Highly Automated Vehicles for Intelligent Transport

ITS Japan
Workshop Automated Driving Systems
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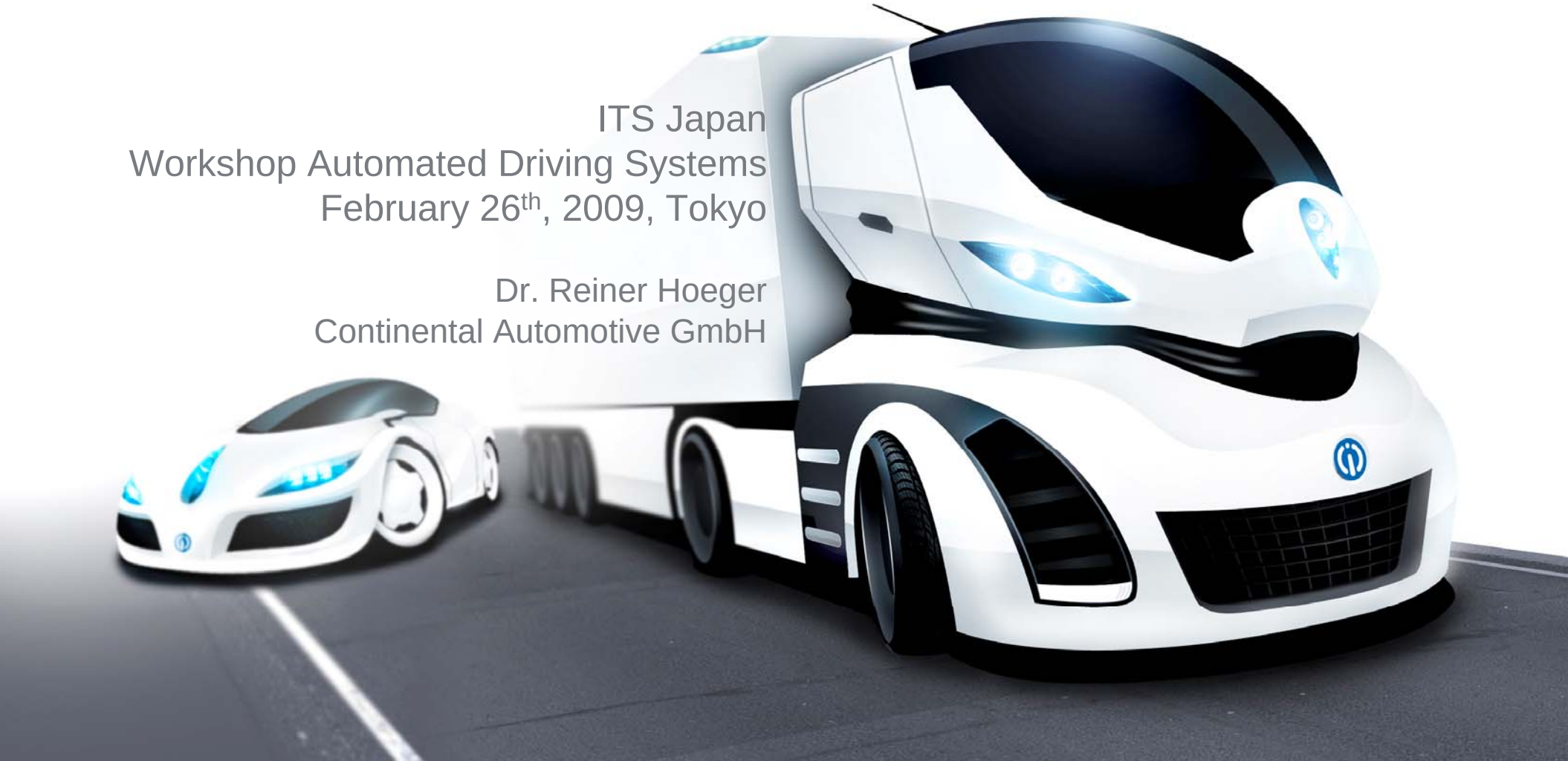
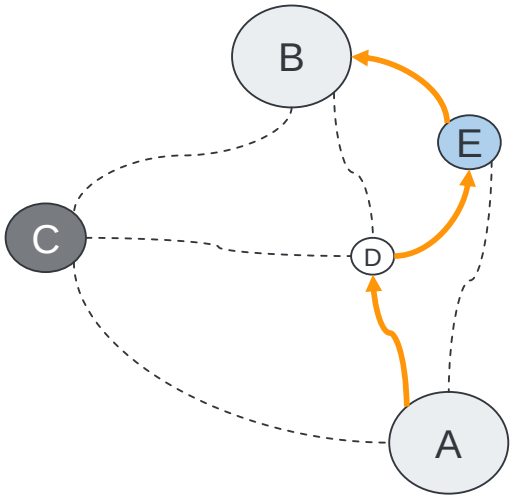


Content

- Starting point for the project HAVEit
- The philosophy and goals of HAVEit
- The center element: Mode Switching Unit
- Architectural considerations
- A glance on the planned demonstrators
- Acknowledgements

Driving a Strategic Task

Goal: Driving from A to B



Strategy: Select optimal route

- Duration, start time
- Fuel consumption
- Topology, weather
- road costs
- etc.

- Experience
- Digitized Map
- Traffic information

Tactics/Execution:

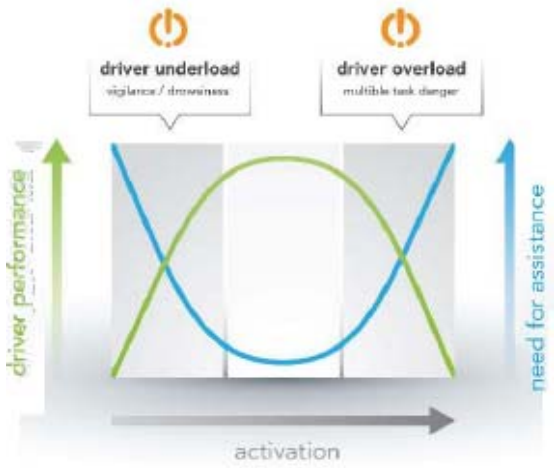
Take appropriate action

- Obey rules
- Avoid/minimize risks
- “Local” solution or start strategy process

- Real-time Scene recognition
  - Cameras
  - Radar, Lidar
  - Car-to-car communication
  - Car-to-infrastructure communication
  - Sensor data fusion

Highly Automated Driving is the Key to Enhance Road Safety

- Pure information providing functions May lead to an information overload of the driver.
- Fully autonomous vehicles may face acceptance problems
- Selective Automated Driving will do the job
  - Keeping the driver appropriately in the loop (enhancing system acceptance)
  - Handing over command to driver if the system can not deal with the situation
  - Assist the driver or even take control if driver can not handle the situation
- Automated Driving is a “Dual Impact” technology
  - It will also serve environmental protection
  - Less traffic jams by steady flow, no disturbance injection
  - In future even lighter vehicles, with “virtual safety zones” will make energy absorbing elements obsolete



European Community funded project HAVEit: Key Objectives

the future of driving.

Overall objective: Safety Enhancement by highly automated driving

Key objectives:

1. Joint system driver – co-pilot system
2. Safe vehicle architecture with migration concepts
3. Highly automated vehicle applications building on 1) and 2)

HAVEit: **H**ighly **A**utomated **Ve**hicle for **I**ntelligent **T**ransport
http://www.haveit-eu.org

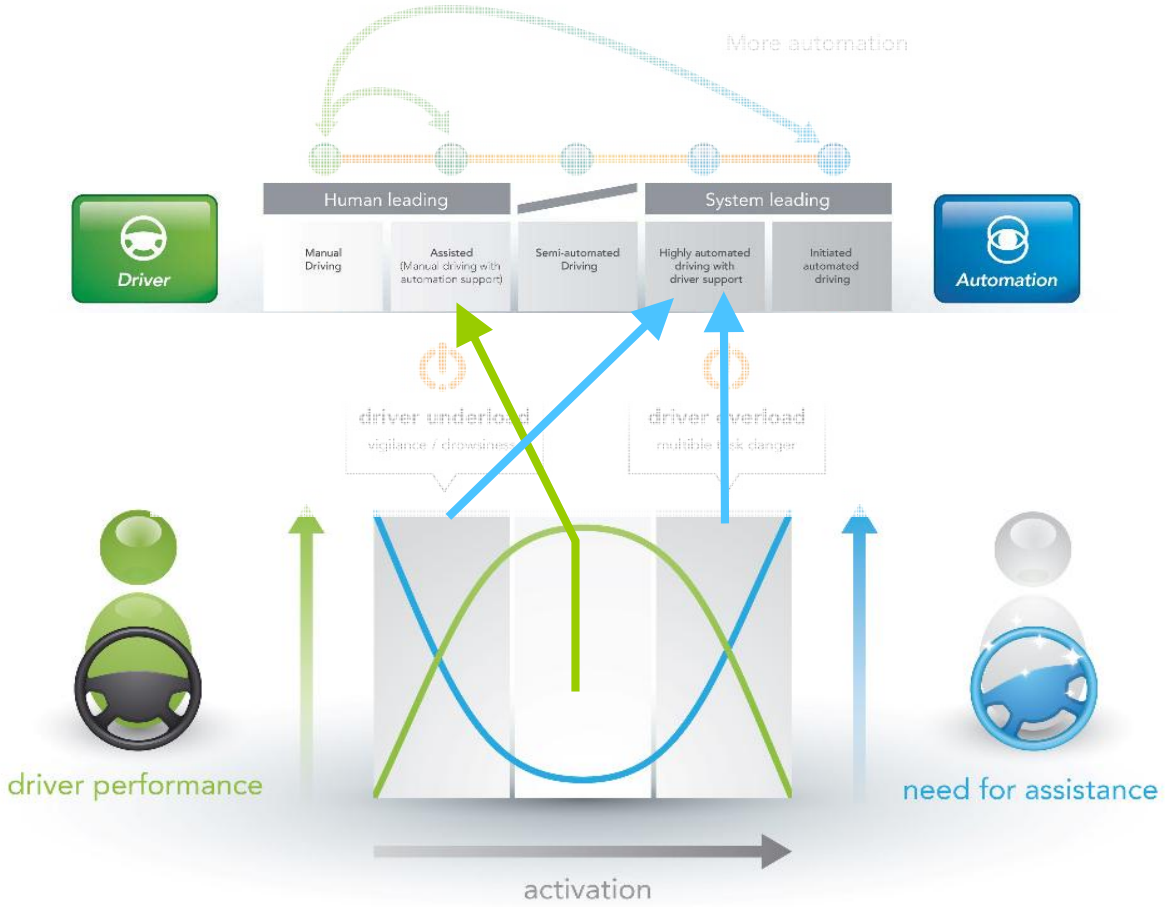
Highly Automated Vehicles - HAVEit Applications

- Safe vehicle architecture
  - Joint system demonstrator (DLR)
  - Brake-by-wire truck (Haldex)
  - Architecture demonstrator to show economic migration path (Continental)

- Highly automated functions
  - Automated assistance in roadworks and congestion (Continental)
  - Automated queue assistance (VOLVO)
  - Temporary auto-pilot (VW)
  - Active green driving (VOLVO)

Adaptive Support for the Driver in Under Load and Overload Situations

- Driver performance degrades in **underload and overload situations**: That can lead to a higher risk of accidents
- A **driver state assessment** is implemented in the HAVEit Joint System to detect such situations
- The Mode Selection and Arbitration Unit of the Joint System organizes a **dynamic task repartition** to support the driver with the optimal level of assistance and automation



driver underload
vigilance / drowsiness
e.g.by boring situation like alone on highway by night

optimal load
attentive driver

driver overload
multible task danger
e.g. by intensive situation requiring lots of activity

Joint System Demonstrator

Demonstration vehicle for HAVEit technology

- System architecture allows rapid prototyping
- Development of safe interactions between driver and virtual copilot
- Test vehicle for data fusion and copilot technology
- Transitions between different levels of automation regarding the driver in the loop assessment

Steer-by-wire functionality

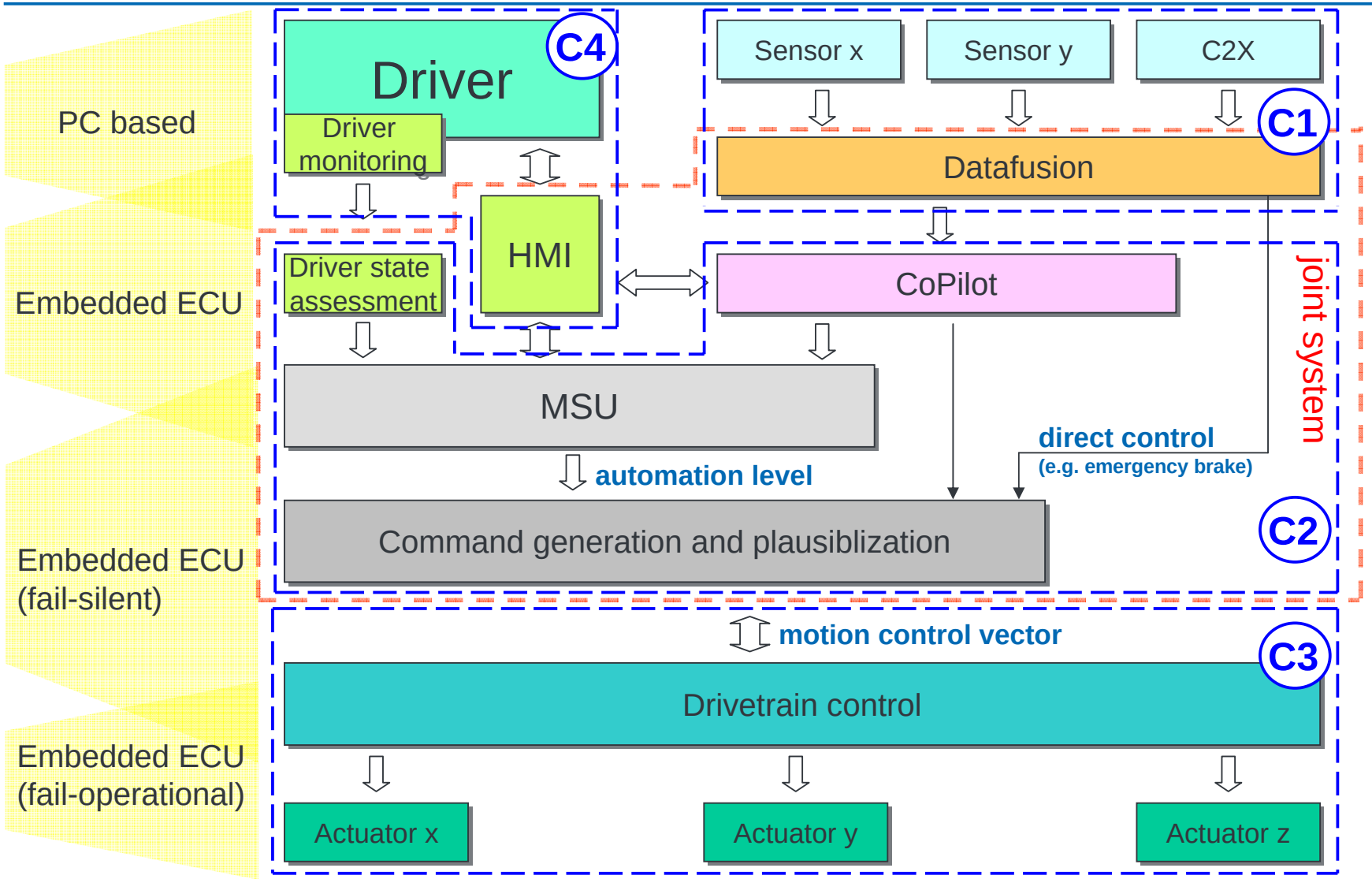
- Mechanically decoupled steering column allows fully independent driver interaction and steering
- In case of failure: Graceful degradation to mechanical backup
- Failsafe communication using Flexray and partly redundant ECUs

Environment detection

- Front object detection using laser scanner sensors
- Positioning by differential GPS and Inertial Measurement Unit, IMU
- Optical lane recognition system
- Open system architecture allows the integration of further sensors e.g. for driver distraction

Generic Architecture

C1: Perception layer
C2: Command layer
C3: Execution layer
C4: HMI to integrate the driver



Automated Assistance in Roadworks and Congestion

Demonstrator vehicle:

VW Passat CC

Key Features:

- Nearly all around environment monitoring by six radar sensors and a mono front camera
- Lane detection by lane marks and guardrail objects
- Recognition of standing obstacles and emergency braking function
- Speed limit sign recognition plus automated ACC adaption to speed limits
- Full Speed Range ACC including stop & go situations
- Permanent lane keeping in roadworks and heavy traffic
- Direct driver monitoring by NIR camera
- Detection of driver distraction and adaption of warning and control strategies
- Different warning and control levels for optimal longitudinal and lateral support

Automated Queue Assistance

- Main purpose of Automated Queue Assistance is to relieve the driver from the monotonous tasks associated with driving a truck at low speeds and in congested traffic situations

- It is intended to improve traffic safety via supporting the driver when their workload is very low

- Steering, acceleration and braking will be controlled using a variety of external vehicle environment sensors

Temporary Autopilot
Semi automated driving on highway situations

Functionality:

Gradual automation between

- Driver only
- Assistance function (hands on)
- Pilot function (hands off)
- Safety function (emergency brake)

Sensor platform:

- Mono camera (front, rear)
- Laser scanner (front)
- 77 GHz radar (front)
- Ultrasonic sensors (front)

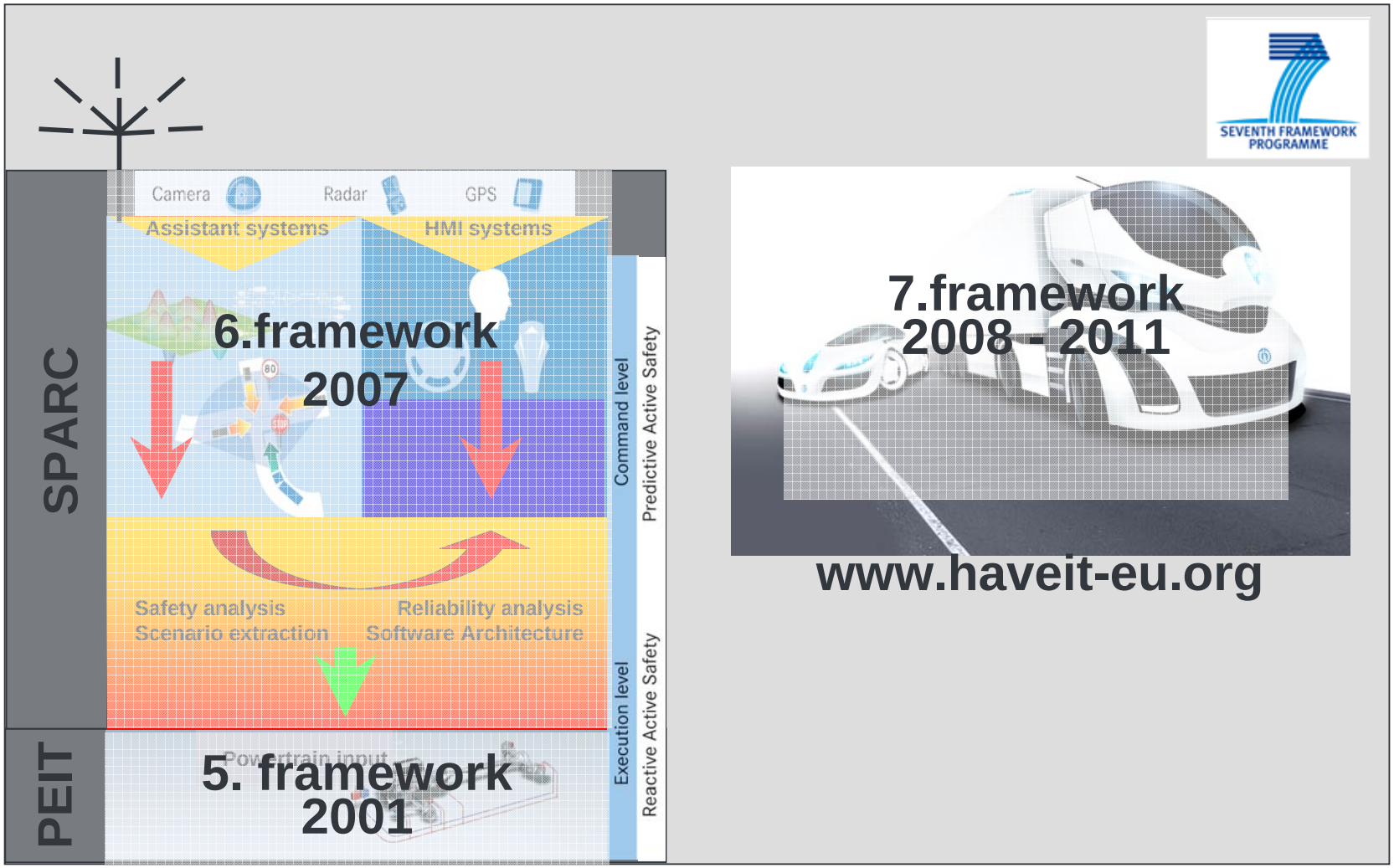
Active Green Driving

- Main purpose of Active Green Driving is to optimize the use of the energy sources in a hybrid powertrain to decrease the fuel consumption

- This function is intended to reduce the environmental impact from heavy duty vehicles

- The powertrain will be controlled optimally by using preview information from a variety of external vehicle environment sensors

The work is ongoing .... realization by increased co-operations between OEM and Supplier supported by forward looking EU funding



There are of lot of challenges ... let´s work on solutions.

Thank you