The HAVEit project
Multiple levels of automation

Anna Schieben

Presentation at the TRB Workshop, 25th of July 2012, Irvine

Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Outline

- The EU-project HAVEit
- Multiple levels of automation: HMI challenges and the HAVEit approach
- Generic design schemes and application examples in HAVEit
- Summary and Outlook

The EU-project HAVEit

- HAVEit: Highly Automated Vehicles for Intelligent Transport
- EU IP-Project led by Continental Automotive
- 17 partners from industry and research institutes
- 17 Million Euros EU funding, total budget of 28 million Euros
- January 2008 to July 2011
- 7 vehicles showing an integrated concept for different automation levels

HAVEit

Driver interface components

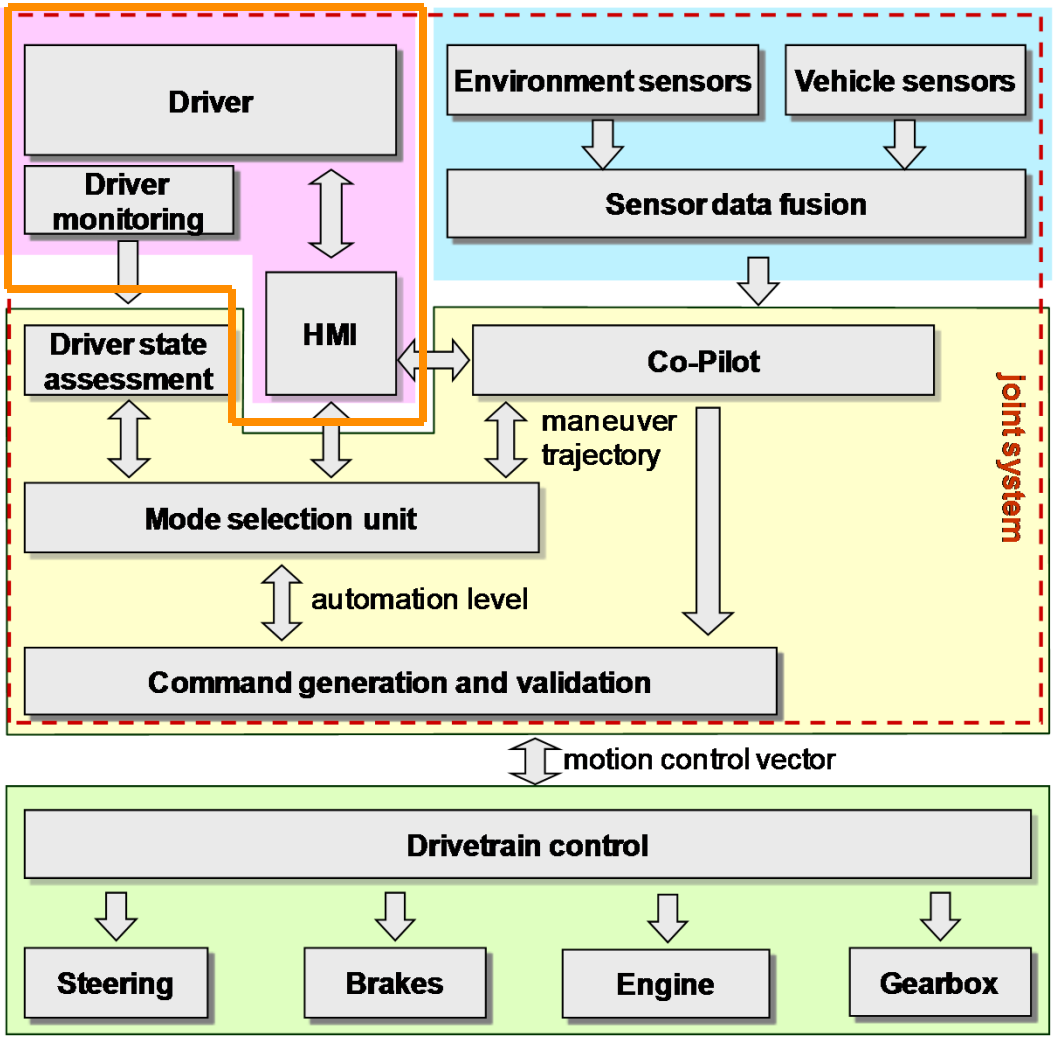
to assess the driver state and to integrate the driver in the automation loop

Command layer

to define maneuver, trajectory and automation level and to generate the safe motion control vector

Execution layer

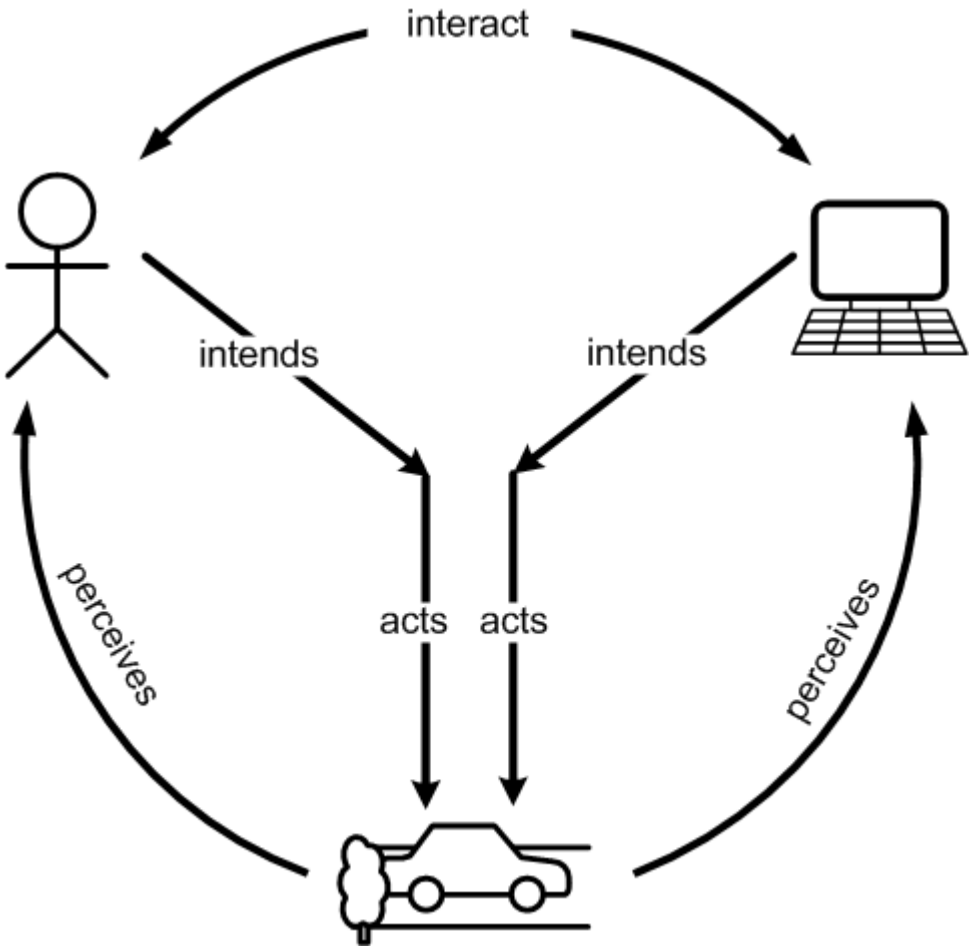
to perform the safe motion control vector



Perception layer

for real-time scene recognition

Multiple levels of automation: HMI challenges & the HAVEit approach

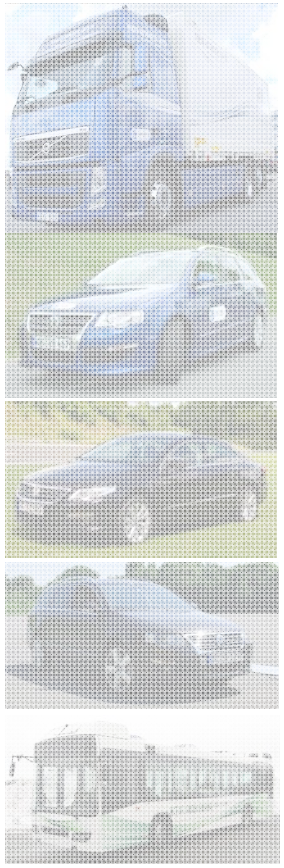

interact
intends
intends
acts
acts
perceives
perceives

Challenges for the HMI design

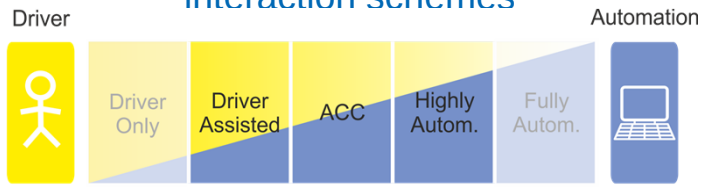
- **Easy to understand** interaction for the driver
- **Combination** of different assistance functions already available (like ACC) with higher levels of automation
- Interface that **reduces complexity** for the driver
- **Alignment** of the interaction design for the involved HAVEit vehicles

Design and evaluation process in HAVEit

Initial demonstrator concepts



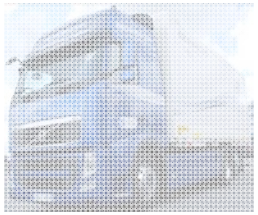
Generic concepts and interaction schemes

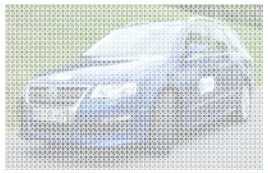


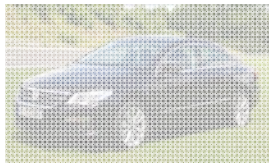
Design with theater-system

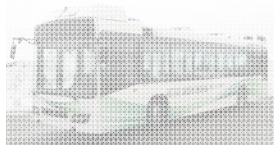
Design and evaluation process in HAVEit

Initial concepts

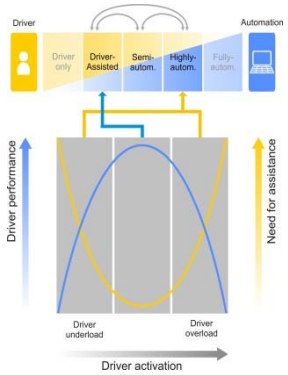




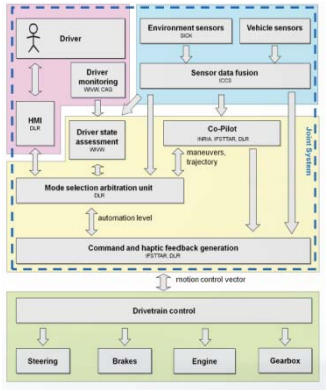




Generic concepts



Implementation



Iterative refinement

Migration to simulators

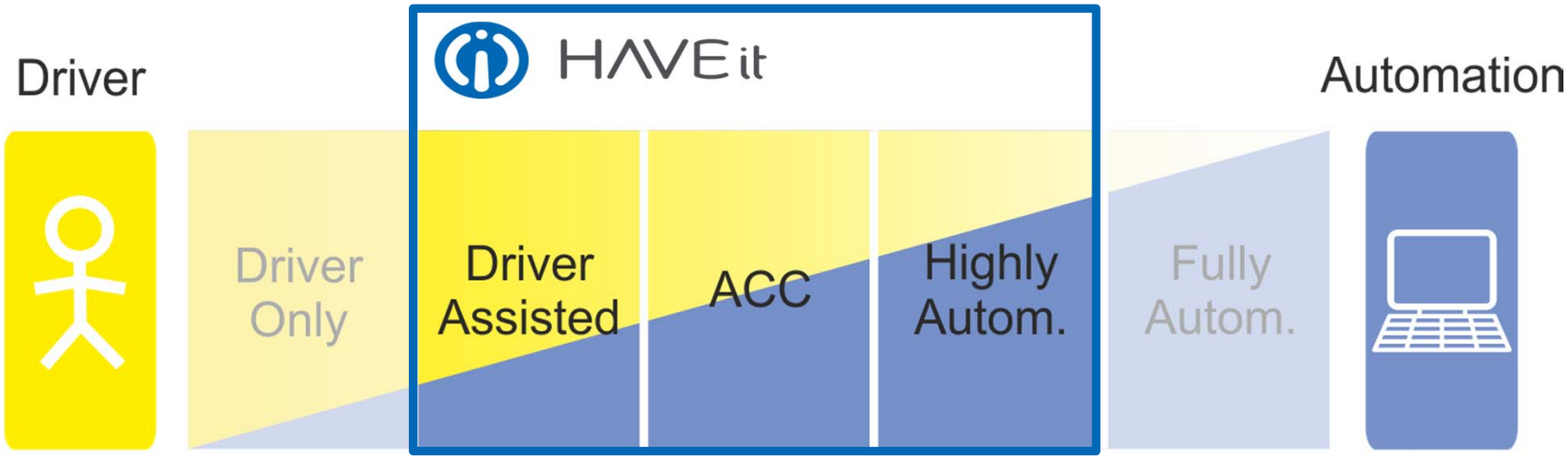
Migration to vehicle(s)

Design with theater system

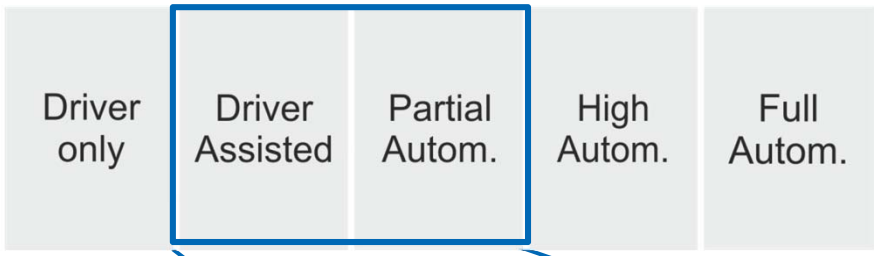
Validation by simulation

Generic design schemes and application examples in HAVEit

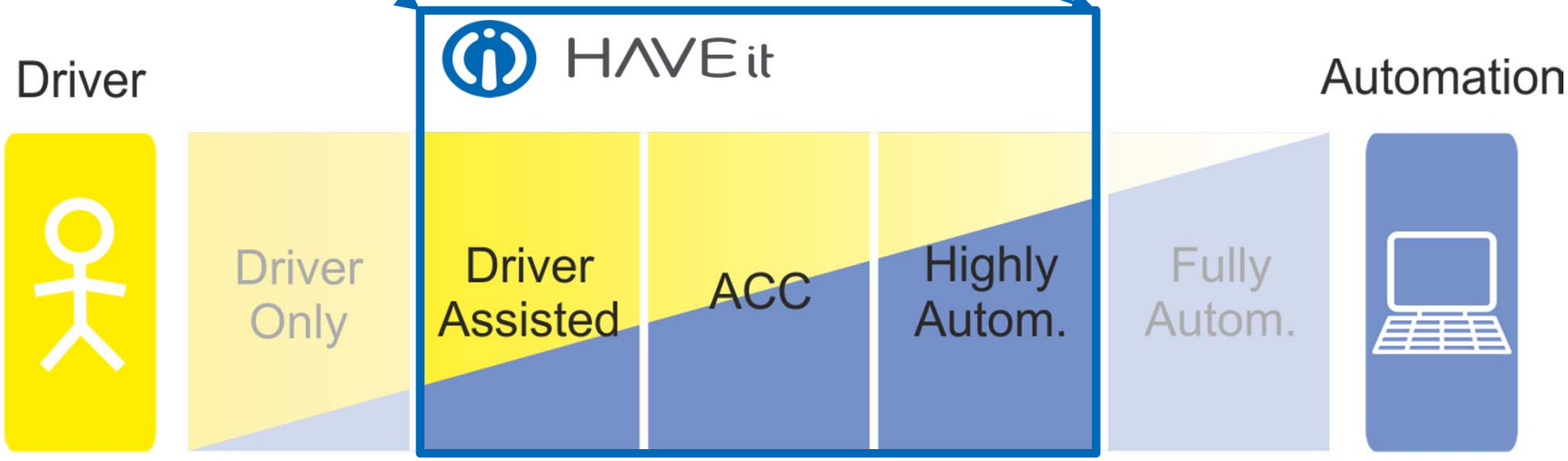
Definition of the levels of automation



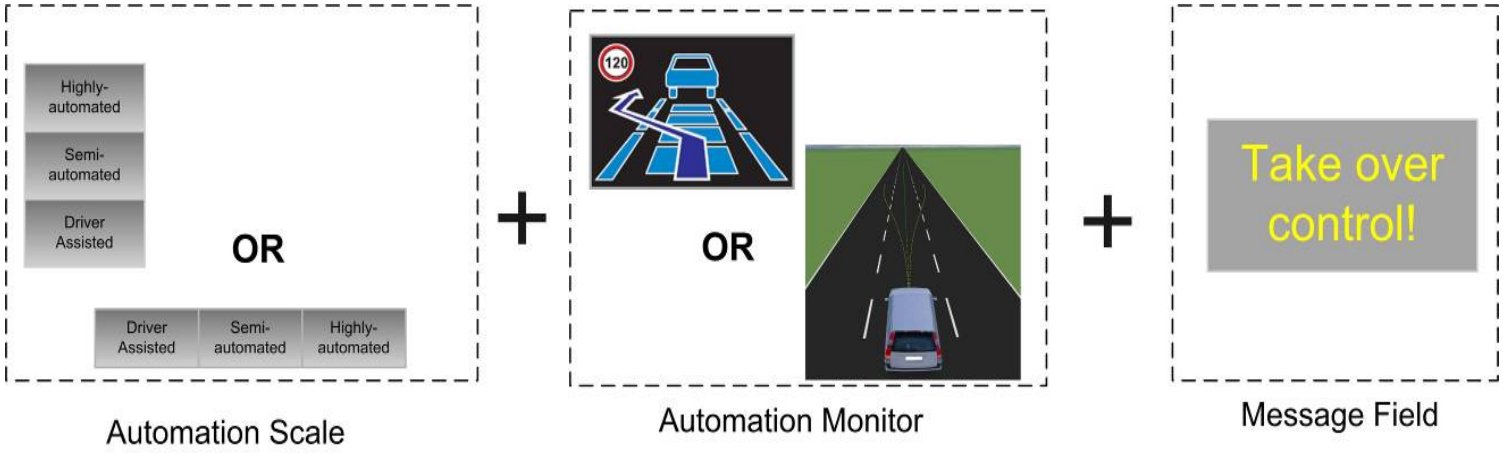
Levels of automation in HAVEit and BaSt



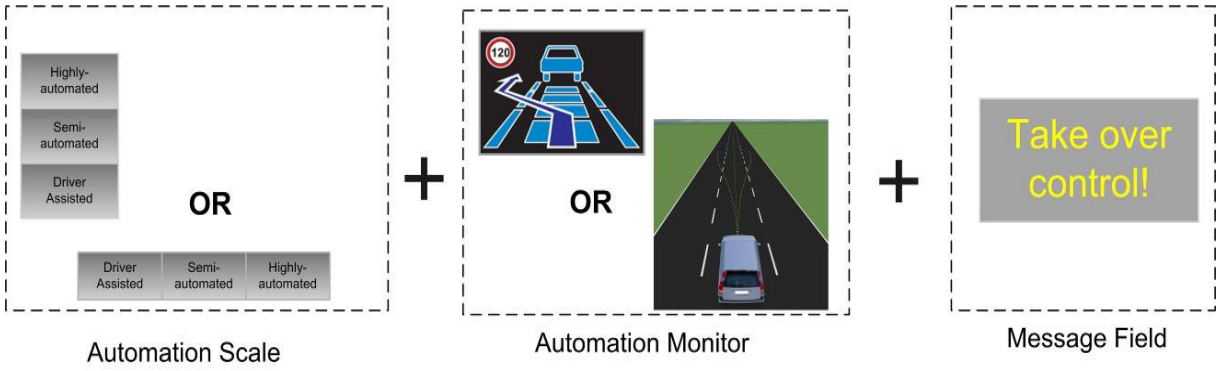
BASt Definition (Gasser et al. 2011)



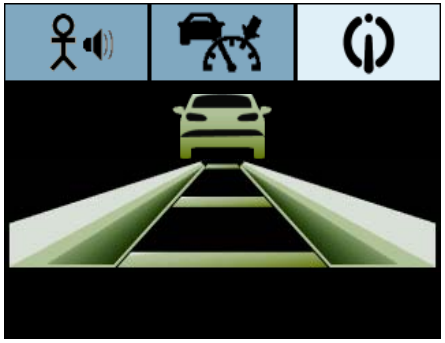
Generic interaction scheme: Display



Generic interaction scheme: Display



Joint System Demonstrator

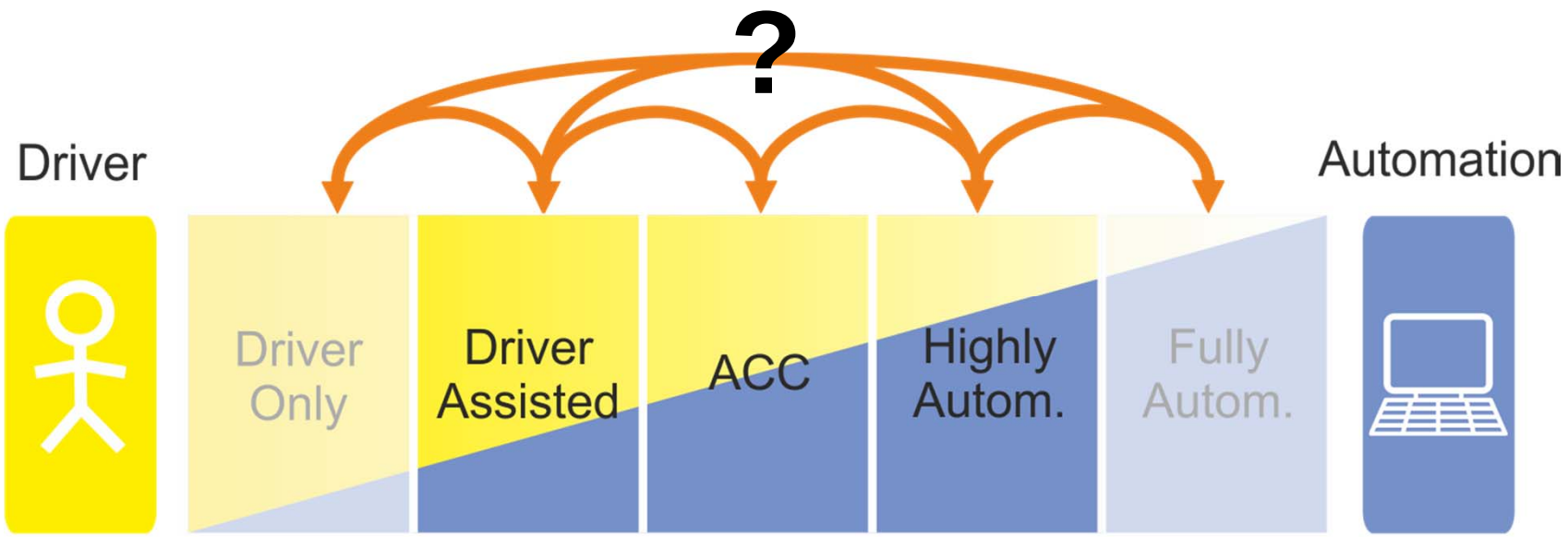


Conti ARC

VTEC AQuA

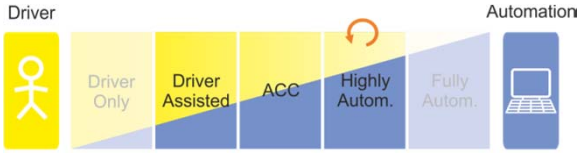
VW TAP

Generic interaction scheme: Transitions

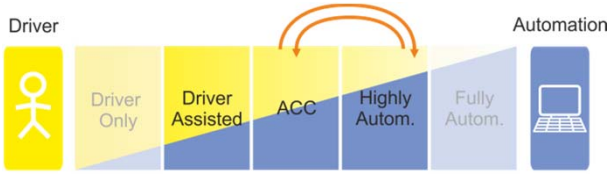


Generic interaction scheme: Transitions

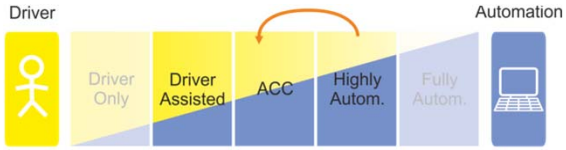
Prototype A

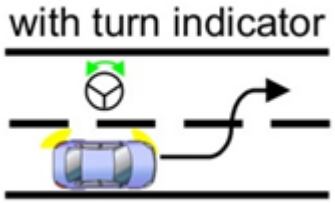


Prototype B

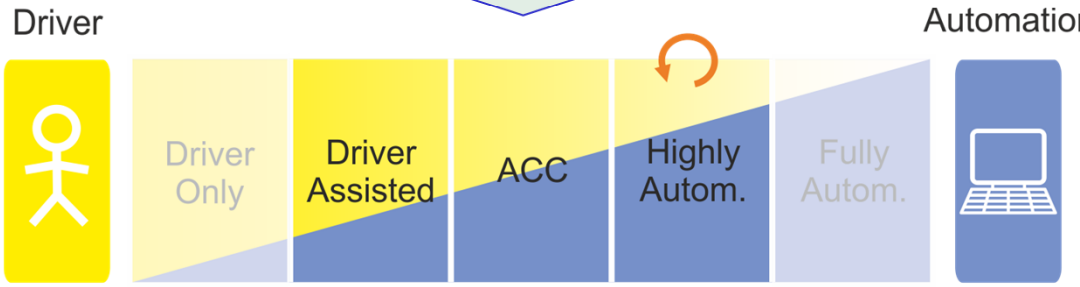


Prototype C



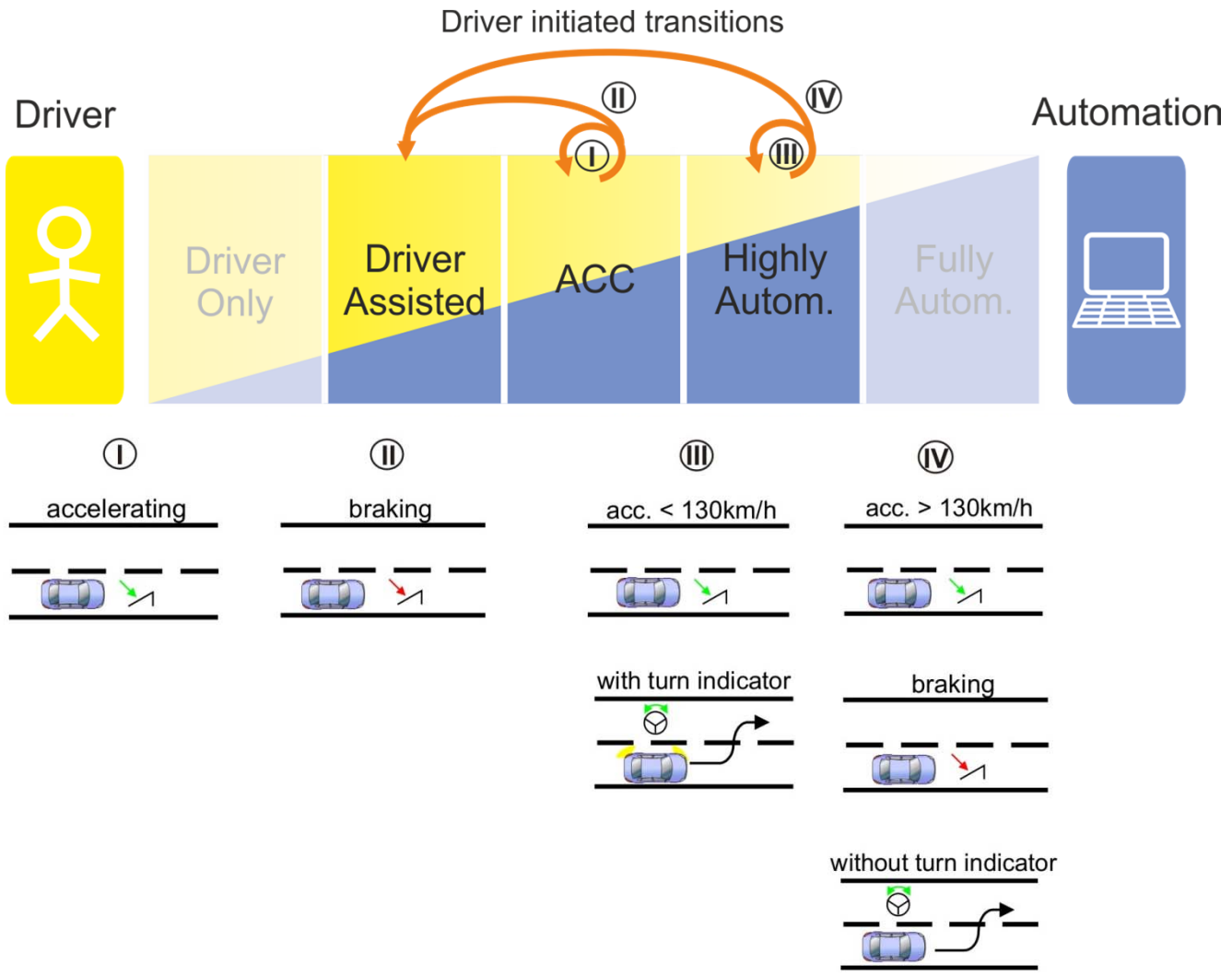


HMI Workshops
Simulator study
Alignment

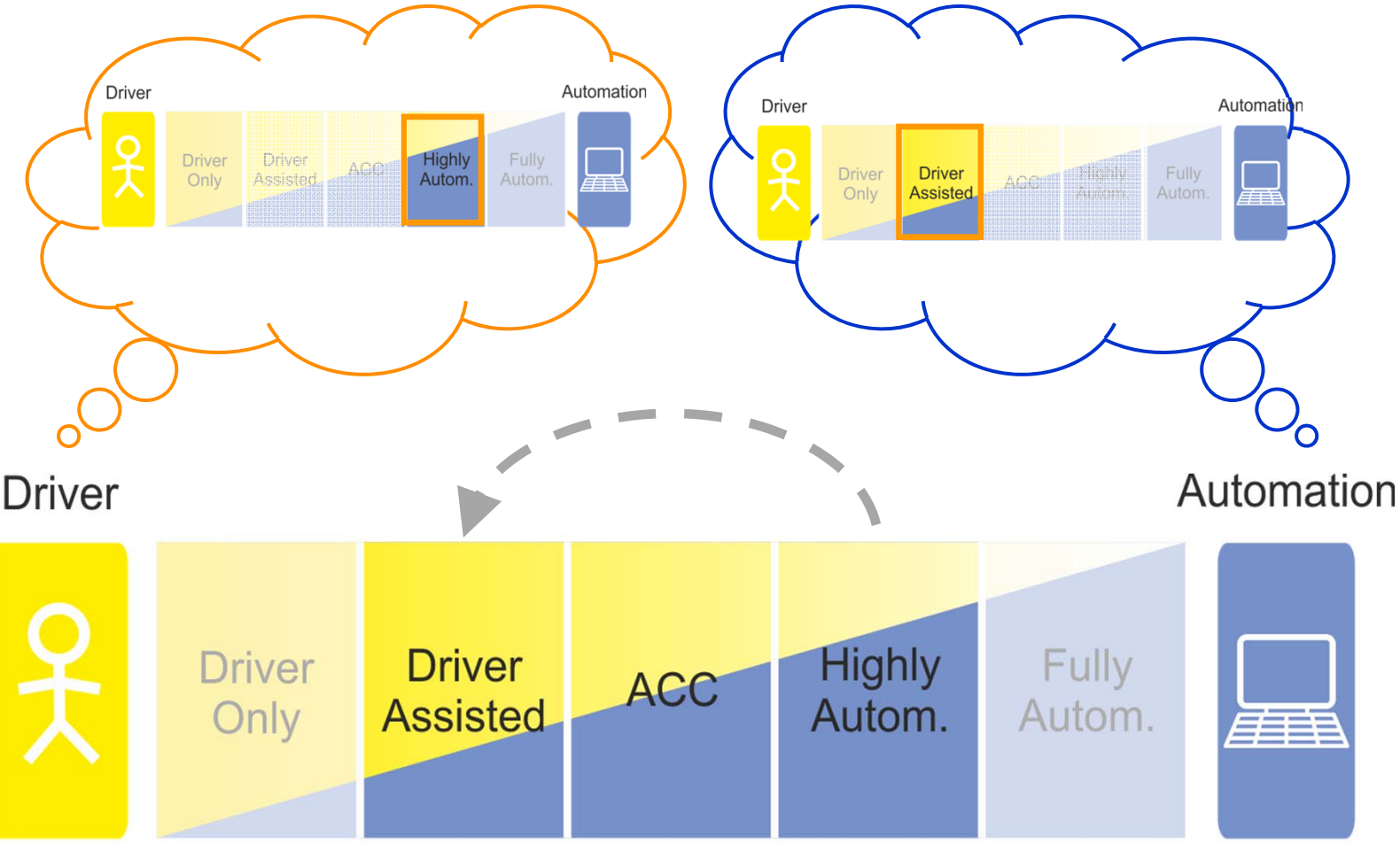


Schieben et al. (2011)

Generic interaction scheme: Transitions



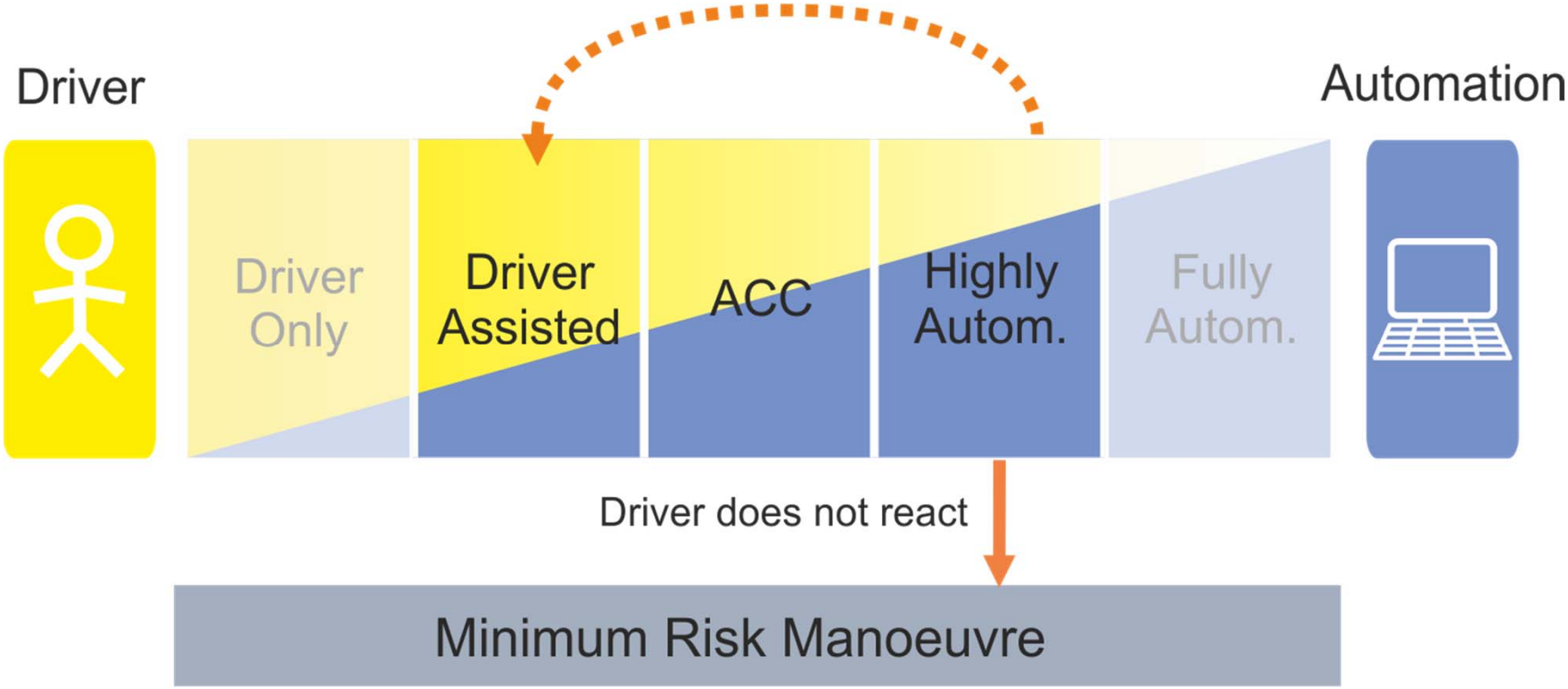
Transitions: Mode Confusion



Generic interaction scheme: Interlocked transitions

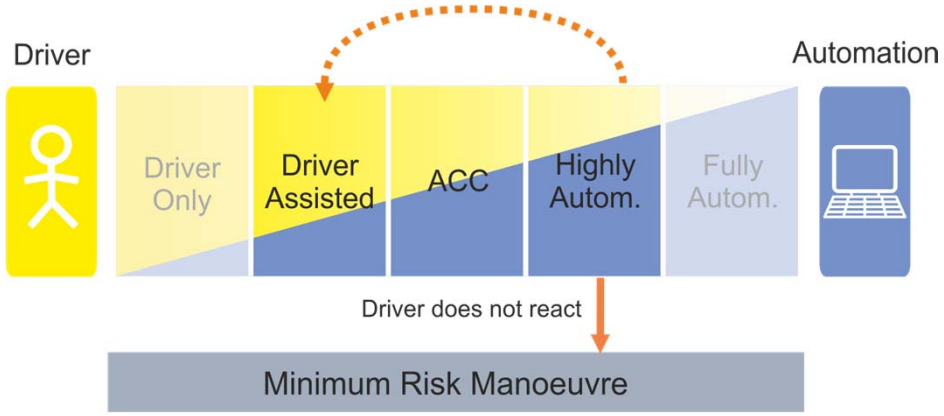
- Explicit transition design
- Hand-over of control only with confirmation by the other partner („Interlocked Transition“, „Handshake“)

Example: Take-over requests



Example: Take-over requests

- Try to bring the driver back in the loop
  - Acoustic & visual alarms
- Check if driver takes over as intended
  - Hands-on check
  - Attention monitor
- If driver does not react, bring vehicle to a safe stop
  → Minimum Risk Manoeuvre



Summary: What we achieved in HAVEit

- **Integrated HMI concept** and **alignment** between demonstrators
- **Iterative approach** for defining **generic interaction schemes**
  - Integration of single functions into **levels of automation**
  - **Automation scale** as underlying structure
  - **Explicit transition design** e.g. by interlocked transitions
- **Migration path** from already existing assistance functions to highly automated driving

Outlook: Further research questions

- **Human factors research** on the design and the effects of highly automated driving e.g.:
  - **Take-over-time** of the driver
  - **Interaction design** for transitions
  - **Integration and alignment** of several functions → one concept
  - **Cooperative behaviour:**
    - Driver/ automation within the vehicle
    - Interaction with other traffic participants

Thank you for your kind attention!

Anna.Schieben@dlr.de

Thanks to all HAVEit partners:

www.haveit-eu.org

References

Flemisch, F., Schieben, A., Strauss, M., Lüke, S. & Heyden, A. (2011). Design of human-machine interfaces for highly automated vehicles in the EU-project HAVEit. In: Proceedings 14th International Conference on Human-Computer Interaction, 9.-14.7.2011, Orlando.

Flemisch, F. & Schieben, A. (Eds.). HAVEit Deliverable D.33.2: Preliminary concept on optimum task repartition in the joint system driver / co-pilot. HAVEit consortium. www.haveit-eu.org.

Gasser, T., Arzt, C. Ayoubi, M., Bartels, A., Bürkle, L., Eier, J., Flemisch, F., Häcker, D., Hesse, T., Huber, W., Lotz, C., Maurer, M., Ruth-Schumacher, S., Schwarz, J., Vogt, W. (2012). Rechtsfolgen zunehmender Fahrzeugautomatisierung. Berichte der Bundesanstalt für Straßenwesen. Fahrzeugtechnik Heft F83

Kelsch, J. (2012): Arbitration between Driver and Automation: why Overriding is just the Tip of the Iceberg. Contributions to InteractIVe Summer School, 04.-06. Jul. 2012, Corfu Island, Greece

Schieben, A. & Flemisch, F. (Eds.) . HAVEit Deliverable D.33.6: Validation of optimum concept for task repartition. HAVEit consortium. www.haveit-eu.org.

Schieben, A., Flemisch, F., Temme, G. & Köster, Frank (2011). What happens when I push the accelerator pedal? Exploration and proposal for the design of driver-initiated transitions between different automation modes in a highly automated vehicle. In: VDI Berichte 2134, pp. 1-21. VDI Verlag GmbH. Der Fahrer im 21. Jahrhundert, 8.11.-9.11.2011, Braunschweig.

Rauch, N., Kaussner, A., Boverie, S., Giralt, A. (Eds.). HAVEit Deliverable D.32.1: Report on Driver Assessment Methodology. HAVEit consortium. www.haveit-eu.org.