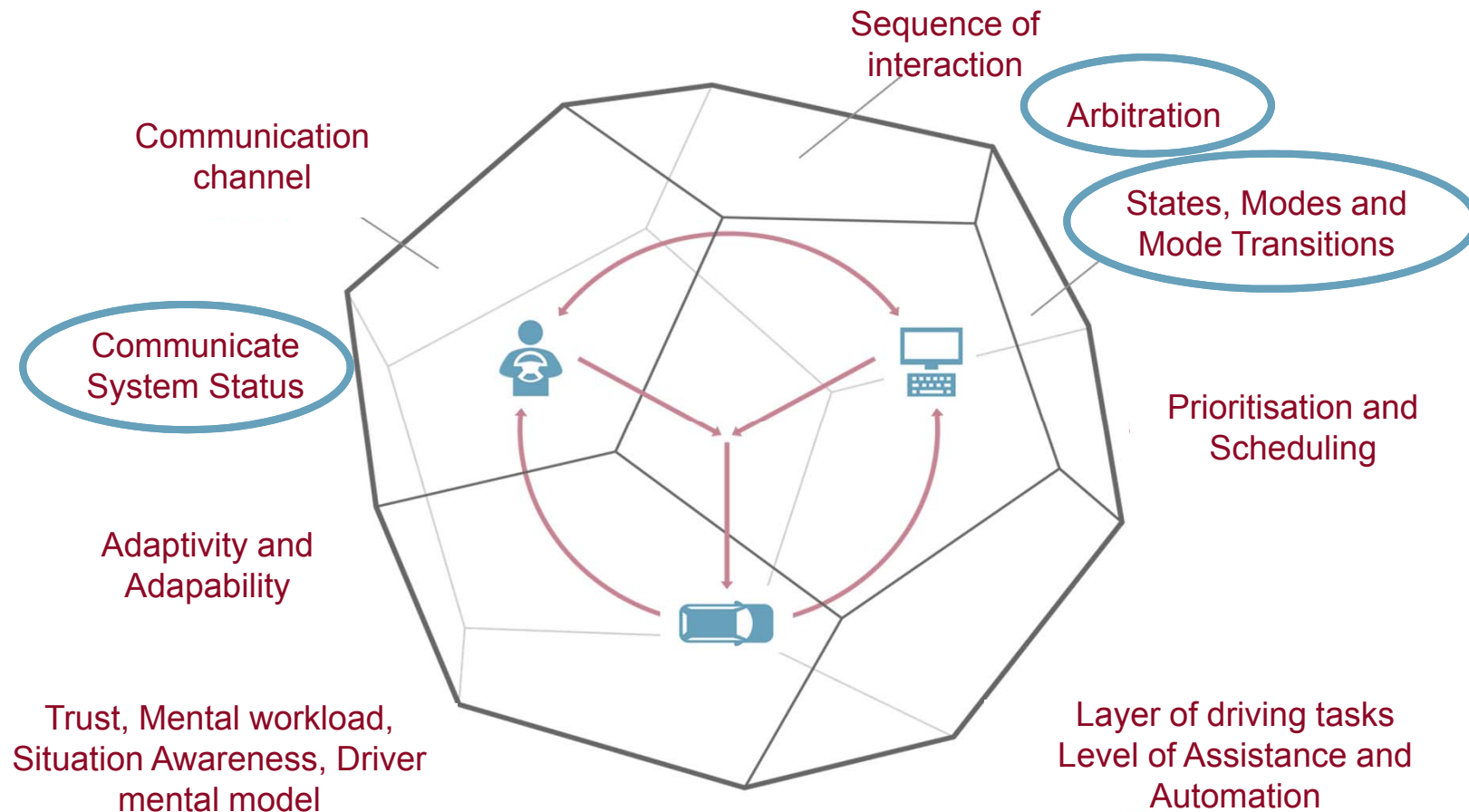
Information, Warning and Intervention (IWI) strategies – Deliverable 3.2



Detailed information on the IWI strategies in interactive
„Deliverable 3.2 - IWI Strategies“

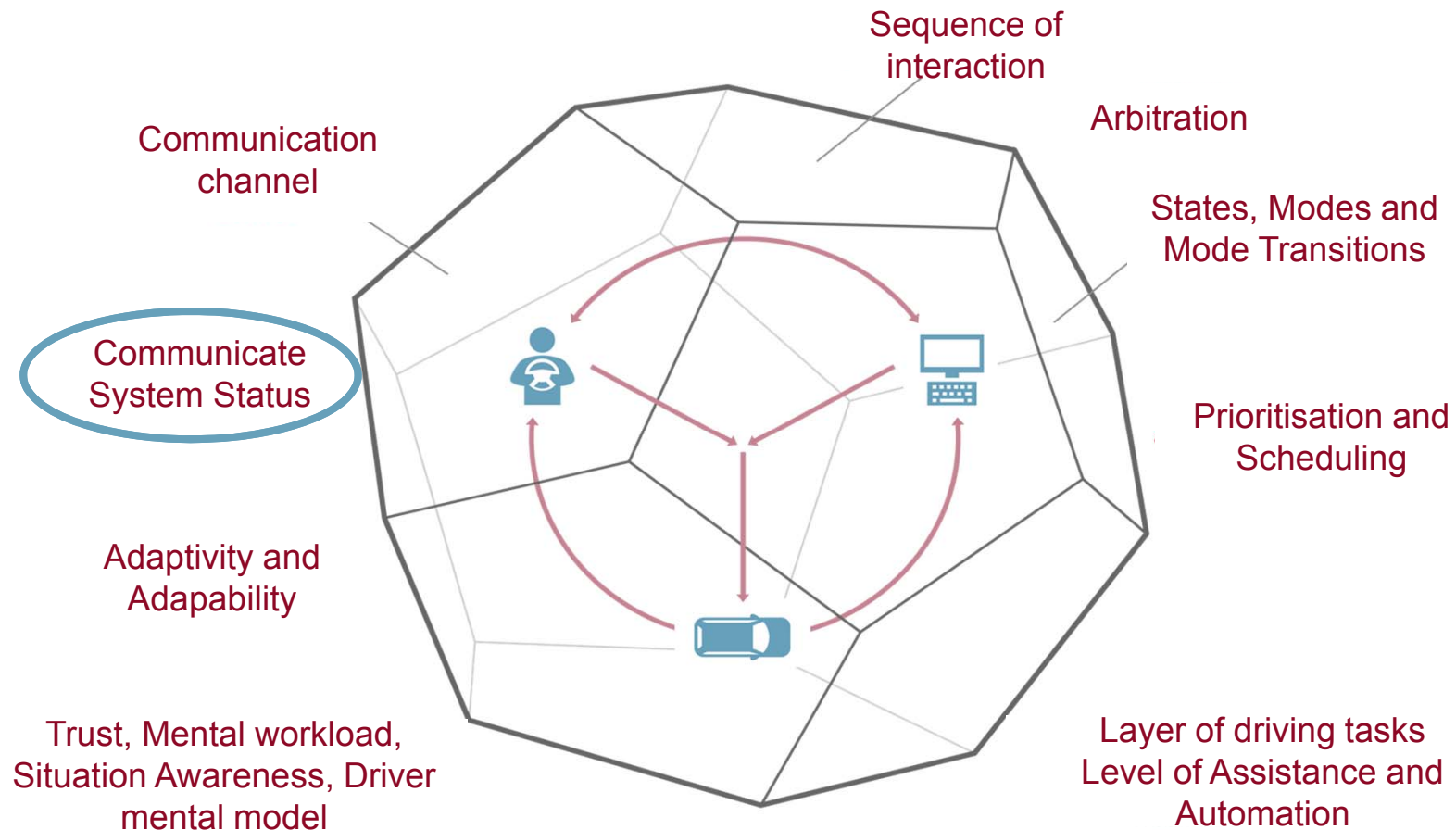
Introduction

Information, Warning and Intervention (IWI) strategies - categories



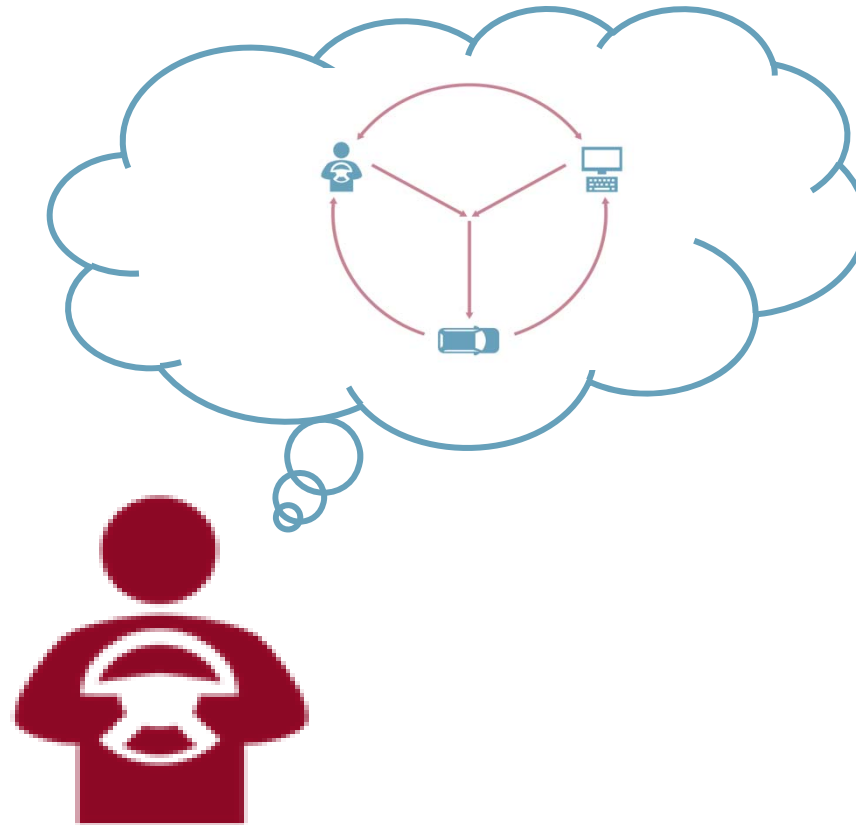
IWI strategies

Communicate System Status



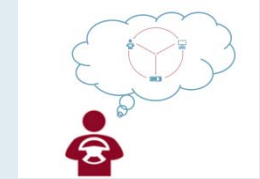
IWI strategies

Communicate System Status



IWI strategies

Communicate System Status



- Help the driver to build up a **correct mental model** about the automation
- Examples of InteractIVe IWI strategies:
 - **Group** continuous intervention / automation functions for normal driving **into modes of increasing degree of automation**



Lowly
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Highly
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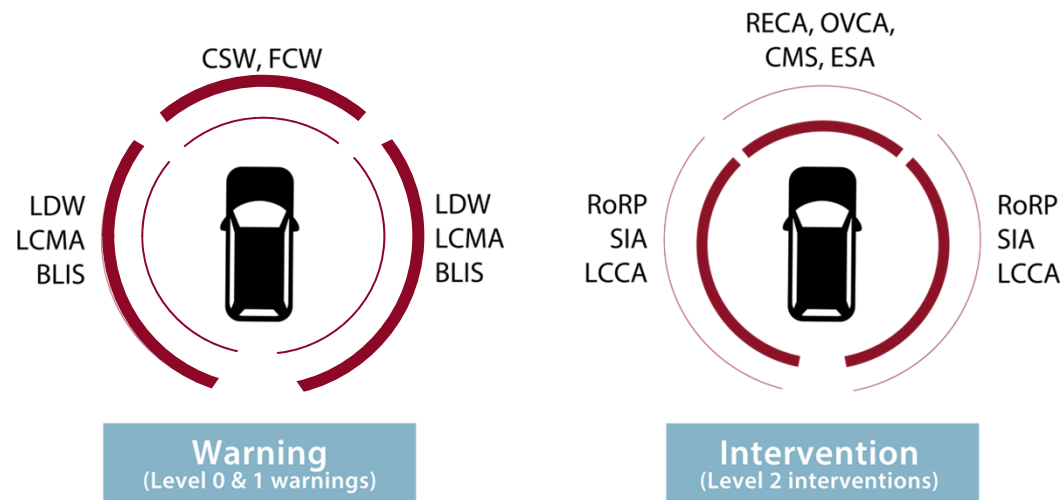


IWI strategies

Communicate System Status

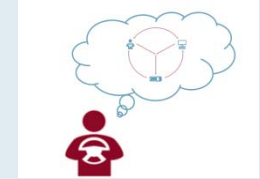


- Help the driver to build up a **correct mental model** about the automation
- Examples of Interactive IWI strategies:
 - **Group** continuous intervention / automation functions for normal driving **into modes of increasing degree of automation**
 - **Group** protection functions **using shield metaphor** (according to type of support and direction)

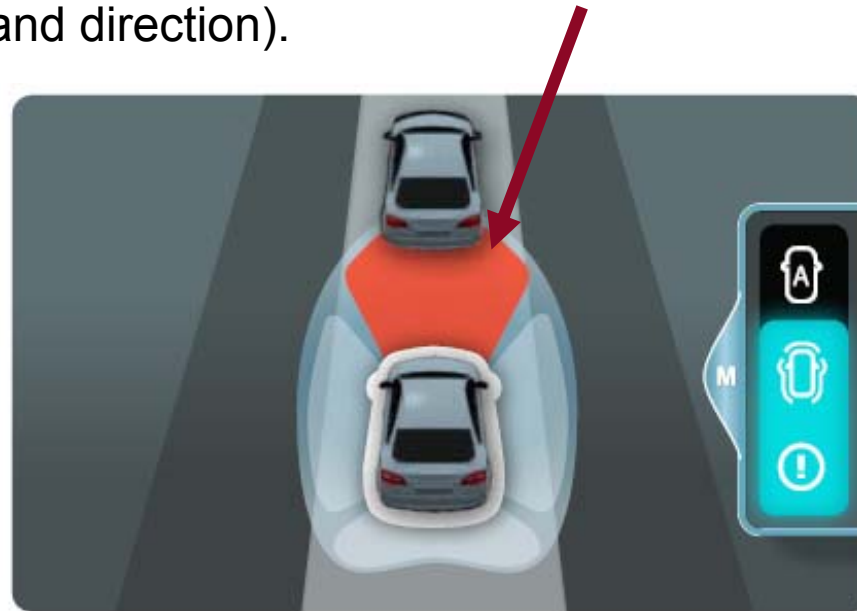


IWI strategies

Communicate System Status

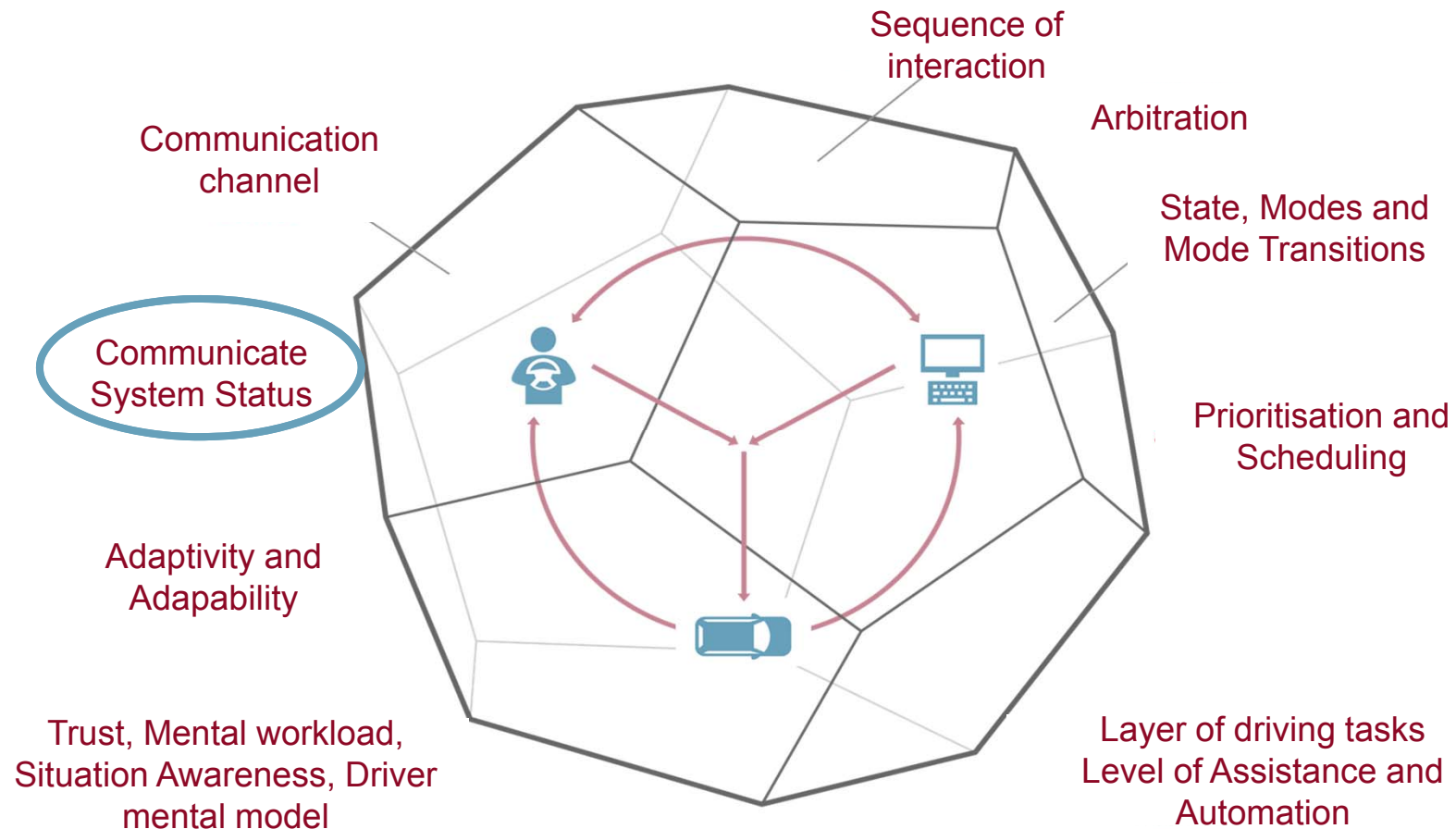
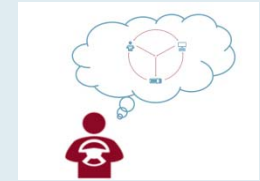


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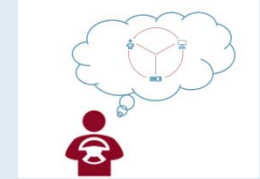
Outlook

Communicate System Status

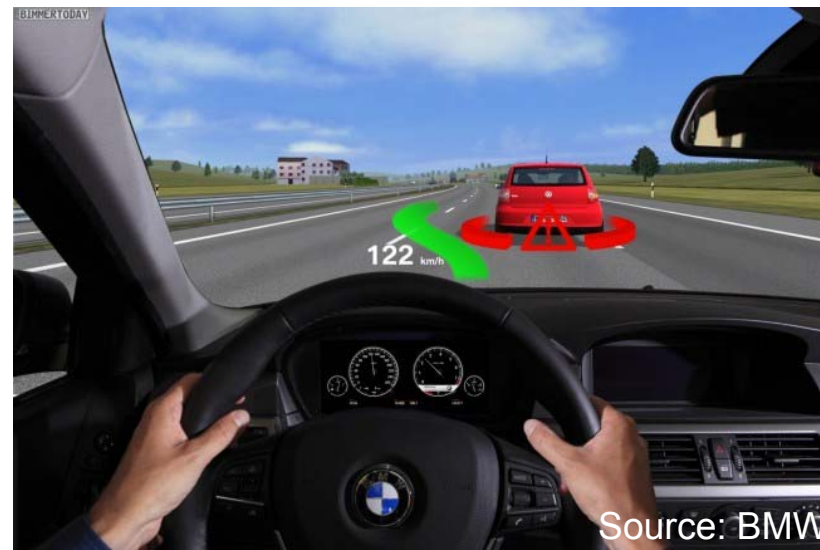


Outlook

Communicate System Status

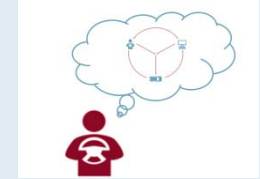


- Use of **new technologies** (e.g. Head-up-displays) to improve driver's understanding of the overall system
- Use of **integrated concepts** covering several assistance and automation functions



Outlook

Communicate System Status



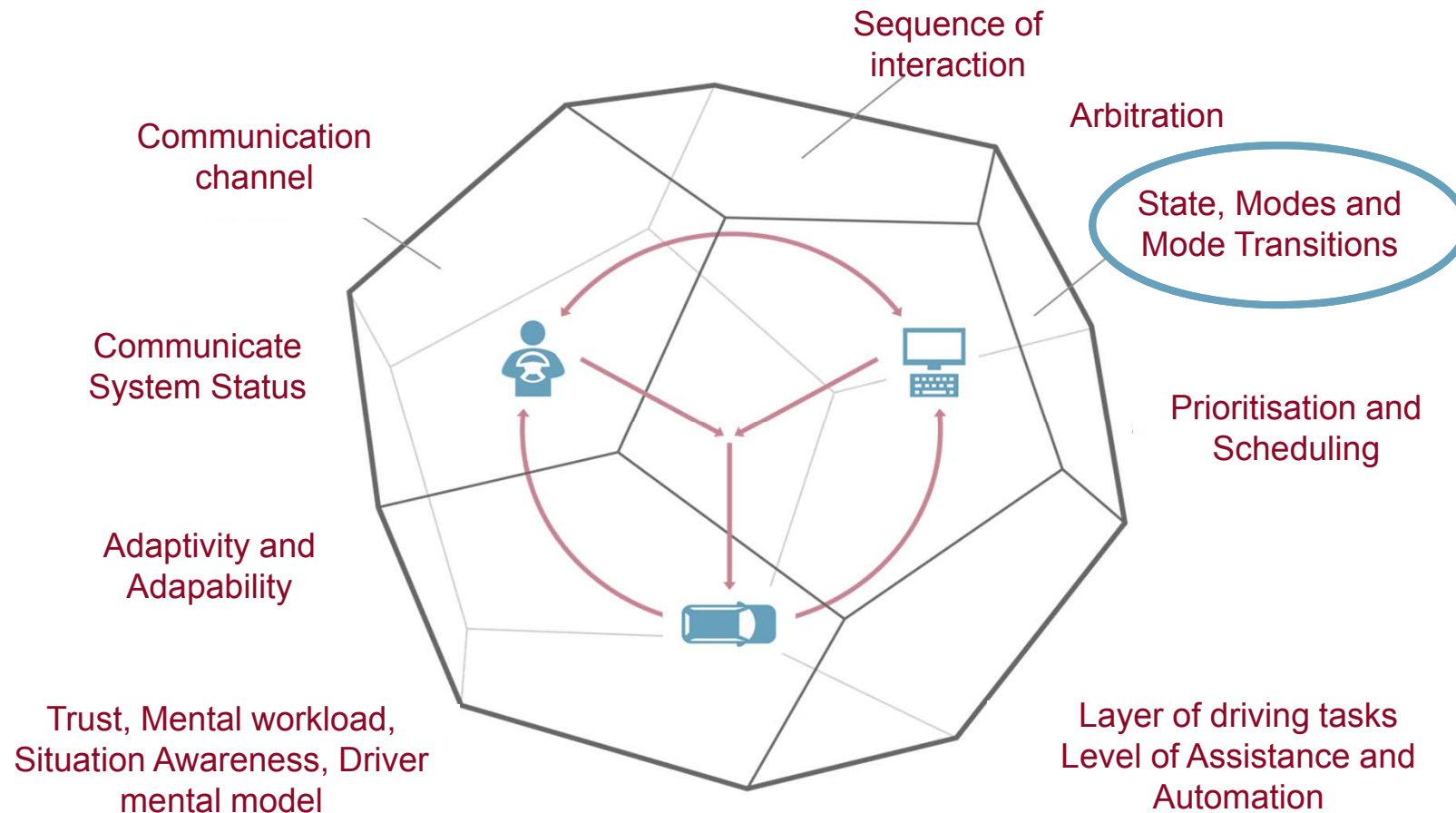
- Use of **new technologies** (e.g. Head-up-displays) to improve driver's understanding of the overall system
- Use of **integrated concepts** covering several assistance and automation functions
- Use information about the **automation state** → e.g. uncertainty information
- Use information about the **driver state** → e.g. adaption of functions and transitions



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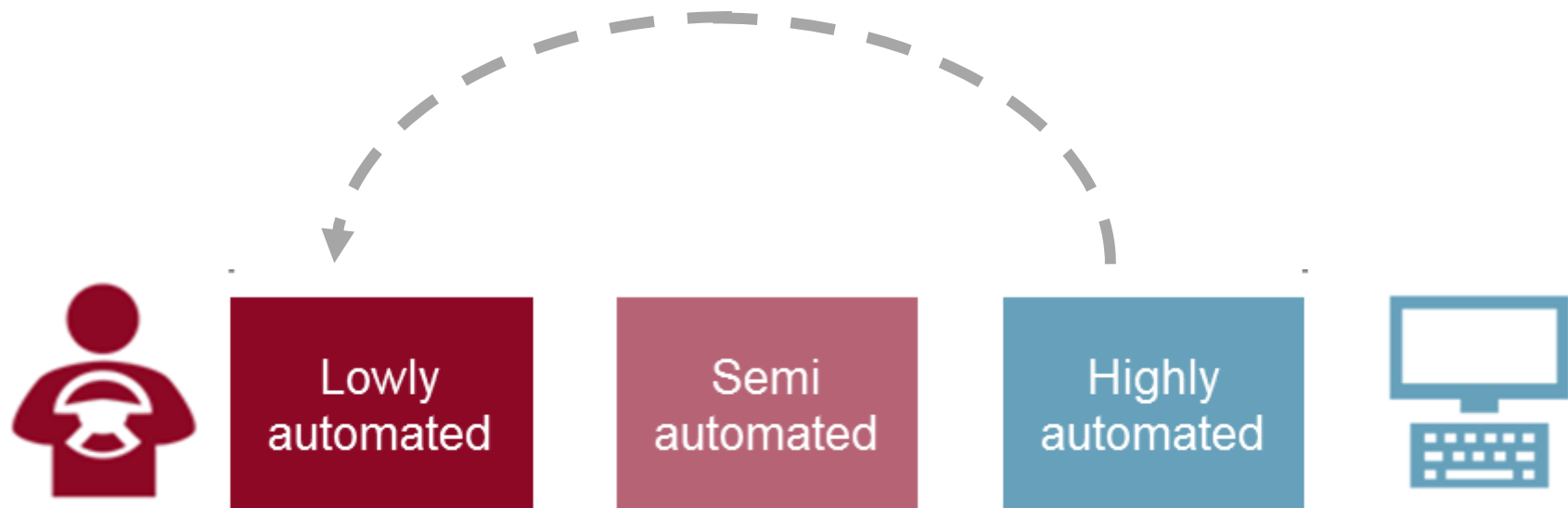
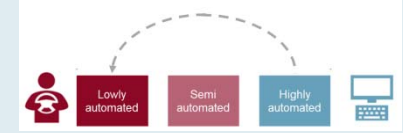
IWI strategies

States, Modes and Mode Transitions



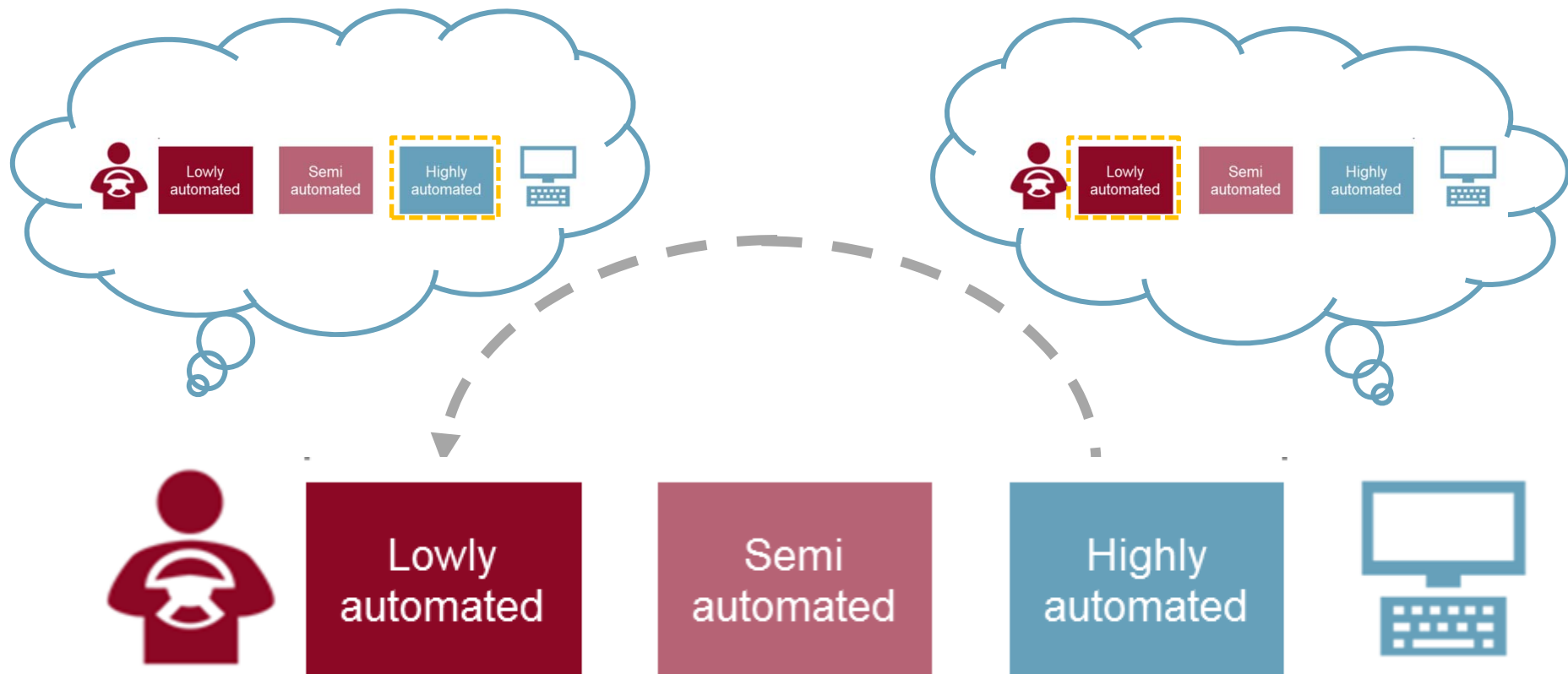
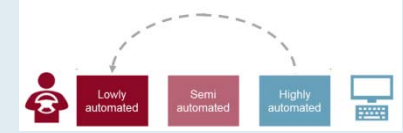
IWI strategies

States, Modes and Mode Transitions



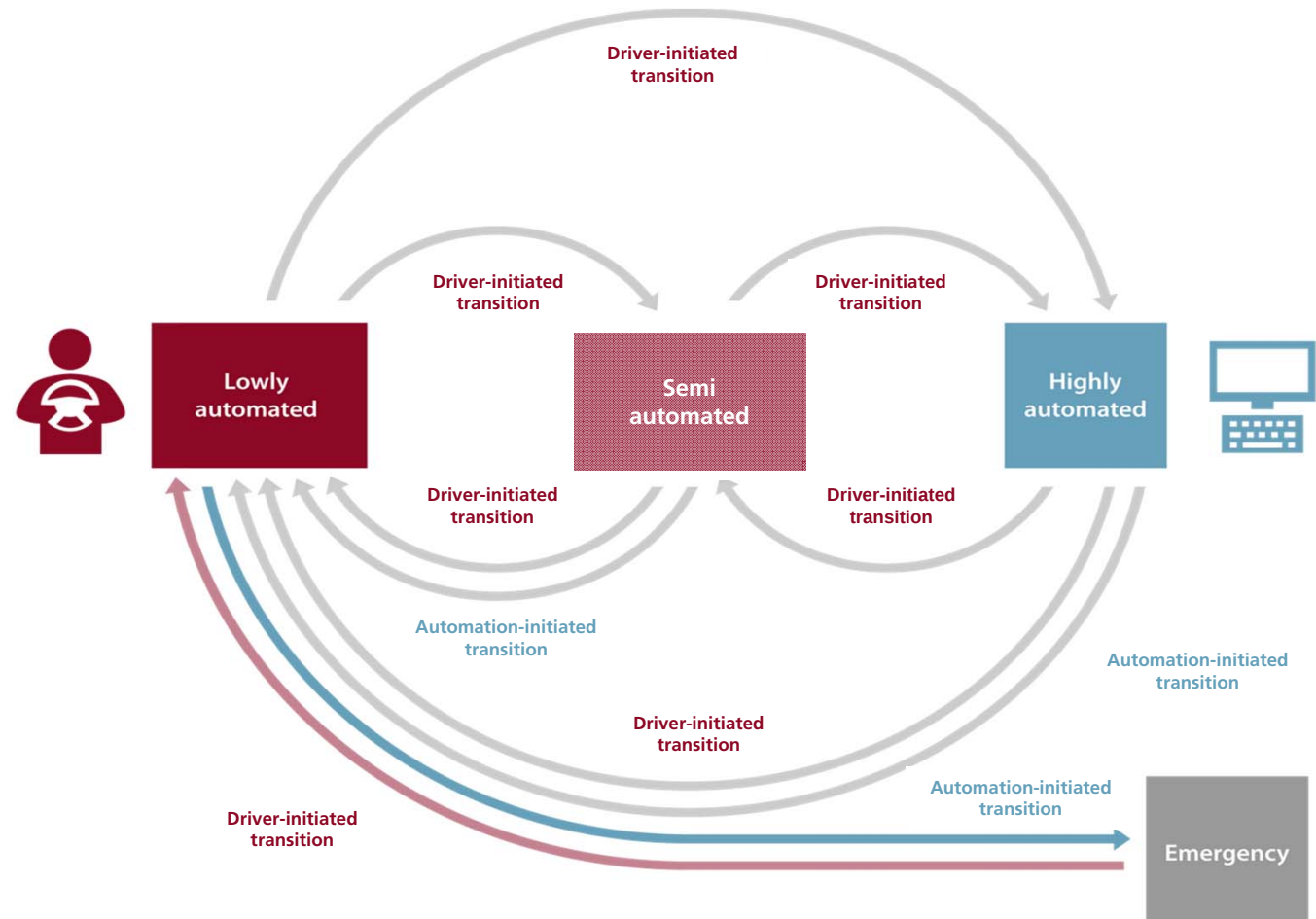
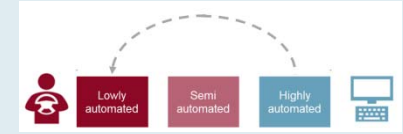
IWI strategies

States, Modes and Mode Transitions



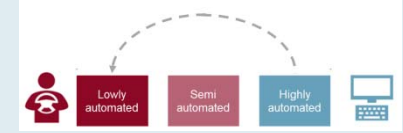
IWI strategies

States, Modes and Mode Transitions



IWI strategies

States, Modes and Mode Transitions

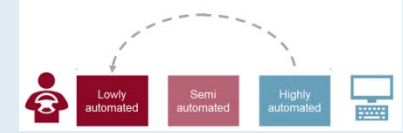


- Help the driver and the automation to always be aware of who is in control
- Examples of InteractIVe IWI strategies:
 - Use **interlocked transitions**

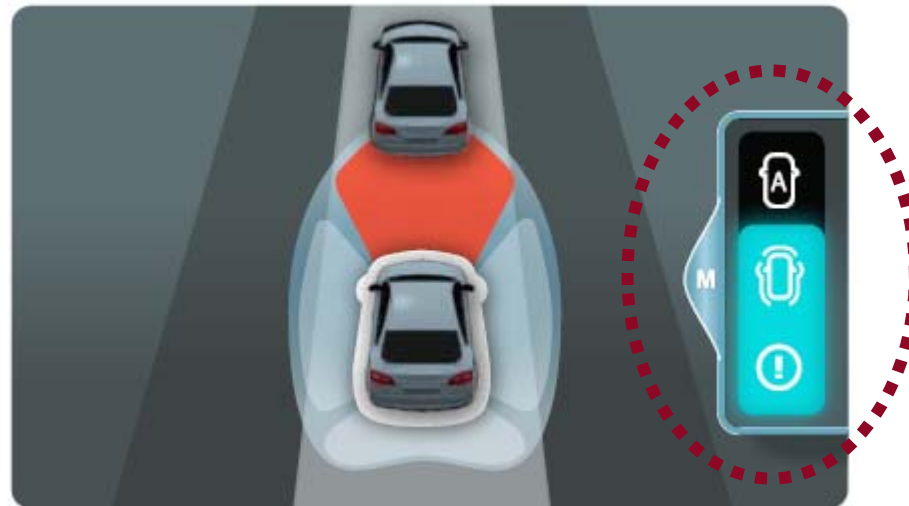


IWI strategies

States, Modes and Mode Transitions

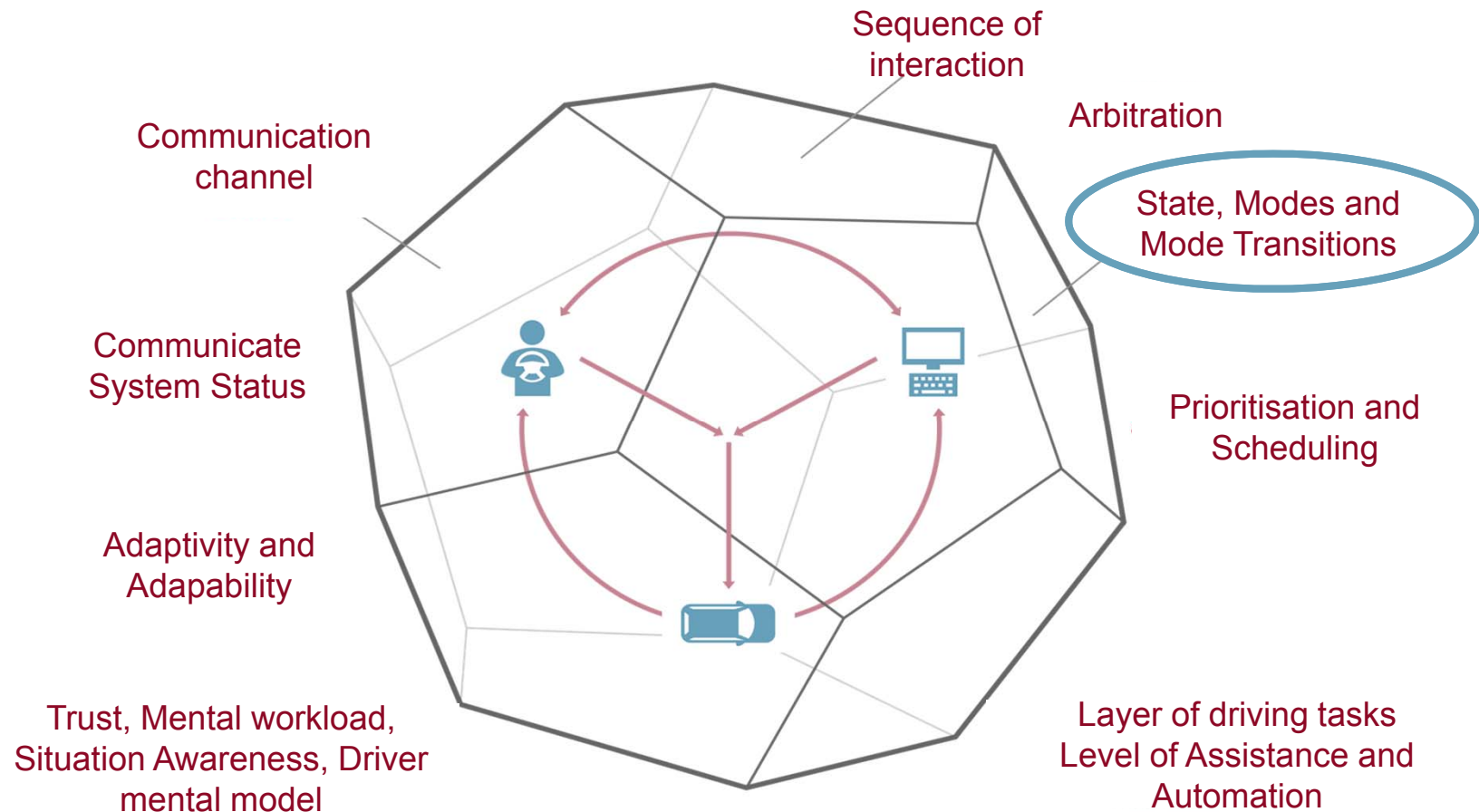
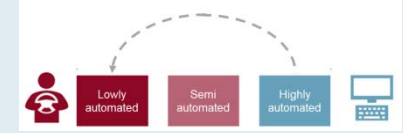


- Help the driver and the automation to always be aware of who is in control
- Examples of Interactive IWI strategies:
 - Use **interlocked transitions**
 - **Display** current and available **modes**



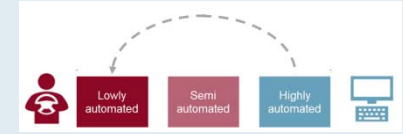
Outlook

States, Modes and Mode Transitions

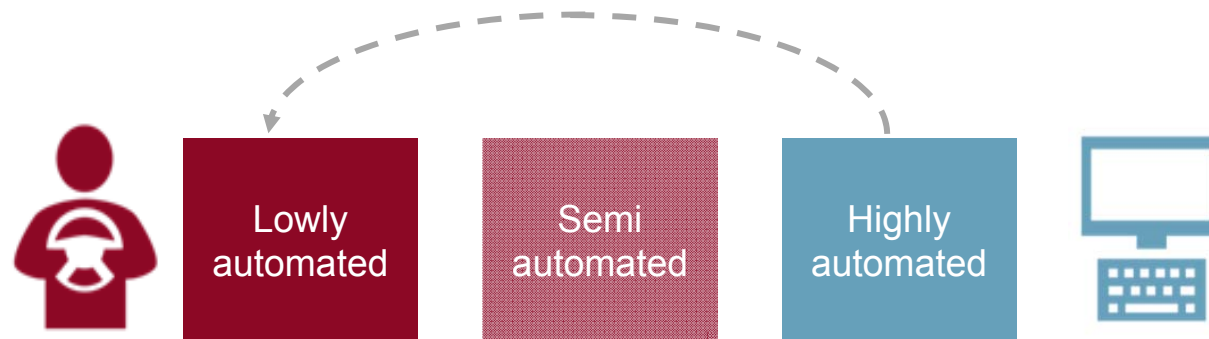


Outlook

States, Modes and Mode Transitions

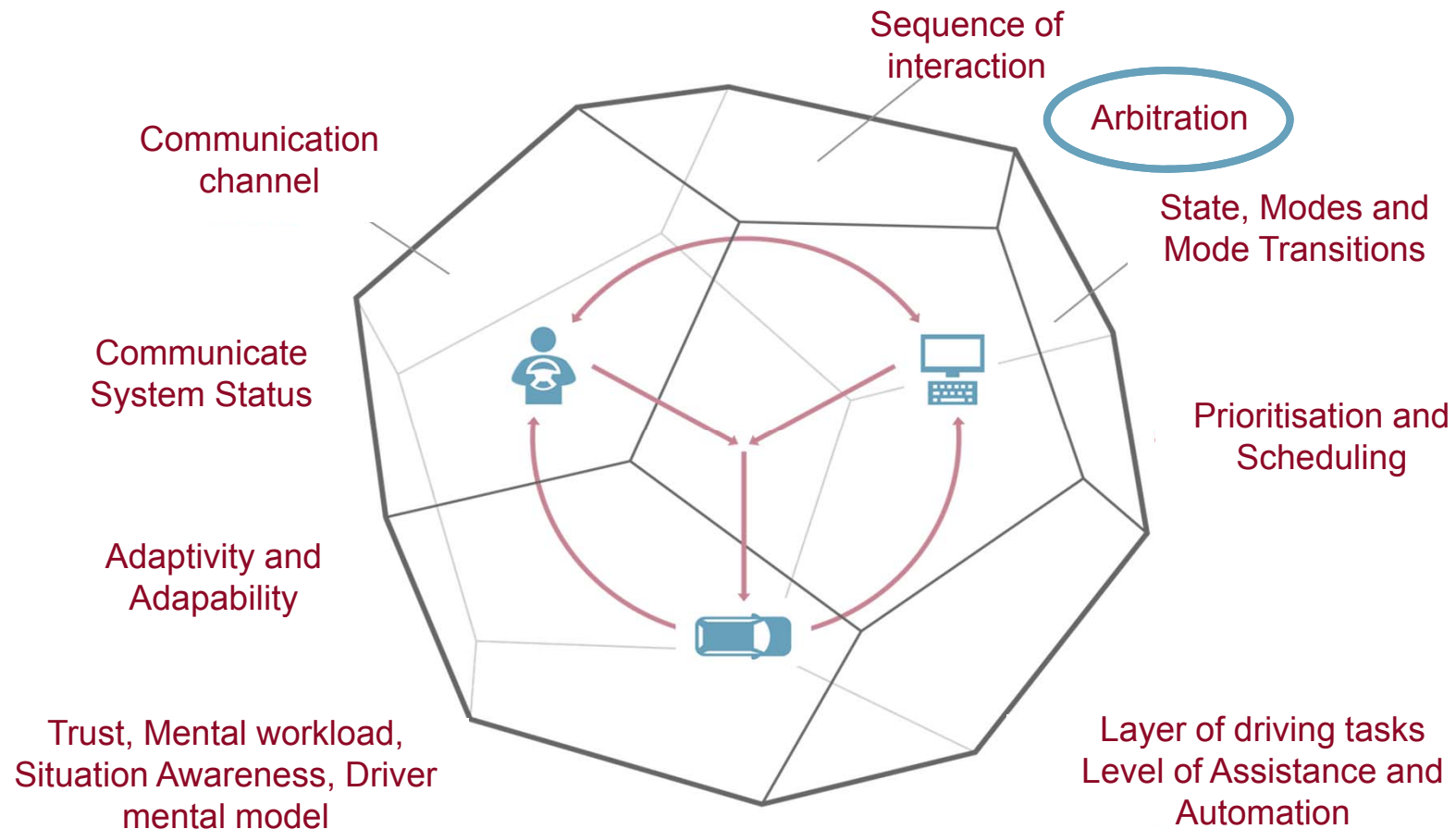


- Exploration of the **drivers ability to take over** after longer periods of driving in highly automated modes
- **Transition design** for transitions directly after automatic emergency interventions
- Exploration of **behavioural adaptation** for vehicles equipped with automatic intervention in critical situations



IWI strategies

Arbitration



IWI strategies

Arbitration



Lowly
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Semi
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Highly
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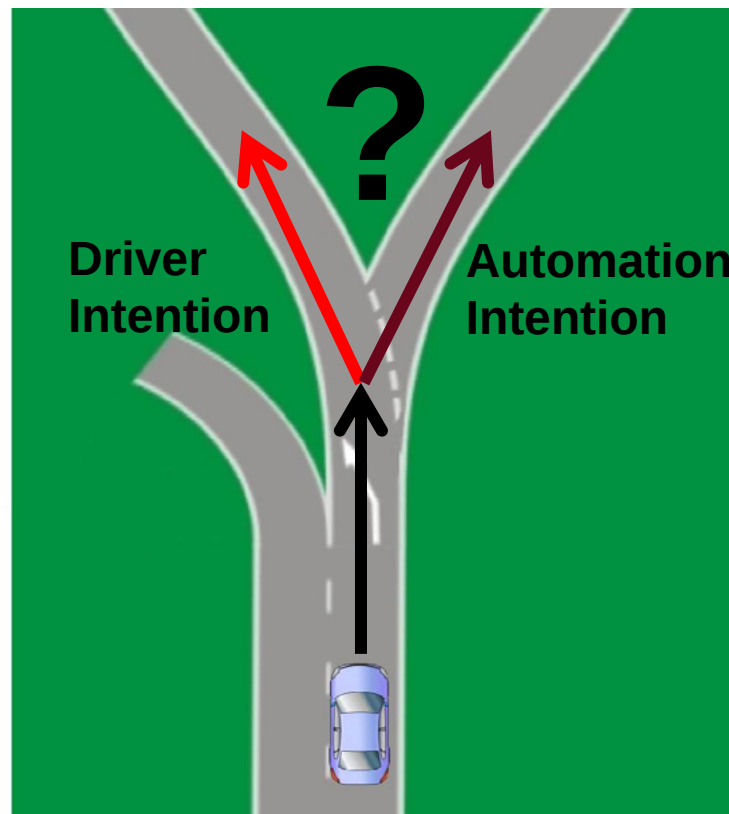


IWI strategies

Arbitration

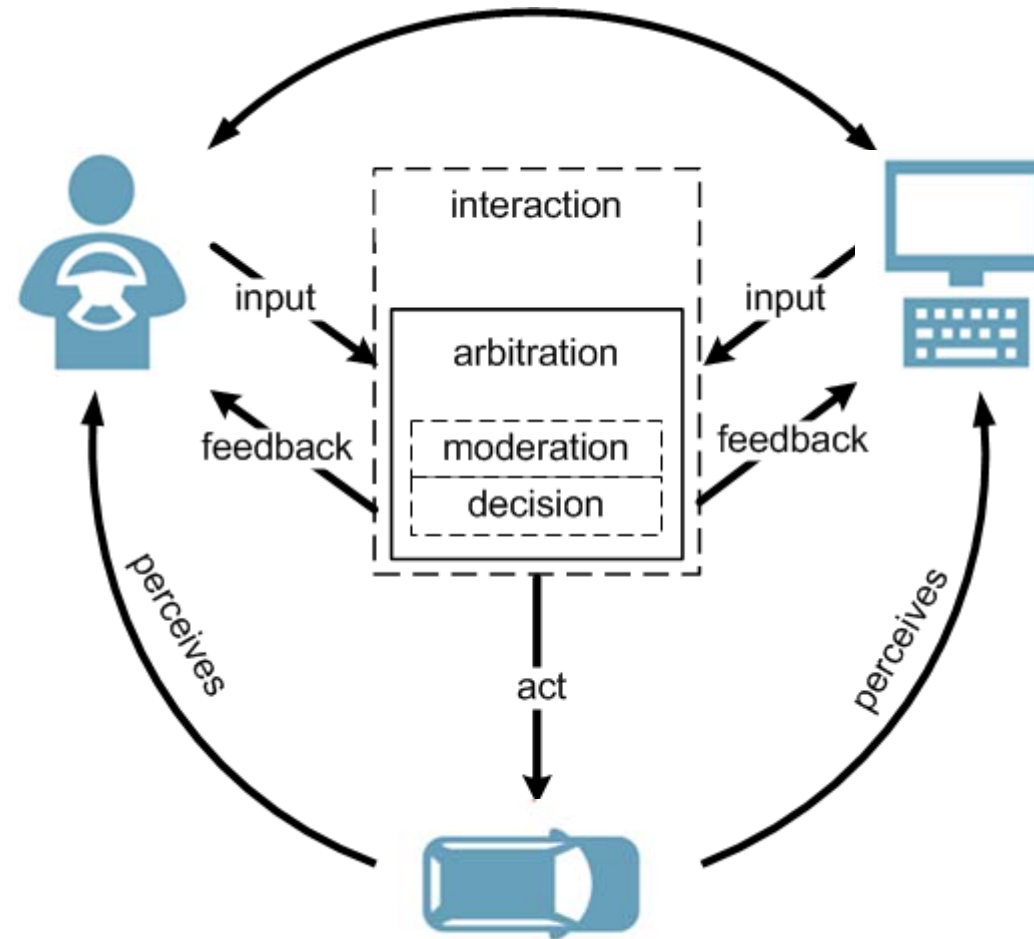


- Arbitration helps to solve situations in which the driver and the automation have different intentions



IWI strategies

Arbitration

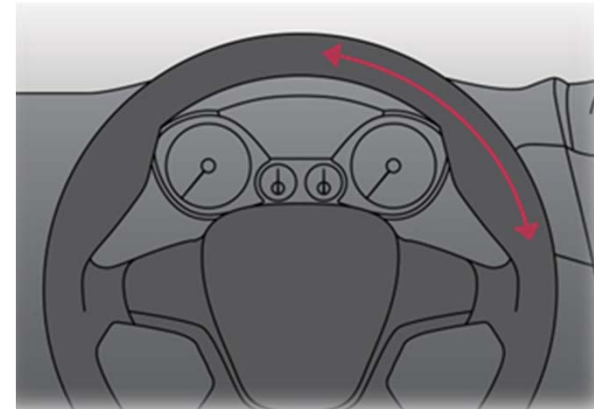


IWI strategies

Arbitration



- Arbitration helps to solve situations in which the driver and the automation have different intentions
- Examples of Interactive IWI strategies:
 - The **driver** should be always able to **control** the system

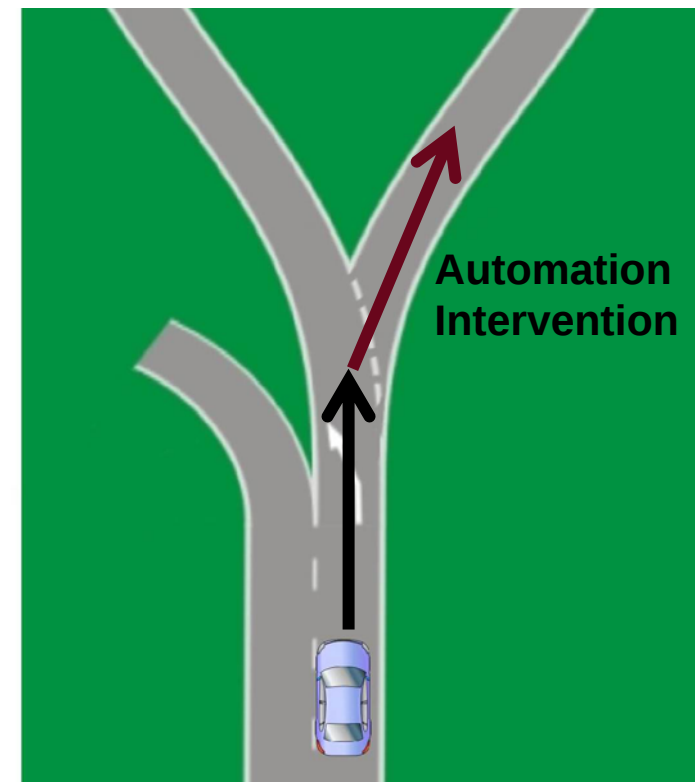


IWI strategies

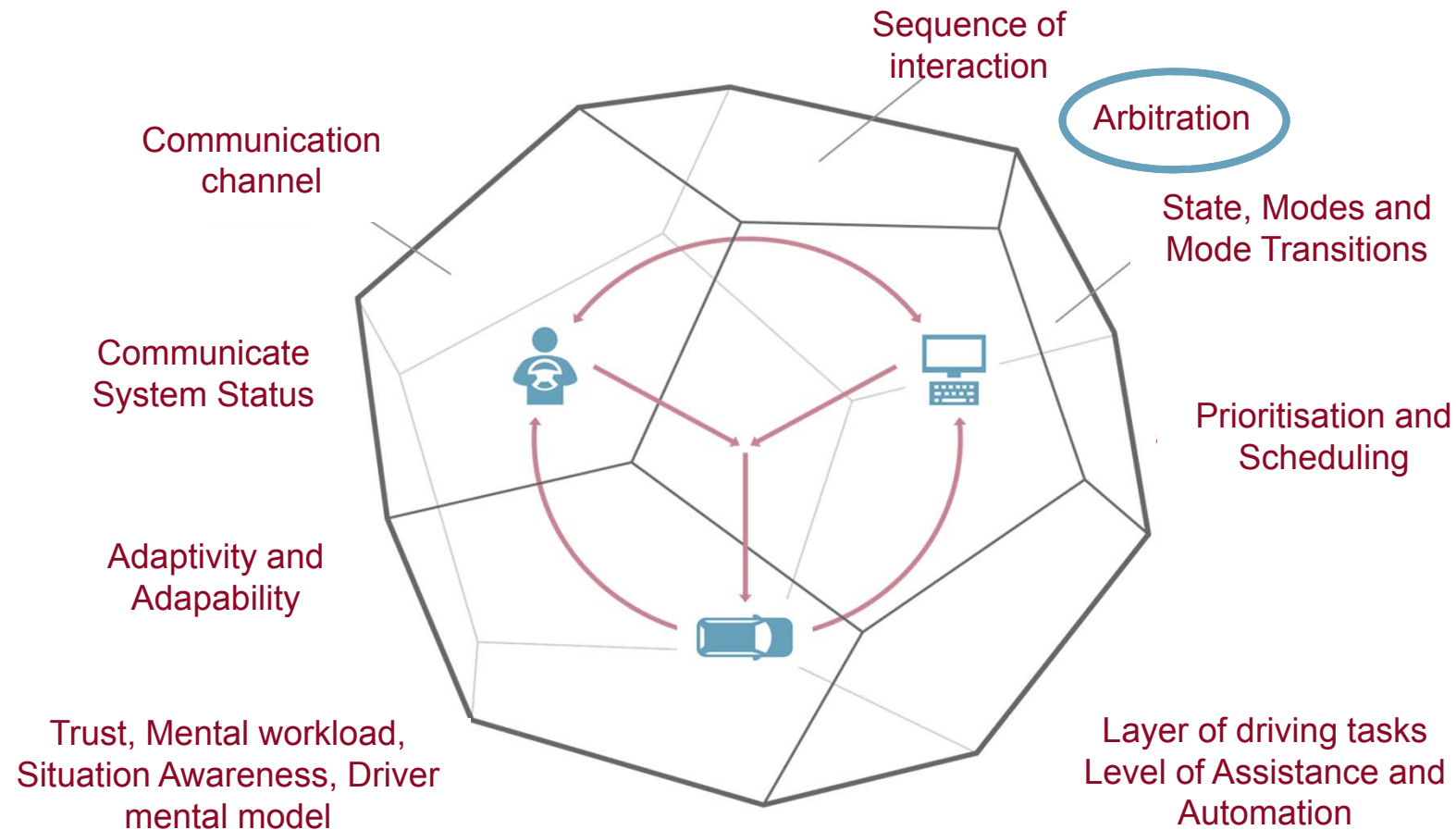
Arbitration



- Arbitration helps to solve situations in which the driver and the automation have different intentions
- Examples of Interactive IWI strategies:
 - The **driver** should be always able to **control** the system
 - Define **degree of authority for automation** according to the criticality and urgency of a situation
 - E.g. **automation can initiate an intervention** without driver input in critical emergency situations



Outlook Arbitration



Outlook Arbitration



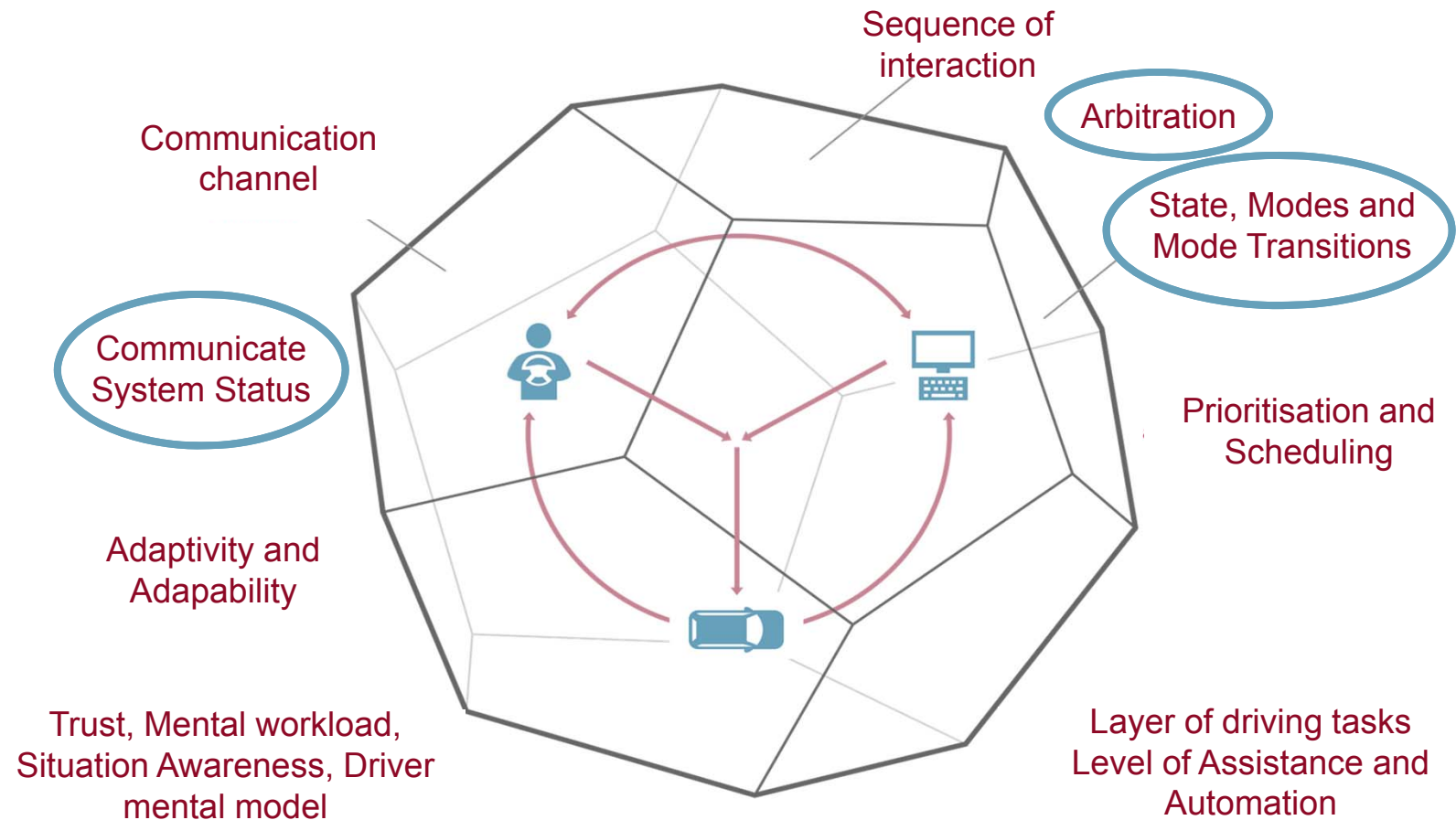
- Decide on the **distribution of authority** in emergency situations
 - Define if and when the automation should have full control
 - Check for controllability issues in false alarm situations

Outlook Arbitration



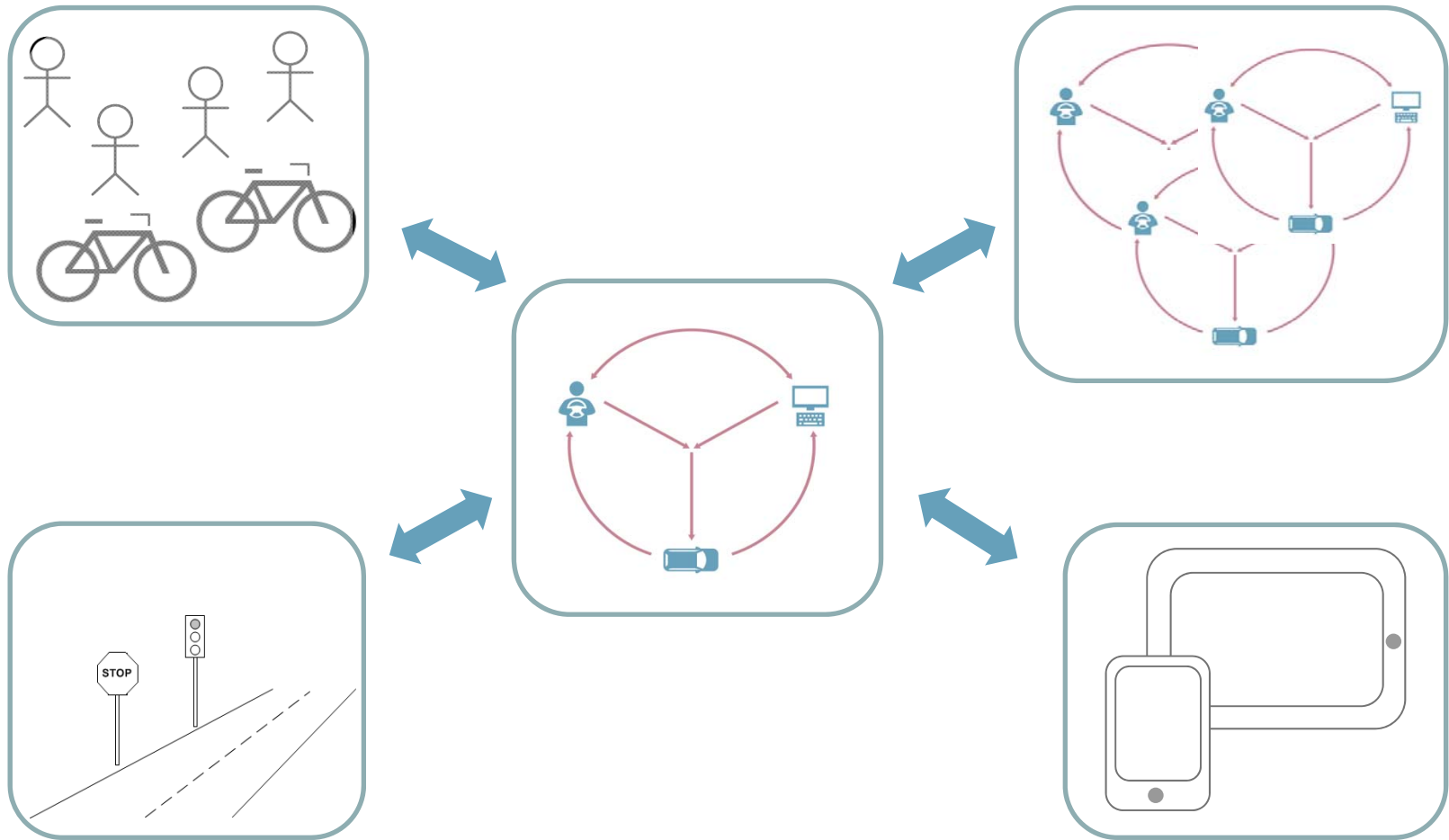
- Decide on the **distribution of authority** in emergency situations
 - Define if and when the automation should have full control
 - Check for controllability issues in false alarm situations
- Decide on the way the driver can **overrule** the automatic intervention
 - Define situations when the driver is allowed to overrule the intervention e.g. based on criticality, urgency or automation mode
 - Explore and define criteria to assess drivers' intention
 - Define criteria to decide on conscious vs. unconscious overruling of the driver

IWI strategies Summary



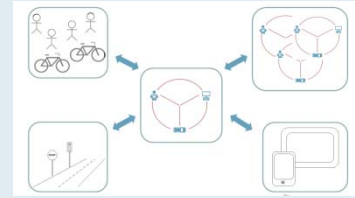
Outlook

Complex cooperative systems



Outlook

Complex, cooperative systems



- Cooperation with infrastructure, other road users and other vehicles brings new challenges for the Human Factors research
- **Modes and mode transitions & communicate system status**
 - Find solutions to integrate complex information not only from vehicle-based assistance systems but also from other entities
- **Arbitration**
 - Enlarge arbitration concepts to negotiations including surrounding traffic participants with different intentions
 - Work on concepts to decided which intentions to prioritize

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- **Volvo Group Trucks:** Emma Johansson, Ida Esberg, Christian Larsson, Pontus Larsson, Per Nordqvist, Erik Karlsson, Christer Lundevall, Johan Engström
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- **DLR:** Tobias Hesse, Anna Schieben, Frank Flemisch, Matthias Heesen, Johann Kelsch, Stefan Griesche, Marc Dziennus, Nicola Fricke, Julian Schindler, Claas Brunken, Christian Löper, Martin Baumann, Astrid Kassner
- **ATG:** Martin Brockmann, Fabienne Stordiau, Angela Allgaier

VOLVO



References

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- Hesse, T.; Engström, E.; Johansson, E.; Varalda, G.; Brockmann, M.; et al. (2011). *Towards user-centred development of integrated information, warning, and intervention strategies for multiple ADAS in the EU project interactiVe*. Paper presented at the HCI Conference 2011, Orlando, US.
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- Kelsch, J.; Temme, G.; Schindler, J. (2013): *Arbitration based framework for design of holistic multimodal human-machine interaction*. Paper presented at the AAET Conference 2013, 6.-7. Feb. 2013, Braunschweig, Germany.
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interactive



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Thank you.

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SEVENTH FRAMEWORK
PROGRAMME

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German Aerospace Center