

Highly and fully automated driving: How can the driver spend the time?

Tobias Hesse

International Conference
The Road to Automated Drive

Stuttgart, 30.06.-02.07.2014



Knowledge for Tomorrow

Institute of Transportation Systems

Residence: Braunschweig and Berlin
Since: March 2001
Director: Prof. Dr.-Ing. Karsten Lemmer
Employees: Presently about 150 employees
from various scientific disciplines

Range of tasks

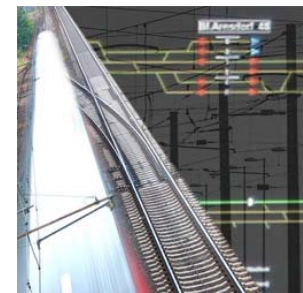
- Basic research
- Creating concepts and strategies
- Prototype development

Fields of Research

- Automotive
- Railway Systems
- Traffic Management
- Intermodal and Public Transport

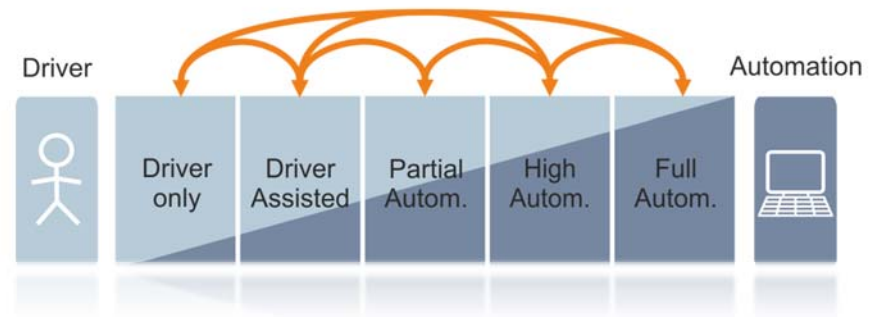
Quality Management

- DIN EN ISO 9001
VDA 6.2
- RailSiTe ISO 17025



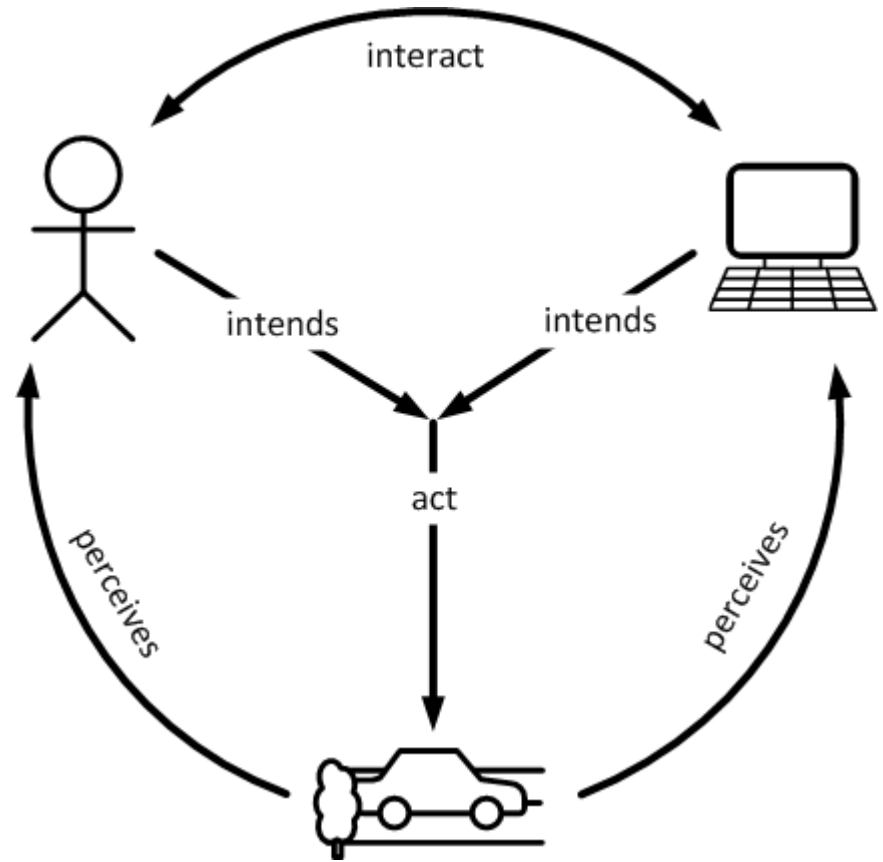
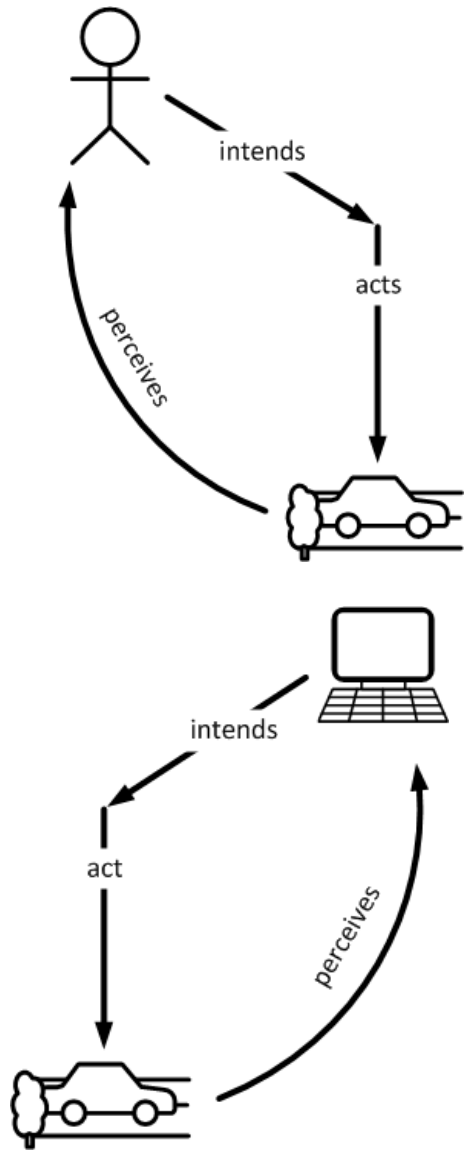
Agenda

- **Levels of automation:**
Roles of driver and automation
- **Transitions between levels**



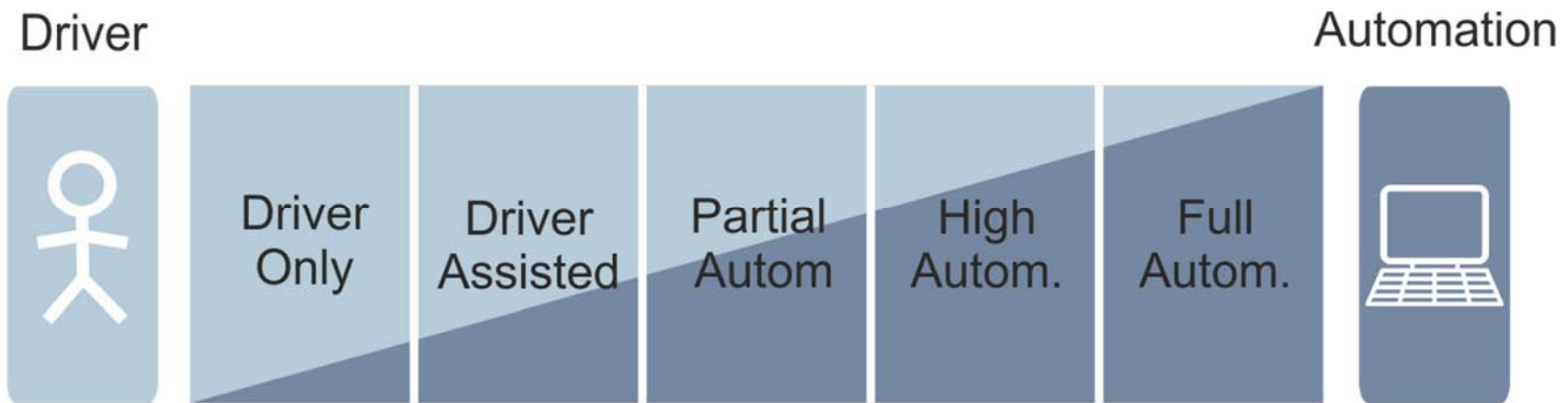
- Integration of mobile devices into the vehicle
- Usage of mobile devices in different levels of automation
- Summary



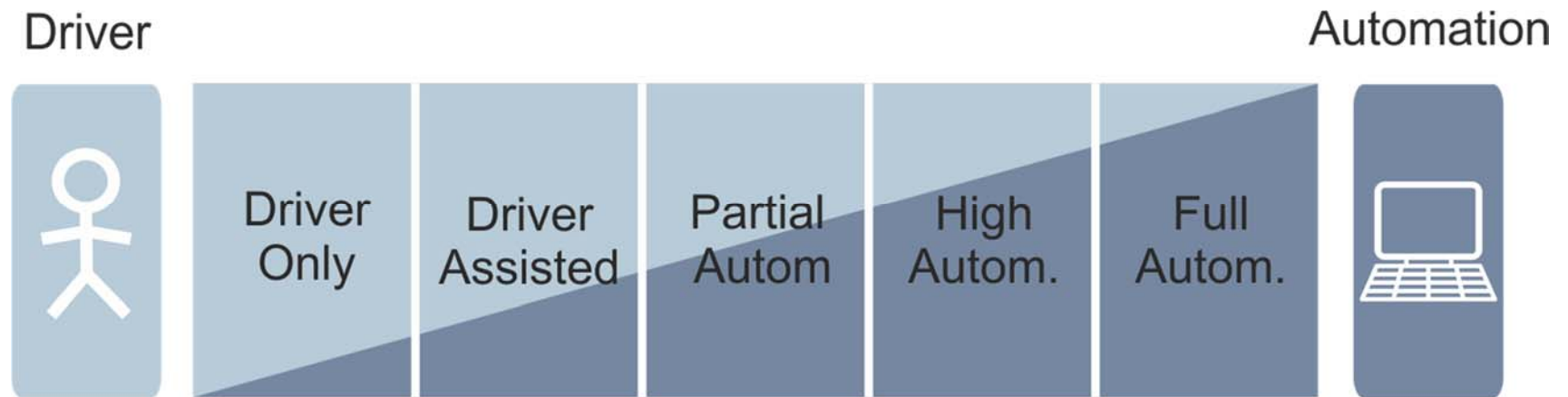


Levels of assistance and automation

- Even in automated vehicles there will be a driver on board (and/or other drivers around)
- Driver needs to build up a correct mental model of the automation
- Grouping of single ADAS functions into automation levels
- Selection of clearly distinguishable levels of automation

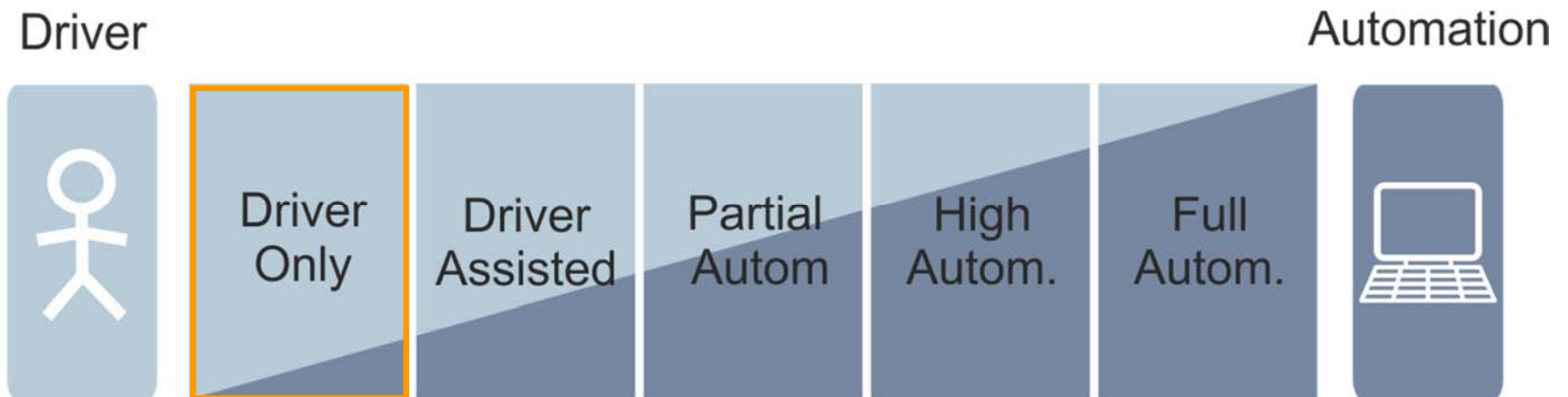


Different levels of automation in one vehicle



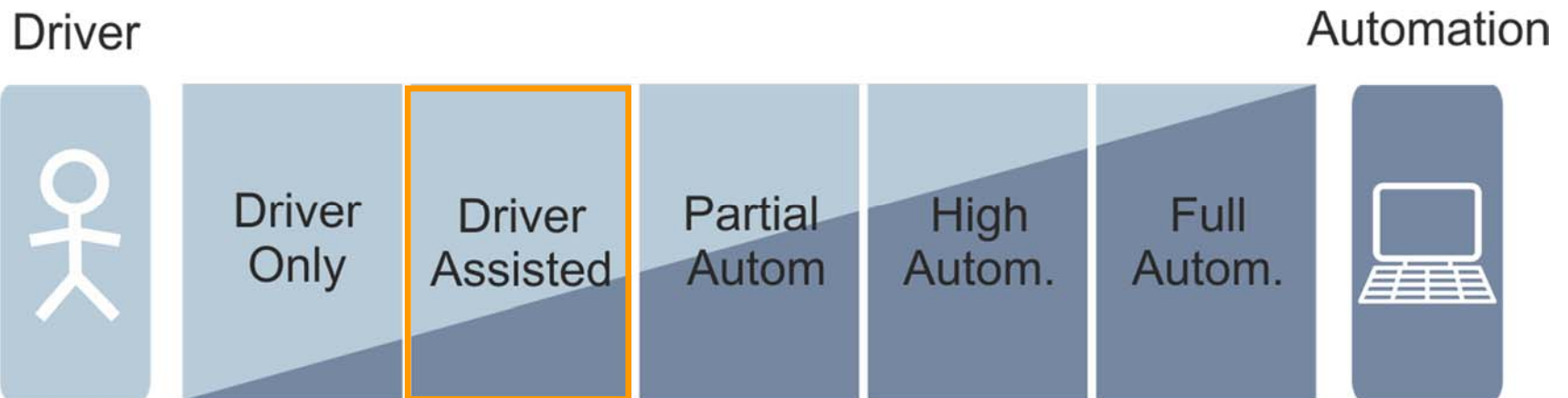
Different levels of automation in one vehicle

BASt Definition: Human driver executes manual driving task



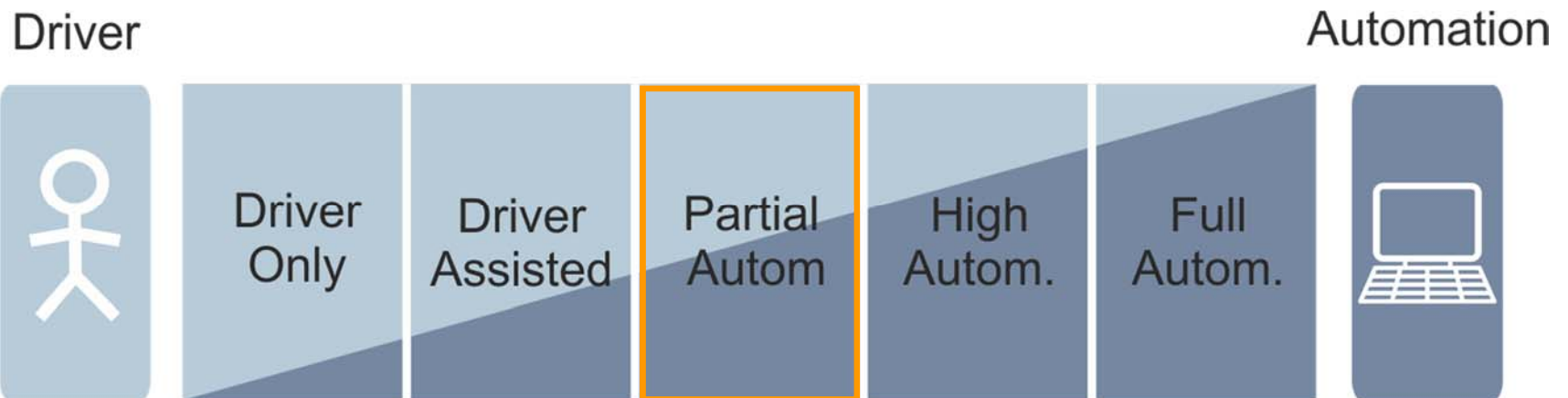
Different levels of automation in one vehicle

BASt Definition: The driver permanently controls either longitudinal or lateral control. The other task can be automated to a certain extent by the assistance system.



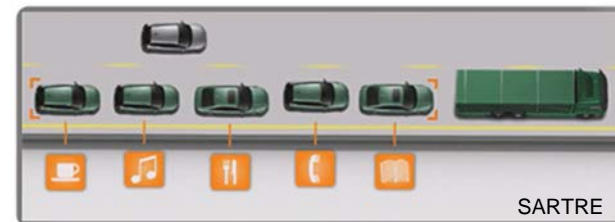
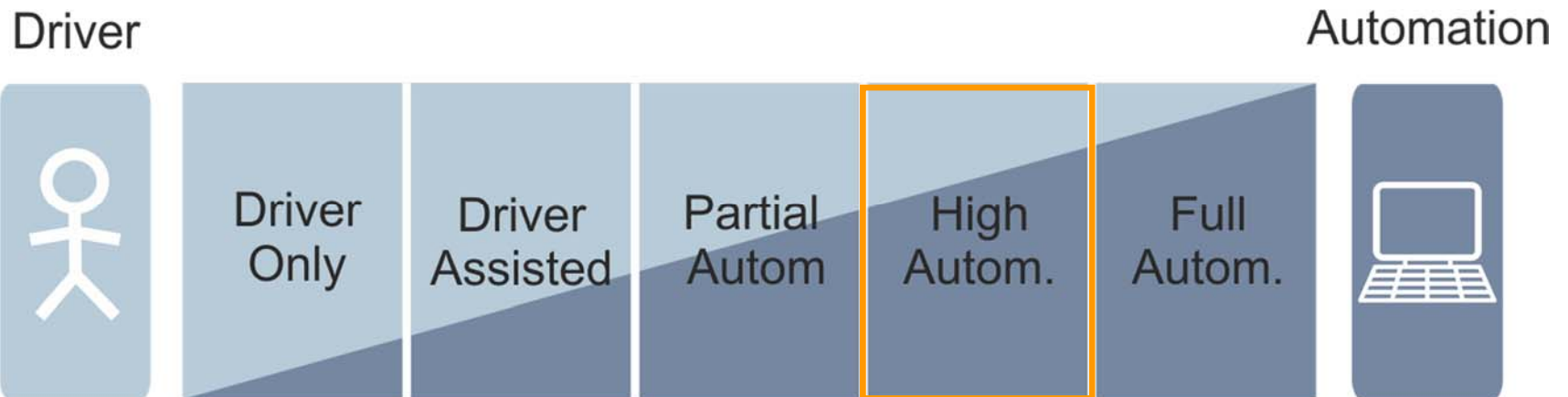
Different levels of automation in one vehicle

BASt Definition: The system takes over longitudinal and lateral control, the driver shall permanently monitor the system and shall be prepared to take over at any time.



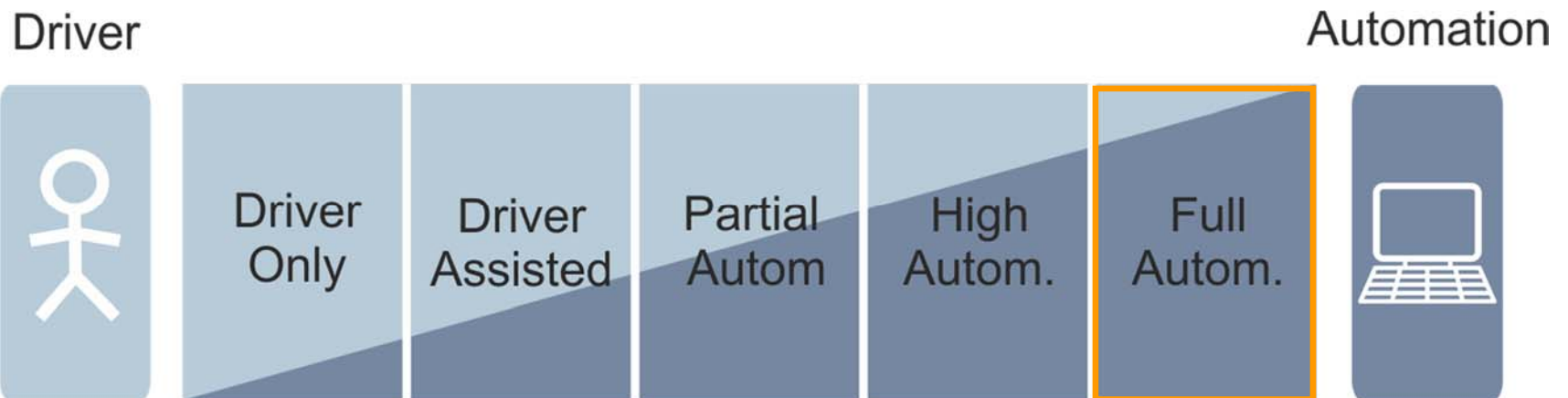
Different levels of automation in one vehicle

BASt Definition: The system takes over longitudinal and lateral control; the driver must no longer permanently monitor the system. In case of a take-over request, the driver must take-over control with a certain time buffer.

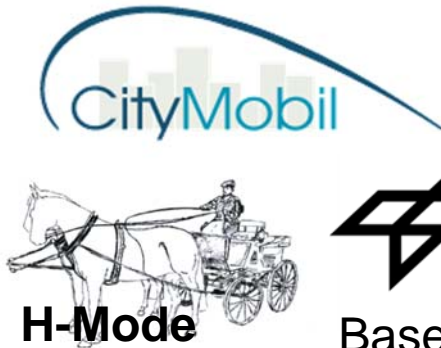
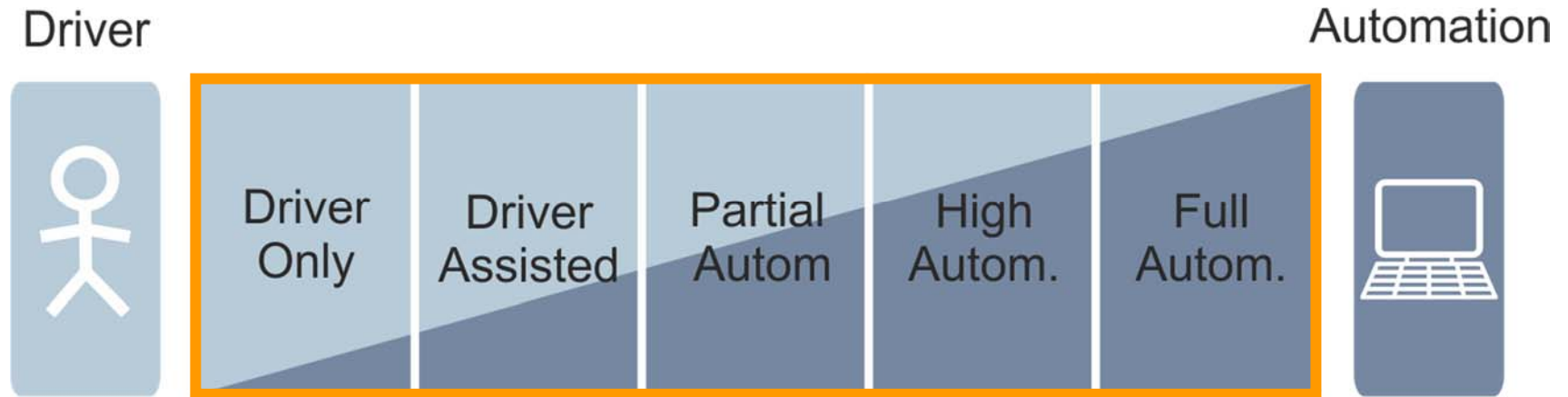


Different levels of automation in one vehicle

BASt Definition: The system takes over longitudinal and lateral control completely and permanently. In case a take-over request that is not carried out, the system will return to a minimal risk condition by itself.

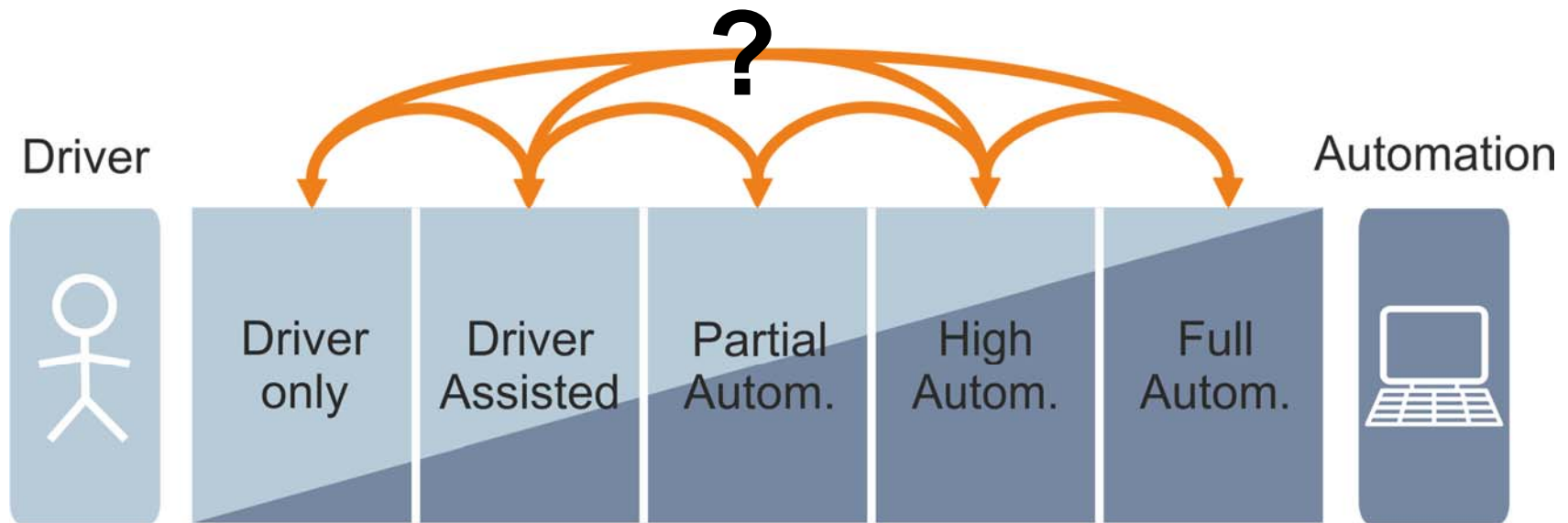


Different levels of automation in one vehicle

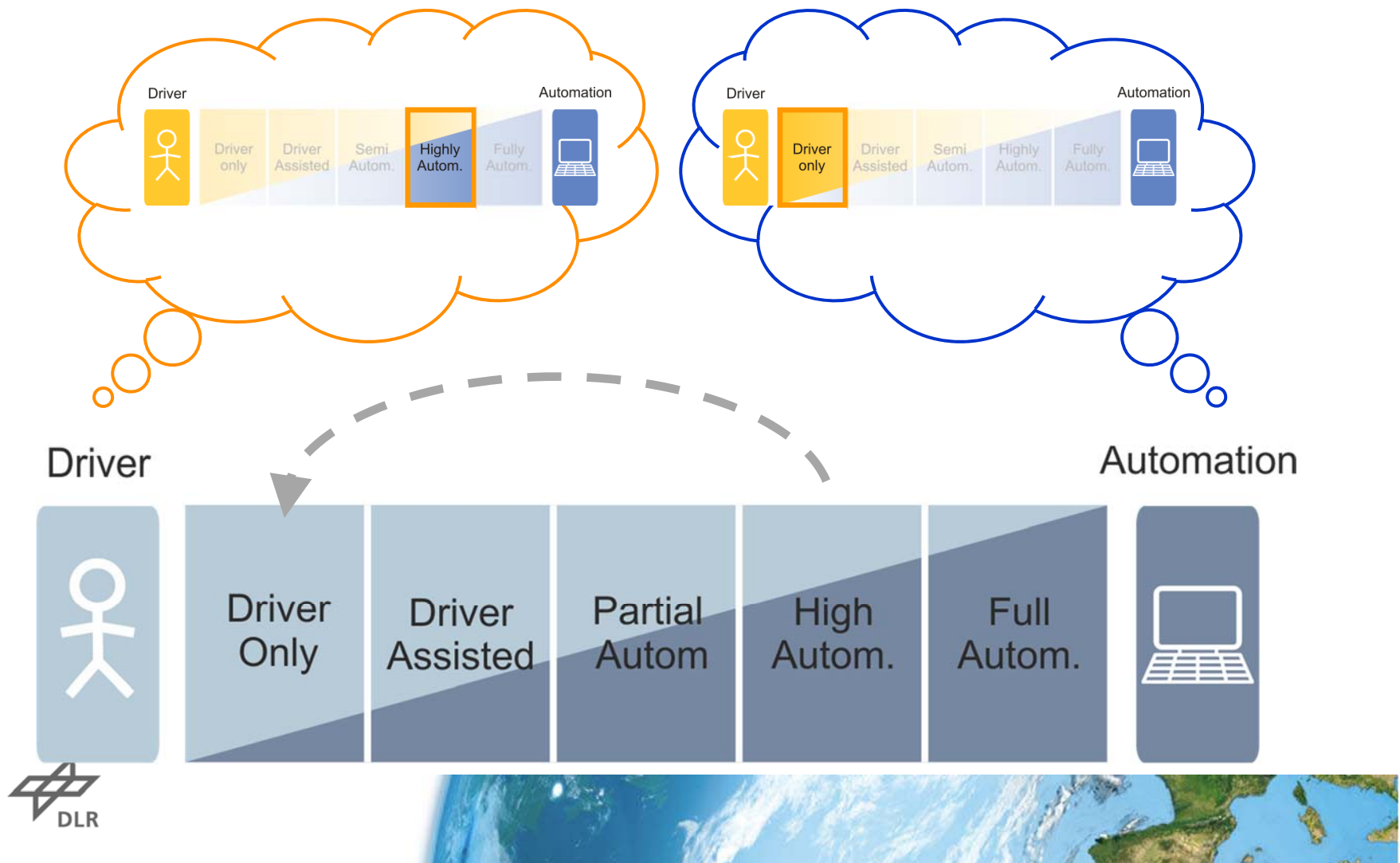


Transitions between different levels of automation

- Definition of transitions between levels of automation
- Driver initiated transitions vs. Automation initiated transitions
- Normal transitions vs. transitions at system limits



Transitions and the risk of mode confusion



Transition design: Interlocked Transitions

- Explicit transition design for transition to higher and lower levels of automation
- Hand-over of control only after confirmation by the other partner („Interlocked Transition“, „Handshake“)

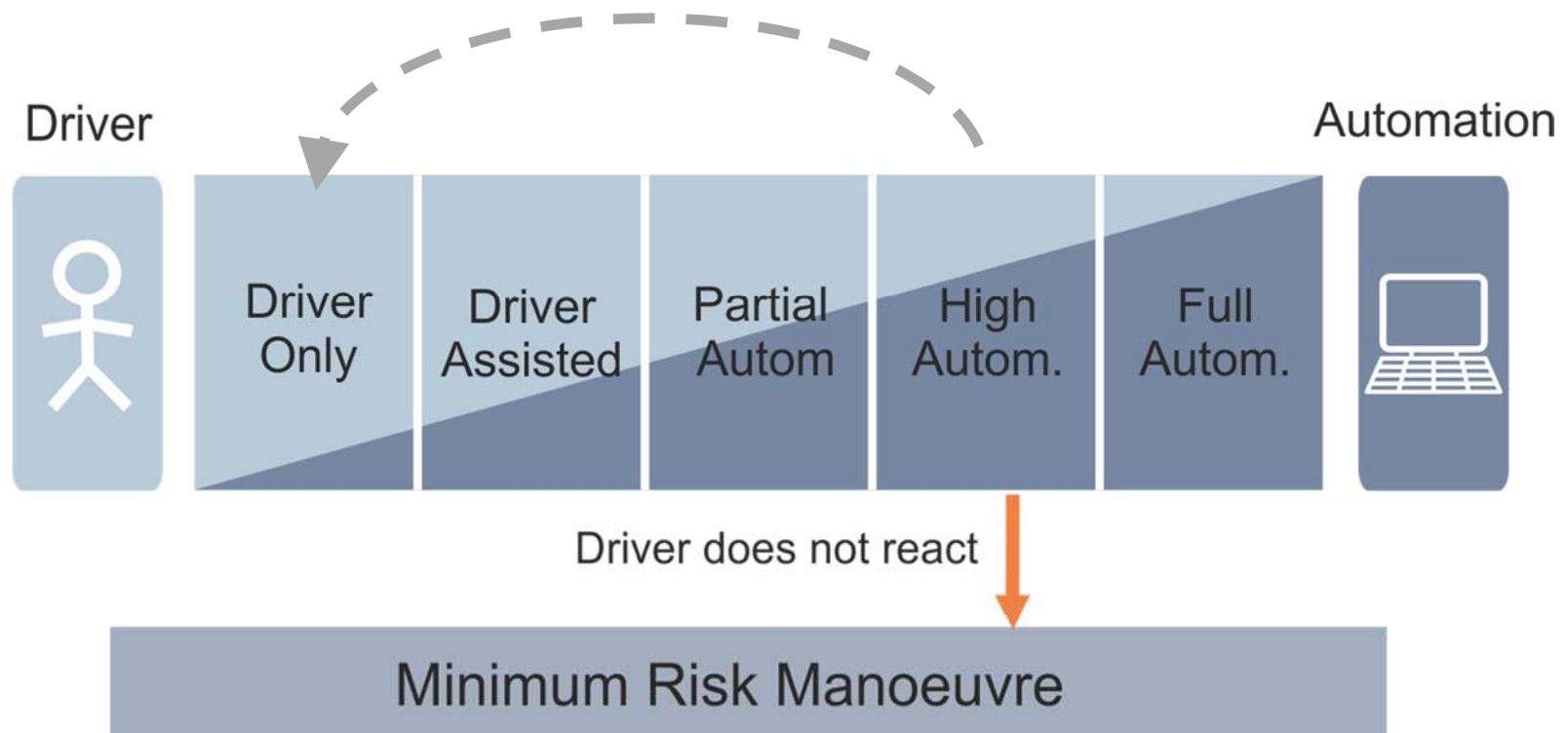
Driver



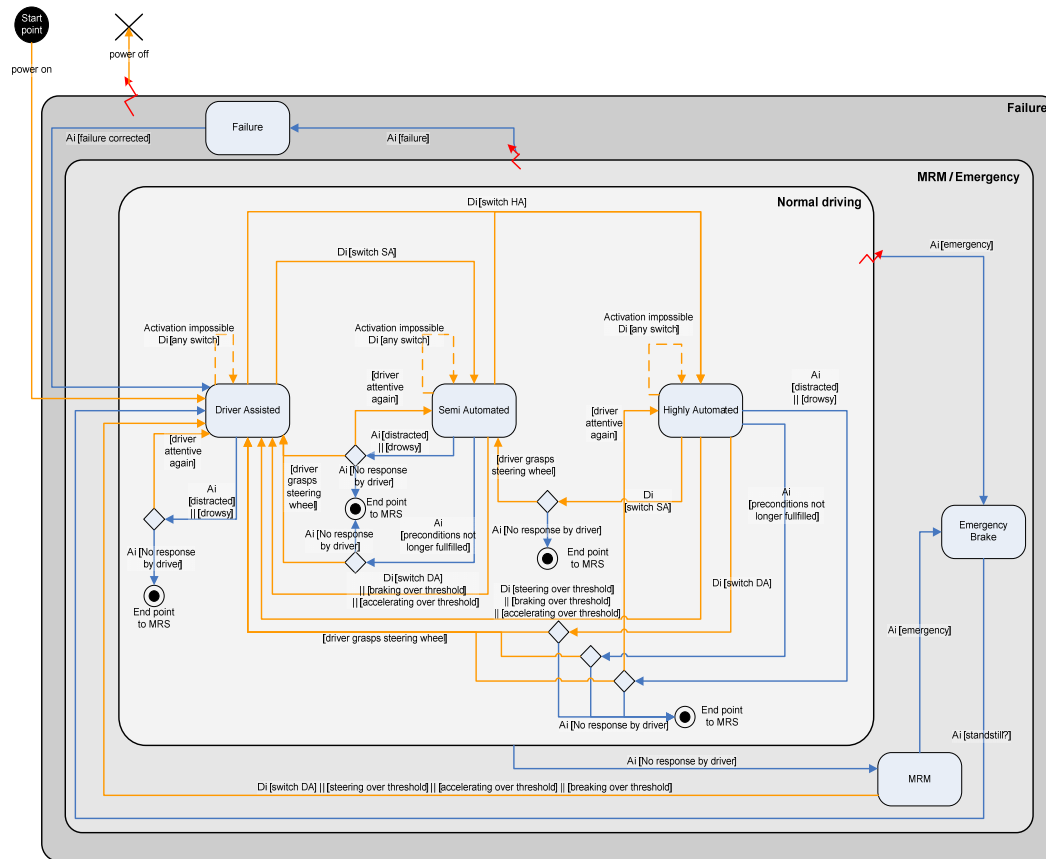
Automation



Transition design: Concept for take-over requests

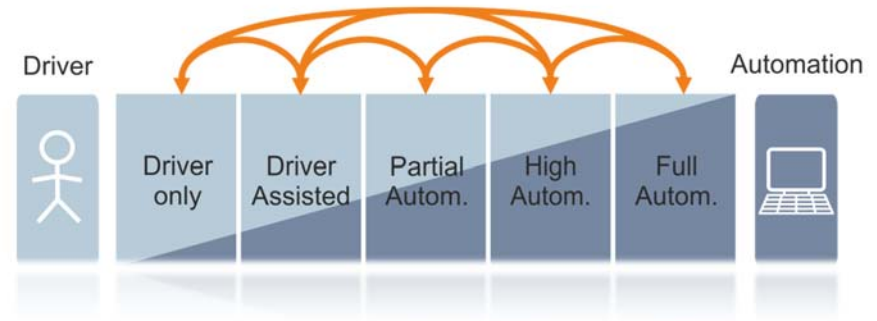


Mode Selection & Arbitration Unit in HAVEit



Agenda

- Levels of automation:
Roles of driver and automation
- Transitions between levels
- Integration of mobile devices into the vehicle
- Usage of mobile devices in different levels of automation
- Summary



Other tasks than driving?

-„What would you like to do while driving highly automated?“

Write emails

Surf in the internet

Make phone calls

Watch TV

Look out of the window

Listen to music

Read something

Eat something

HAVEit Usability Assessment, 2009

8 participants, multiple answers were possible



Introduction

- Nomadic Devices can be used for entertainment, work, news etc.
- People already use nomadic devices illegally while driving (450.000 recorded violations in Germany, 2011)

How to safely integrate nomadic devices in automated vehicles?



Vehicle Prototype



Vehicle Prototype



Tablet Retainer



Vehicle Prototype



Buttons for the supported automation modes



Nomadic Device Integration – Concept

- While driving highly automated, the driver can use the nomadic device as usual
- Attention of the driver may completely shift to the nomadic device
- Mirror warnings, alerts and take-over requests on the device
- The automation decides which content is accessible depending on current driving-mode and situation



Nomadic Device Integration – Technology

- Loose coupling of nomadic device and vehicle
- Only data unveiled from the automation is accessible via a gateway
- Gateway to the automation is read-only (security against trojan horses, viruses and malicious data)
- Bluetooth based communication



Scenario

- Driving highly automated on a two-lane highway scenario
- Roadwork ahead, that the assistance system cannot handle



- Driver has to take over control to guide the vehicle through the roadwork

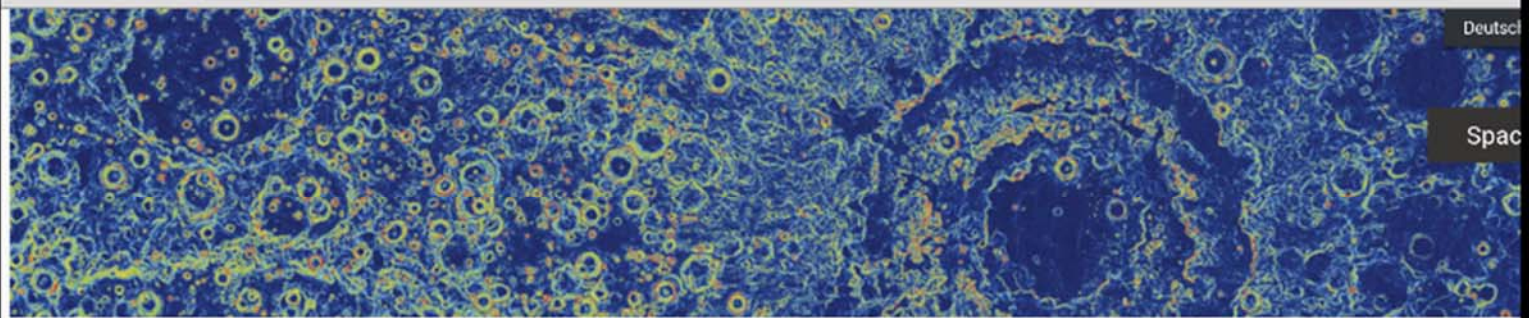




10:22

Highlyautomated driving activated

www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10008/



DLR AERONAUTICS **SPACE** TRANSPORT ENERGY SECURITY SPACE ADMINISTRATION

News Multimedia Communications & Media Enter Search

- Space Research and Technology
- Institutes
- Missions
- News Archive

Spacelab-1: Where the known meets the unknown

27. November 2013
 Ten days, seven hours and 47 minutes – this was the duration of Ulf Merbold's first experience in space, which began on 28 November 1983, when the Space Shuttle Columbia delivered him to Earth orbit.



SWARM – Earth's magnetic field to be accurately measured by three European satellites flying in formation

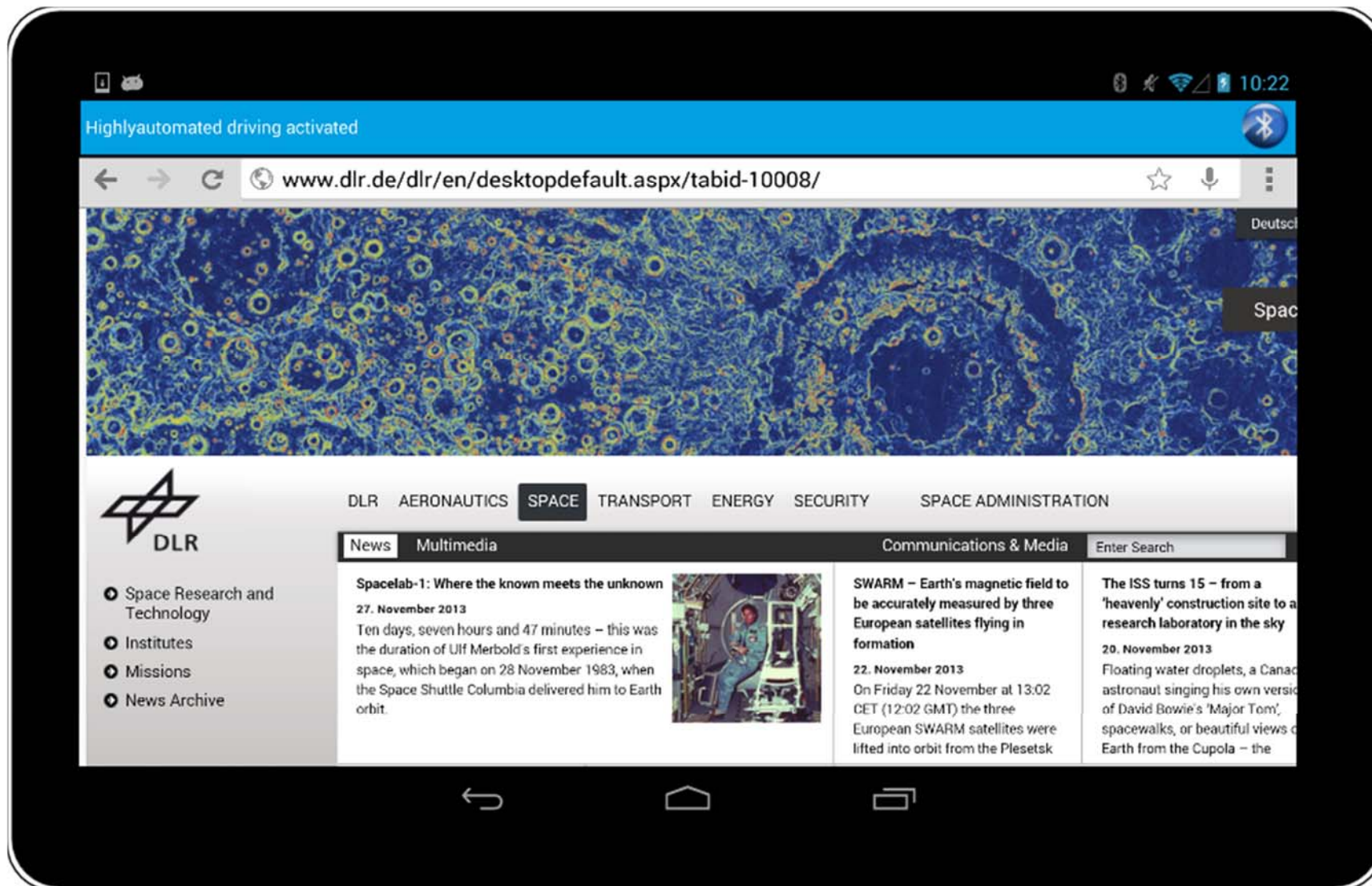
22. November 2013
 On Friday 22 November at 13:02 CET (12:02 GMT) the three European SWARM satellites were lifted into orbit from the Plesetsk

The ISS turns 15 – from a 'heavenly' construction site to a research laboratory in the sky

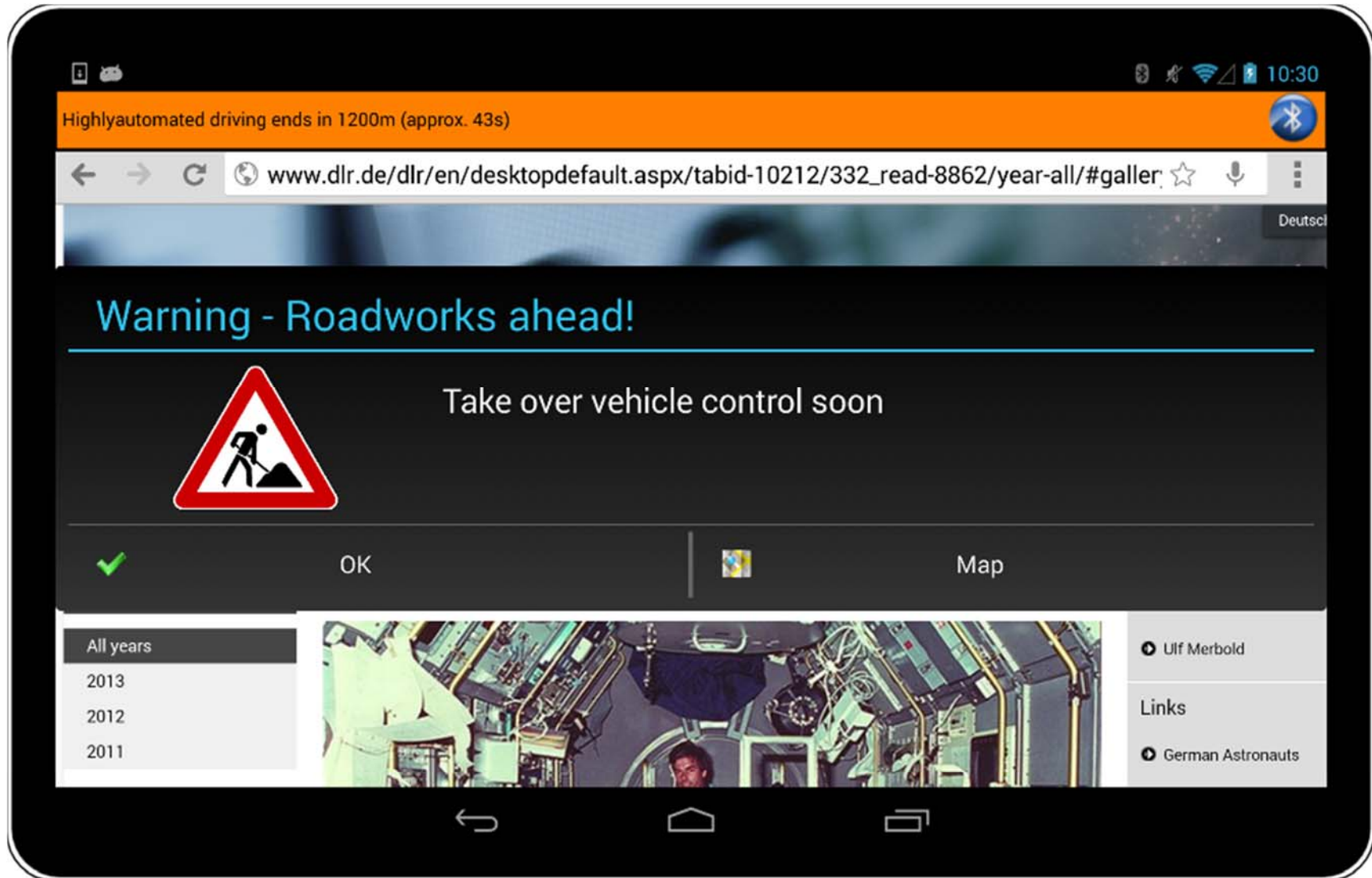
20. November 2013
 Floating water droplets, a Canadian astronaut singing his own version of David Bowie's 'Major Tom', spacewalks, or beautiful views of Earth from the Cupola – the



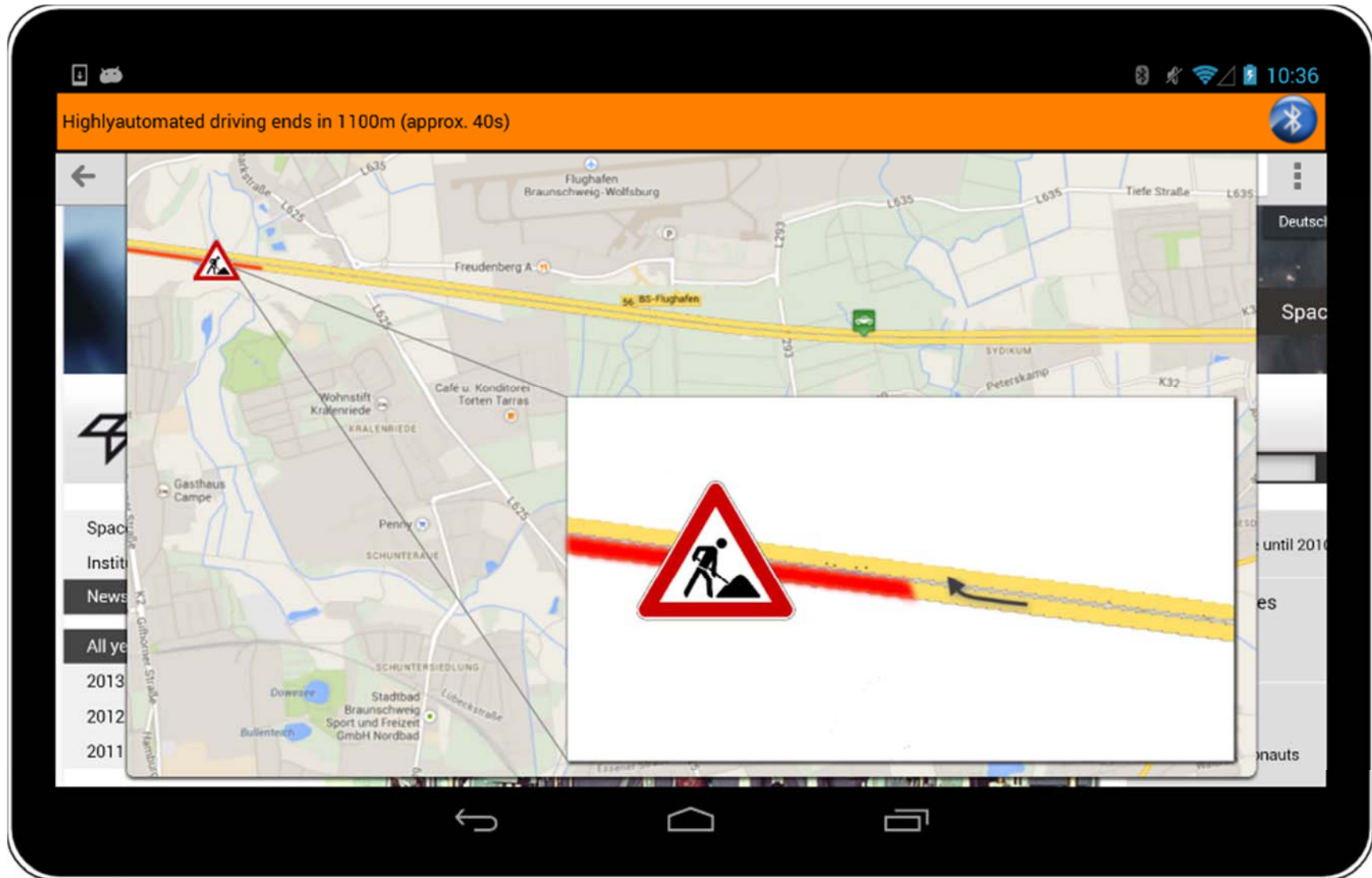
Scenario



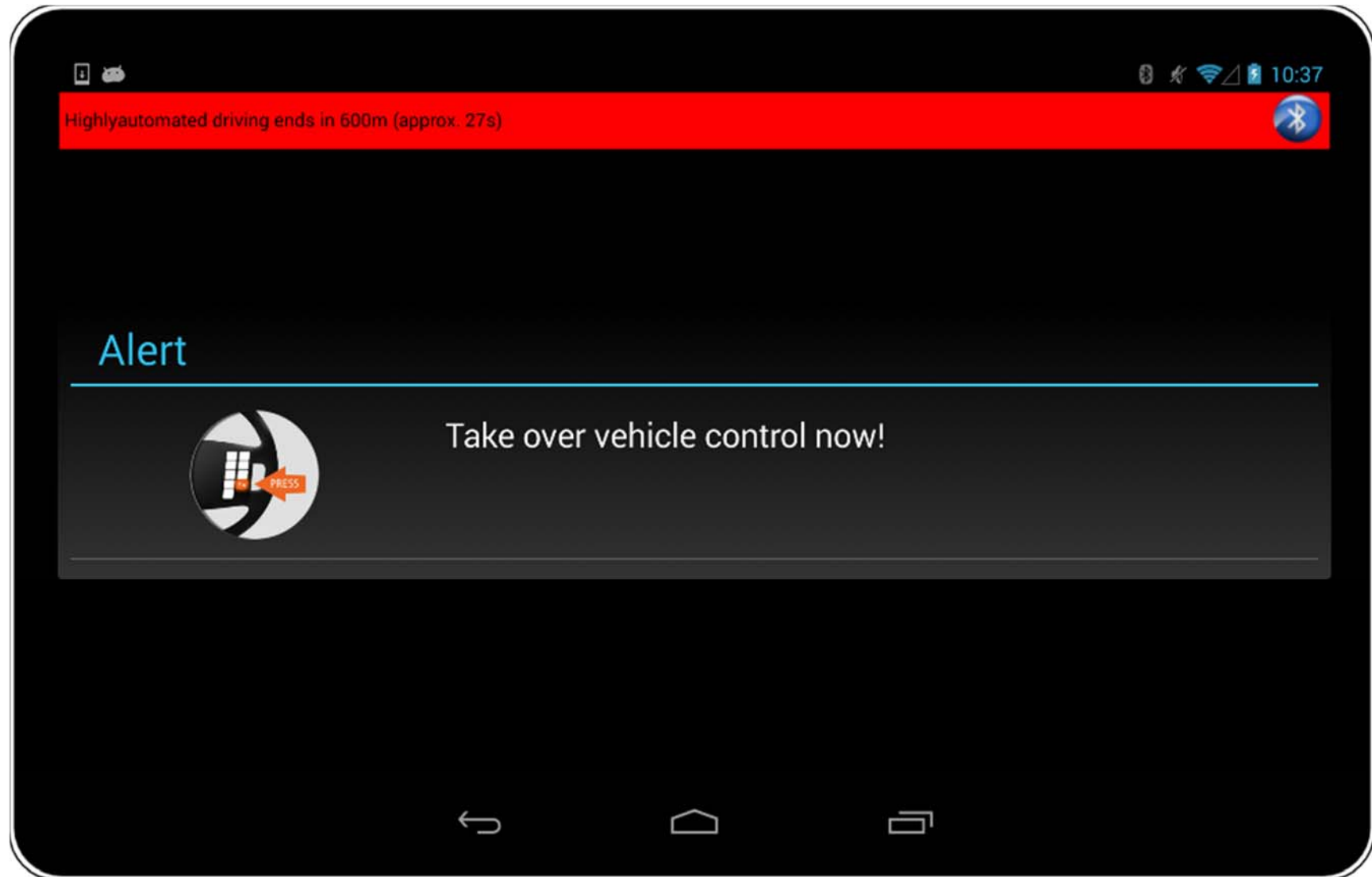
Scenario



Scenario



Scenario





10:37

Highlyautomated driving ends in 600m (approx. 27s)



Alert

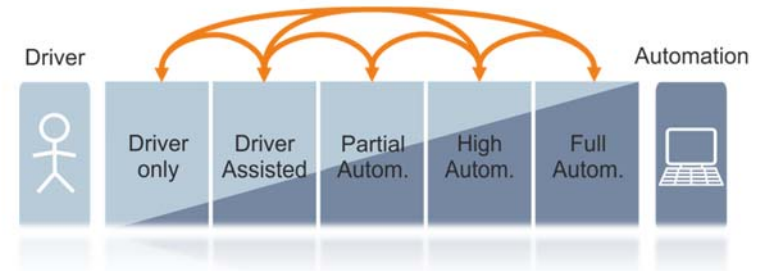


Take over vehicle control now!



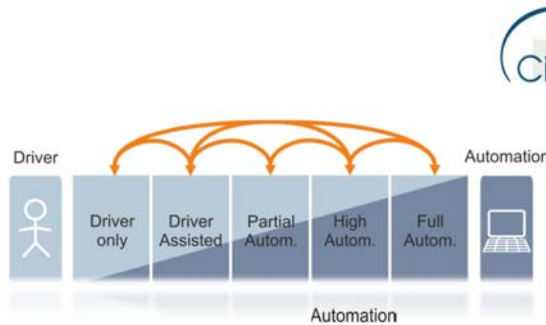
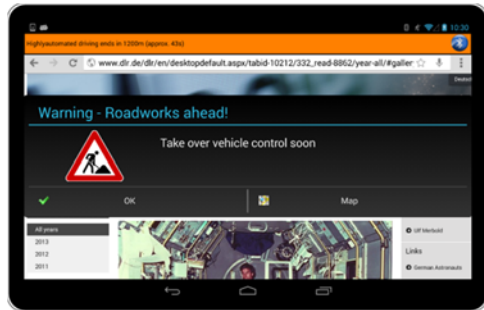
Summary

- Several levels of automation in vehicle
- Transitions between levels are critical



- Highly automated driving requires no constant supervision and freedom for driver, but predictable takeover by driver
- Safe usage of nomadic devices in highly automated vehicles seems possible if device is linked with vehicle automation
- Vehicle automation maintains communication channel to driver

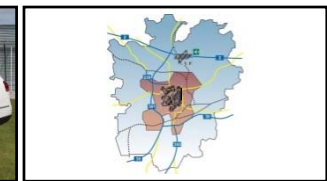
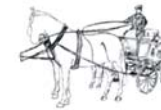




Driver



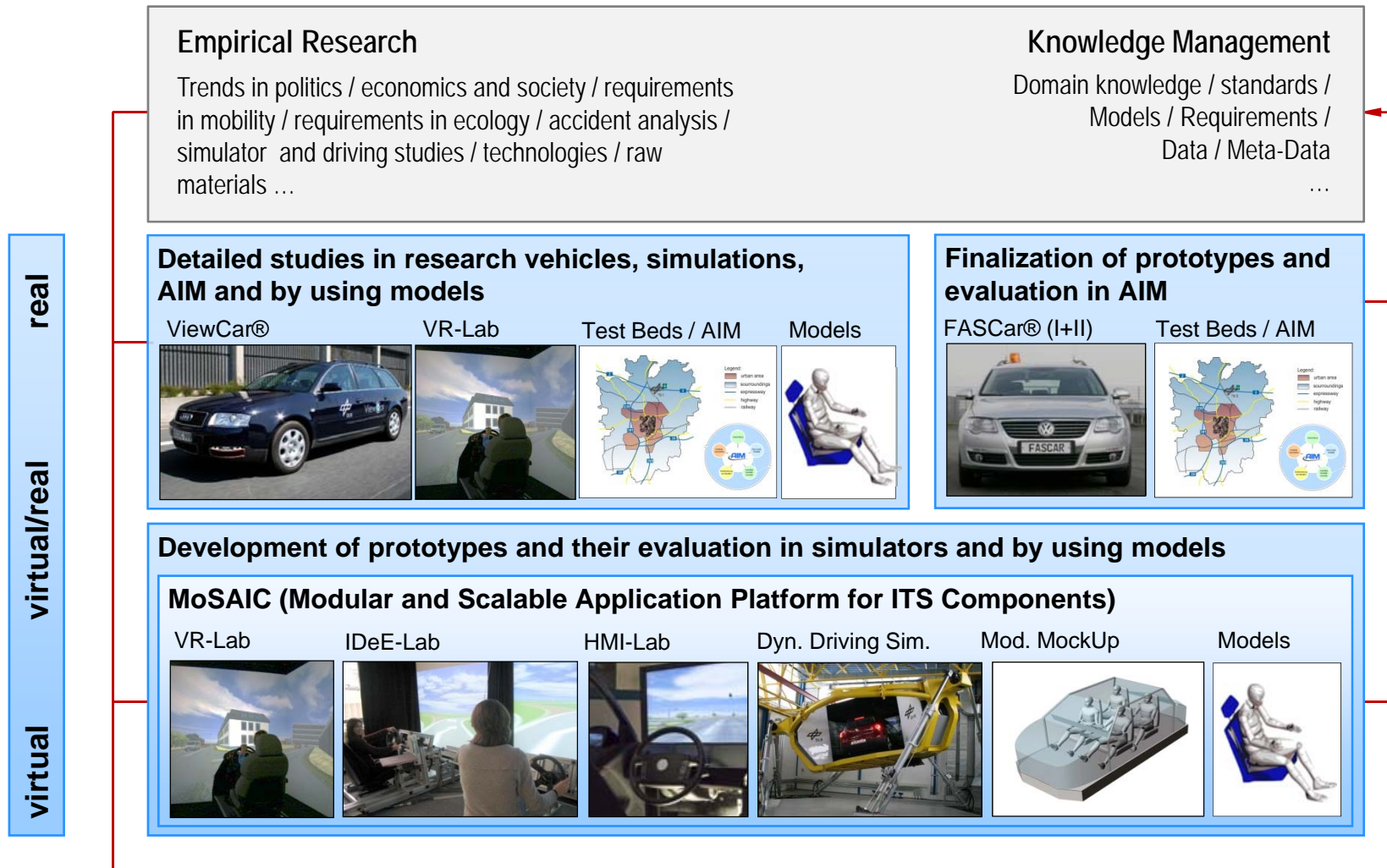
Automation



Thank you very much!
tobias.hesse@dlr.de

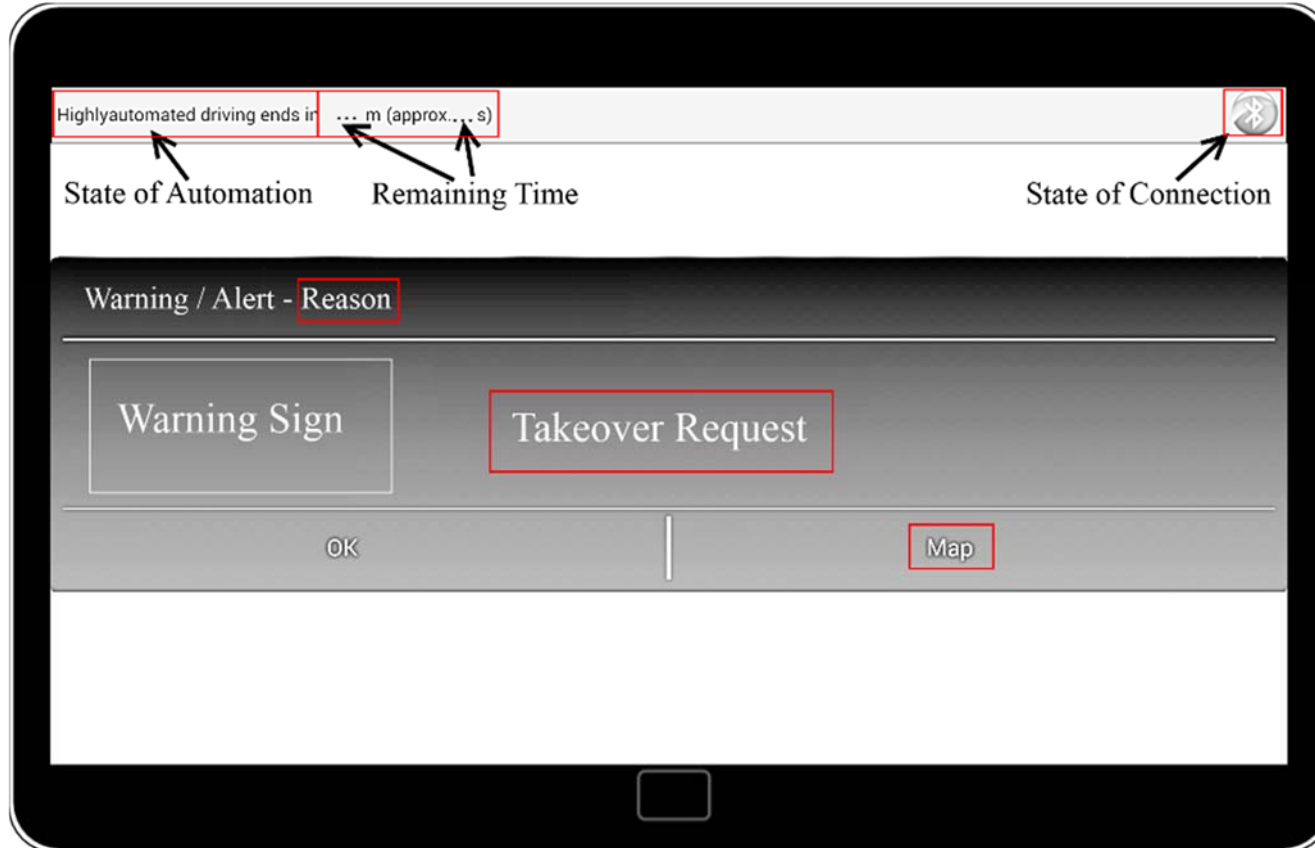


Institute of Transportation Systems - Toolchain





Nomadic Device Integration – Concept



Conceptual design of a take-over request, presented on a tablet as an overlay

