CRUSADER

A full vehicle integration facility

Crossfunctional **u**nique **s**ystemtest **a**pproach **d**riven by **e**ntire **r**elationships

An innovative vehicle-in-the-loop test bench

We're talking about....

CRUSADER

an **U**nique test bench

completely new test bench setup

Driven by **E**ntire **R**elationships from system point of view

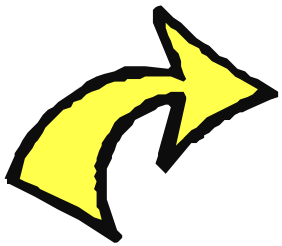
simulate reality as close as possible (environment- and traffic simulation)

CRoss-functional testing

not only one local function: testing at whole system (vehicle level)

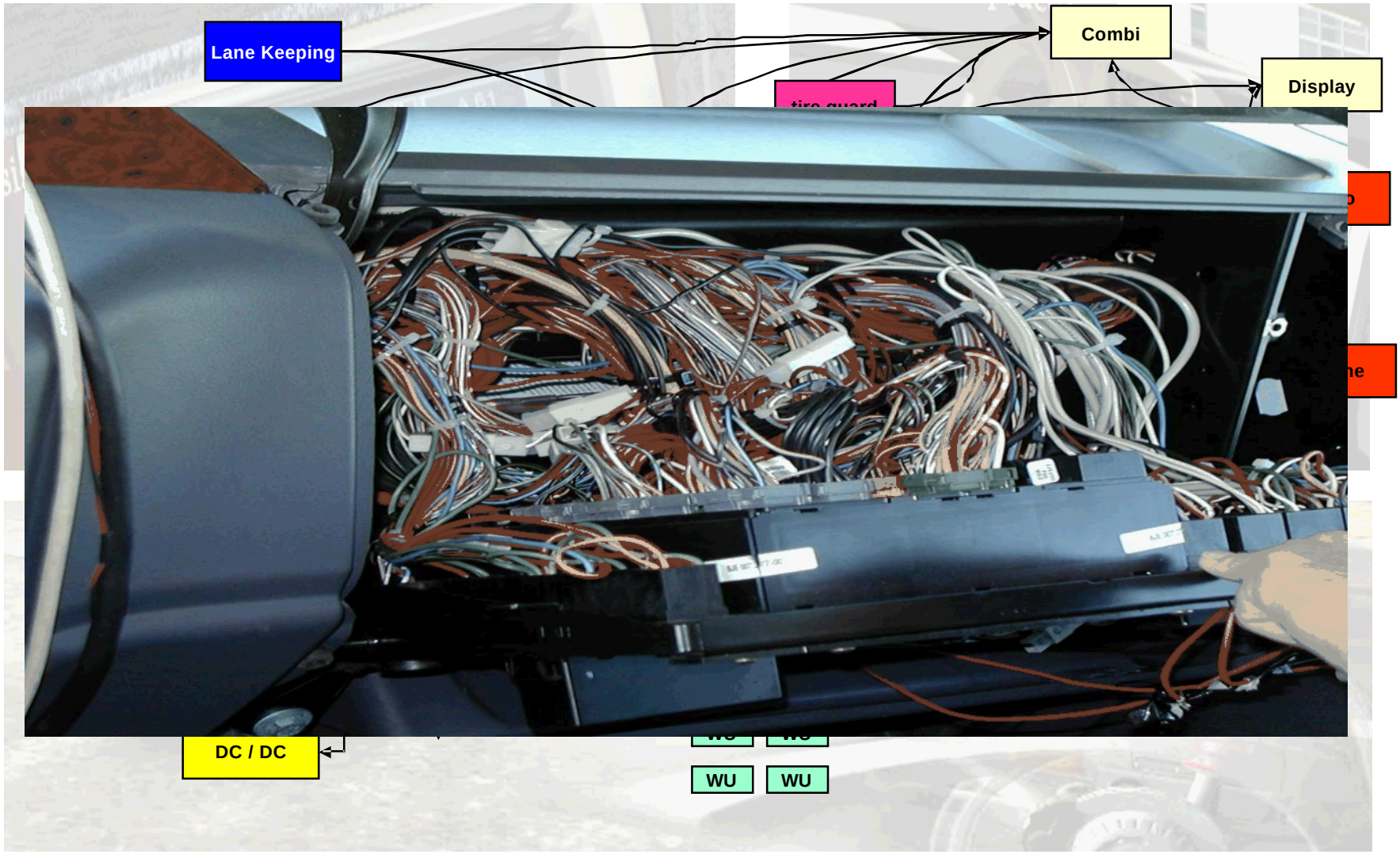
an innovative **S**ystem test **A**pproach

a new kind of system testing



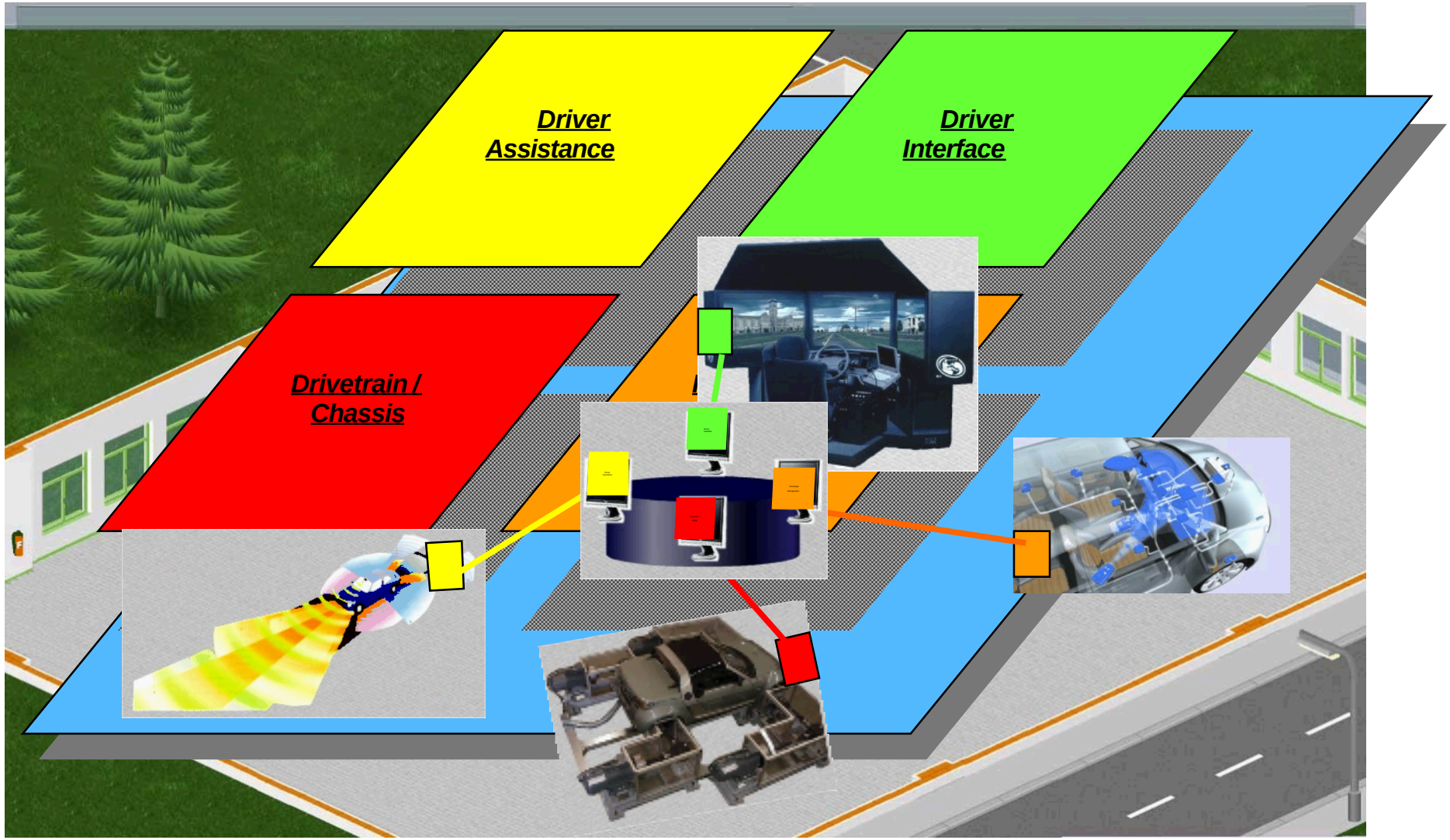
Motivation

An ever increasing inter-dependability ... ... reaching the limits of integration



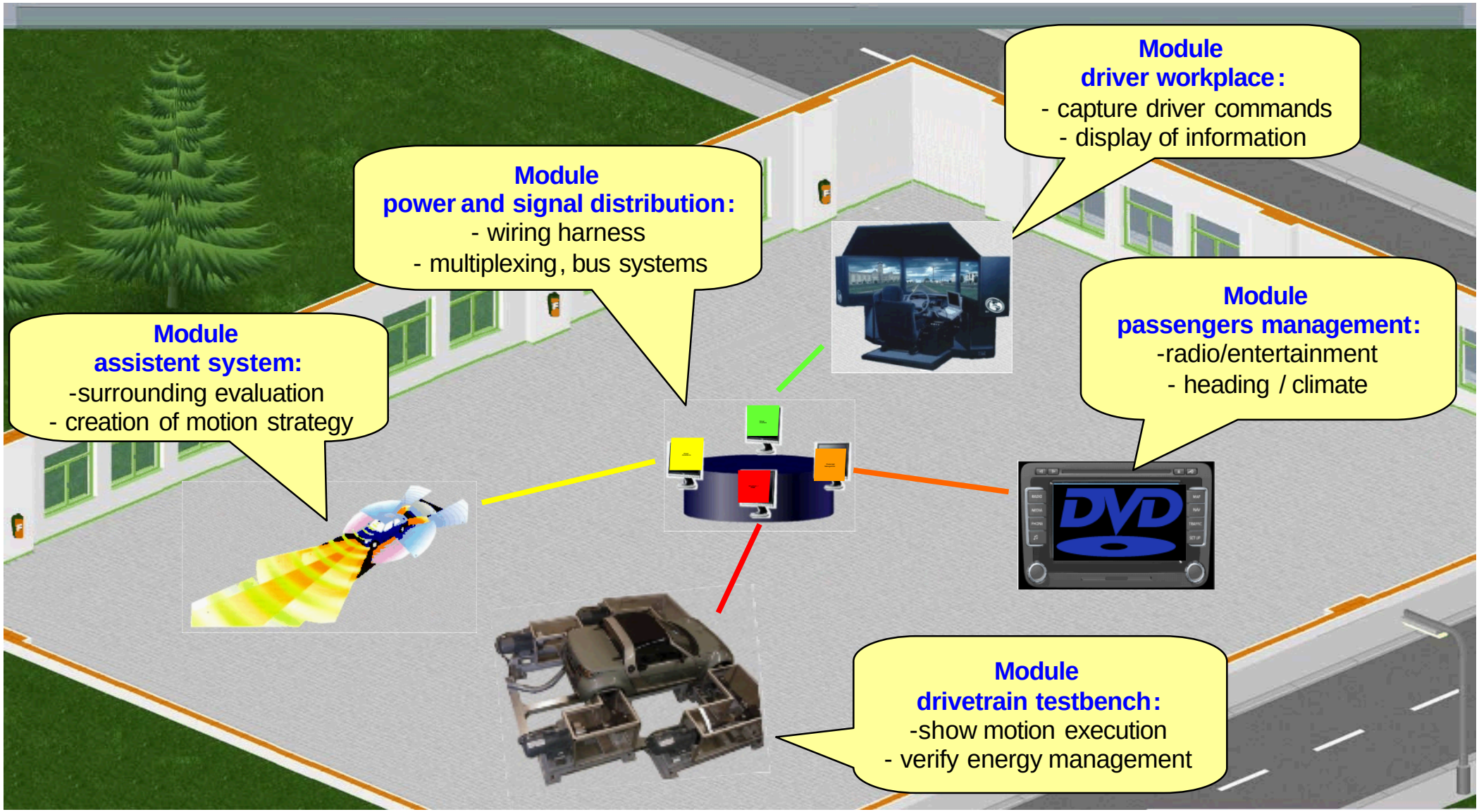
Motivation

New possibilities of integration on vehicle level



Complete Vehicle Integration Facility CRUSADER

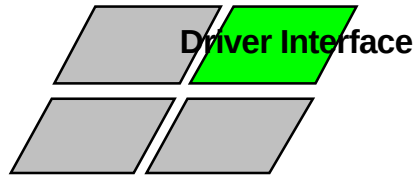
The modular deployment

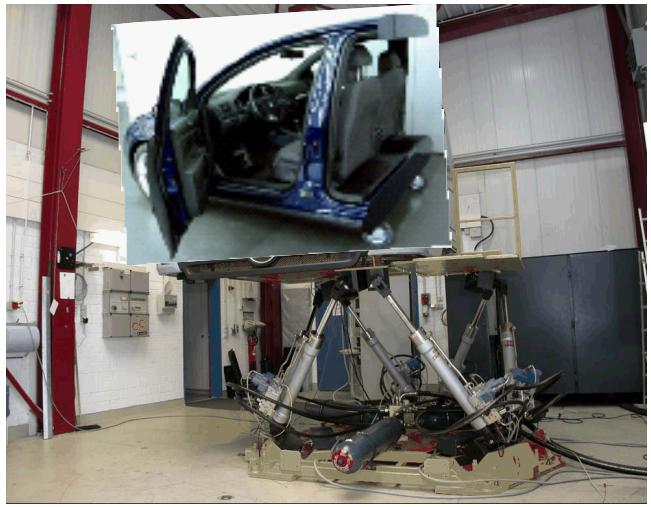


Overview module: driver workplace

A dynamic driving simulator

- six-degrees dynamic driving simulator platform
- VW Golf mockup mounted on top (original CAN and serial components)
- simulator and mockup controlled by traffic- and environment simulation
- visualisation of traffic in front of the windscreen (screen display)
- operation with a real driver (man-in-the-loop)





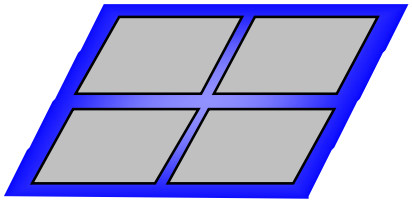
traffic simulation

environment simulation

Overview module: signal distribution, E/E infrastructure

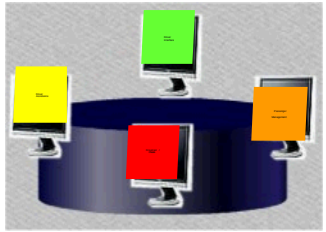
Visualization of the interfaces

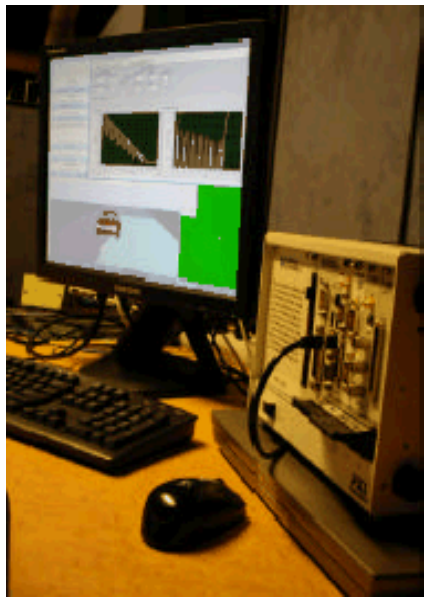
- represents the E/E infrastructure of the whole test system
- has been realized by the inter-module connections itself (CAN, ethernet...)
- analyse data on the interfaces by means of using the suitable tooling
- optimize interfaces in terms of improving performance or reducing complexity



E/E Infrastructure

show dataflow of the interfaces:

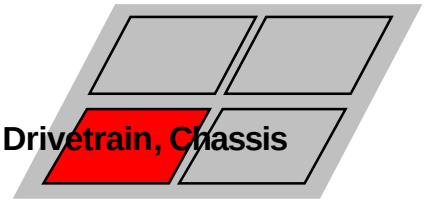




Overview module: drivetrain/chassis

Vehicle-in-the-loop testbench

- drivetrain testbench to verify the motion execution of the vehicle
- consists of 4 independently controllable electric motors (asynchronous)
- basically the torques on the wheels will be measured
- the corrosponding counterforces will be provided



emulate all counter-forces
which are originally active in reality
(between wheel and road)

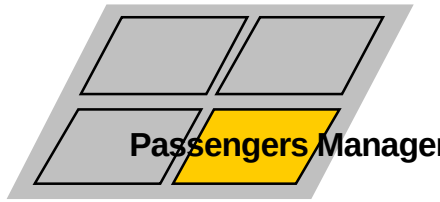
DÜRR

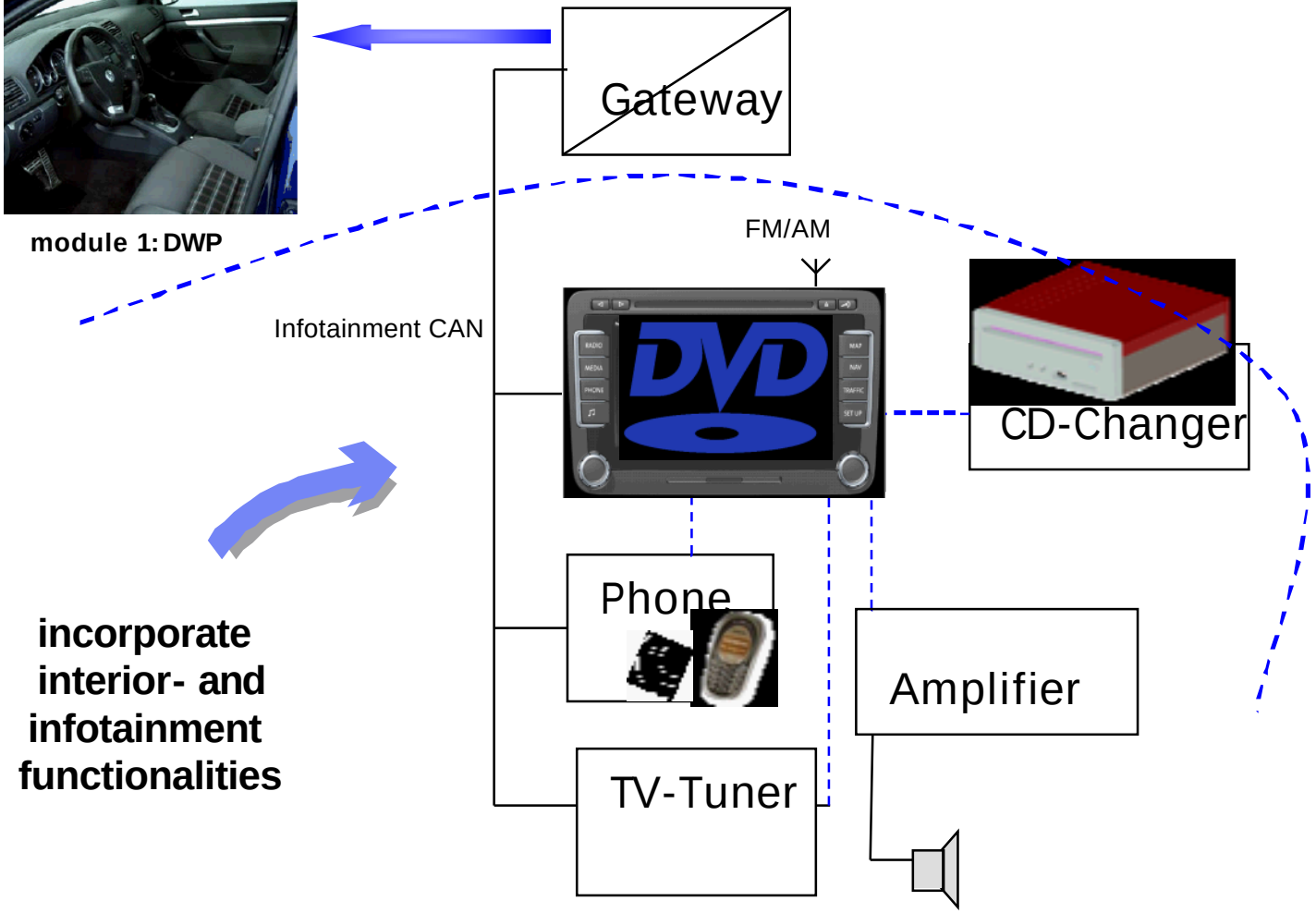
Continental

Overview module: passengers management

All tasks independent from driving

module 1: DWP





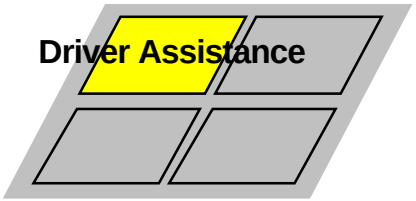
incorporate interior- and infotainment functionalities

- multimedia system including navigation and map data
- surrounded by additional components

Overview module: assisting system

Surrounding evaluation, simulation of sensor data

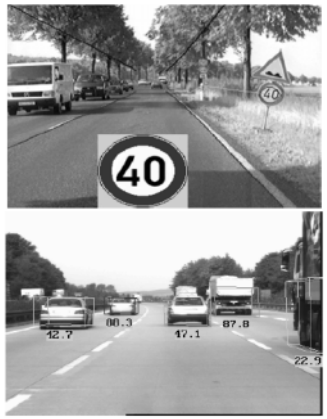
traffic scenario and
environment simulation



**object data: distance,
relative speed, dimensions
of obstacles**

- calculation of object data
- provision of route and map data
- injection of object data directly
  into CAN bus-system
  (bypass radar sensors)

eHorizon:
navigation + map data

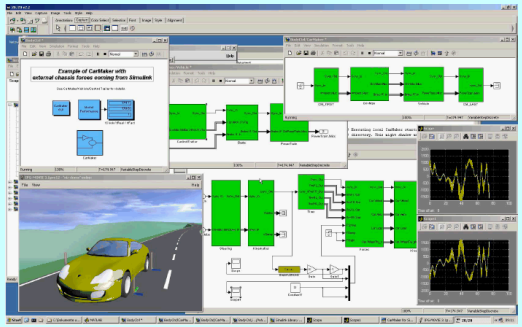


CRUSADER

A closed loop testing, overview

dynamics, model-in-the-loop

environment, traffic-in-the-loop

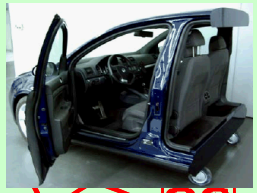


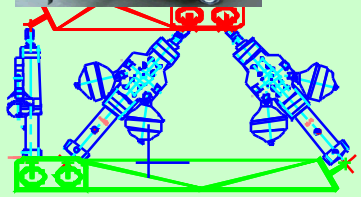
position

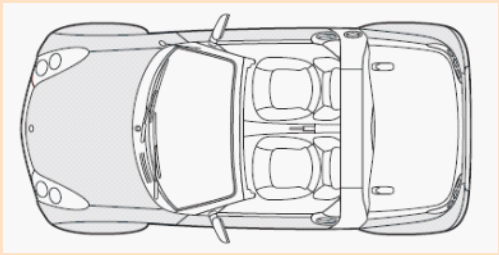
Closed Loop Operation

vehicle behaviour

visualisation







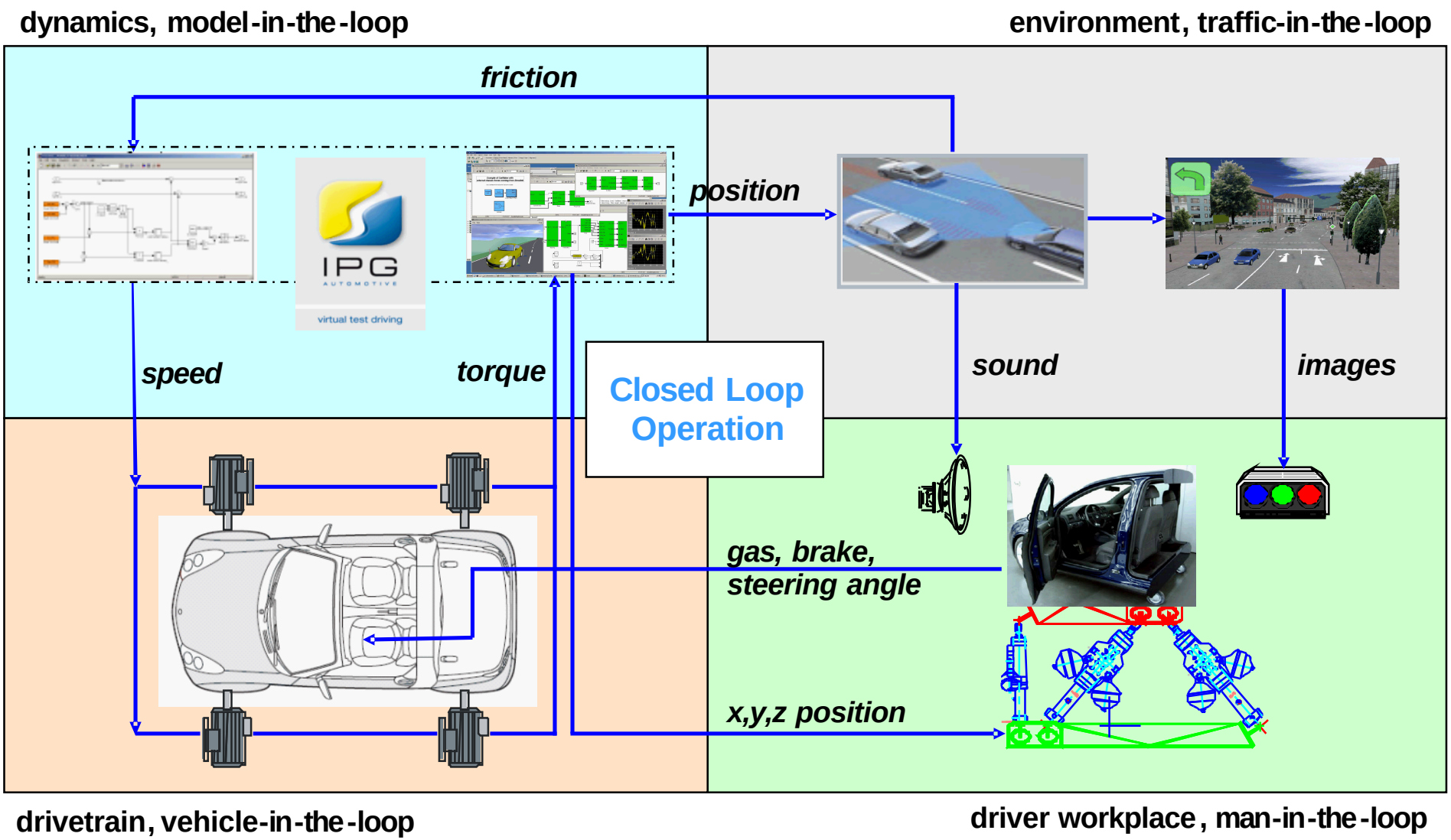
driver wish

drivetrain, vehicle-in-the-loop

driver workplace, man-in-the-loop

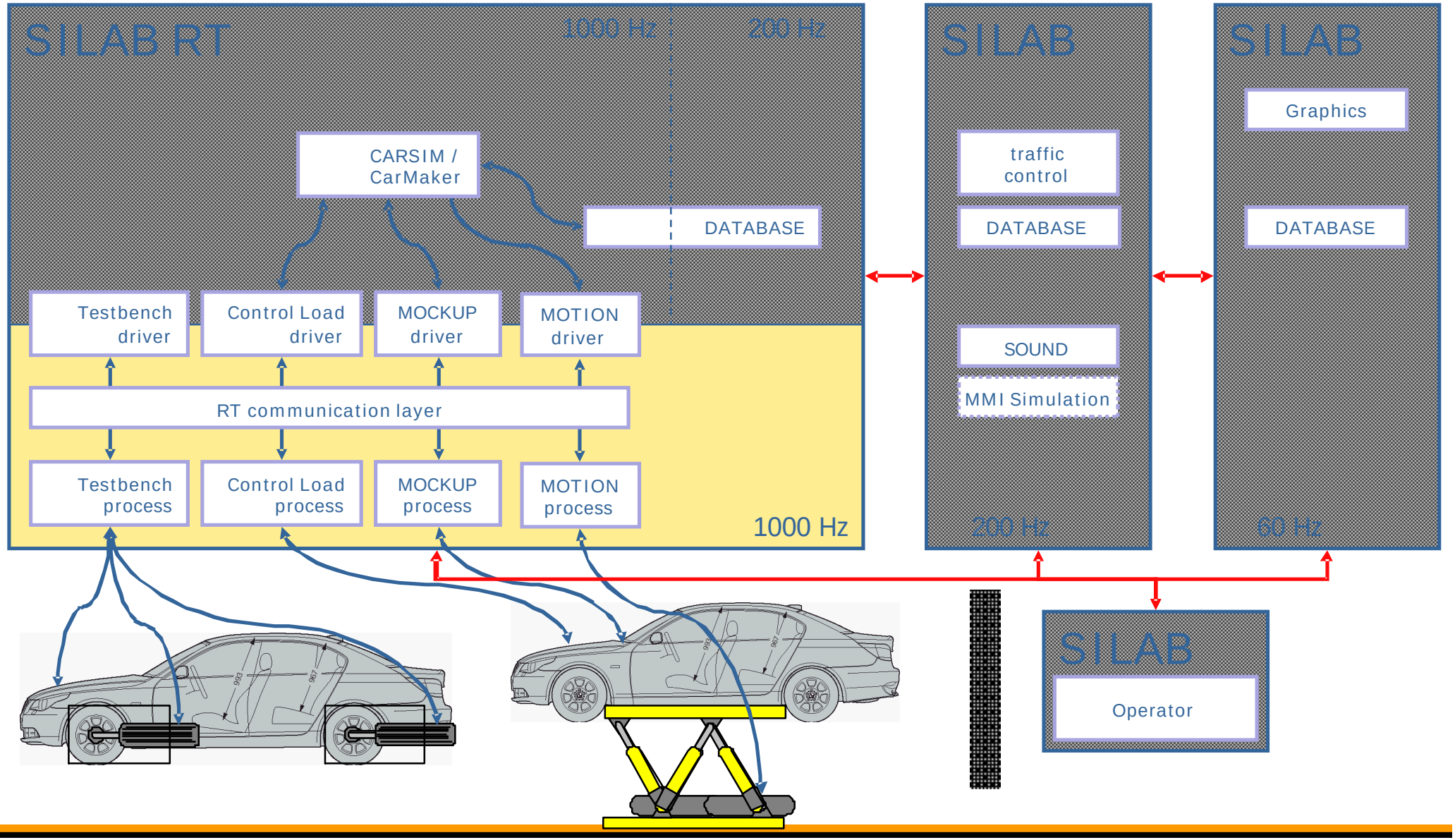
CRUSADER

A closed loop testing, the basic principle...



CRUSADER

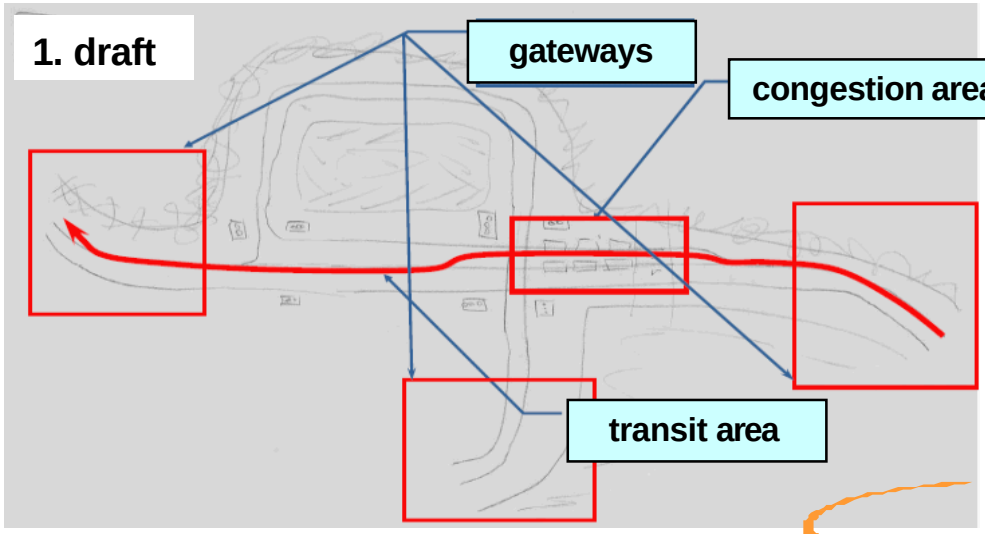
SILAB Real Time Approach, System architecture

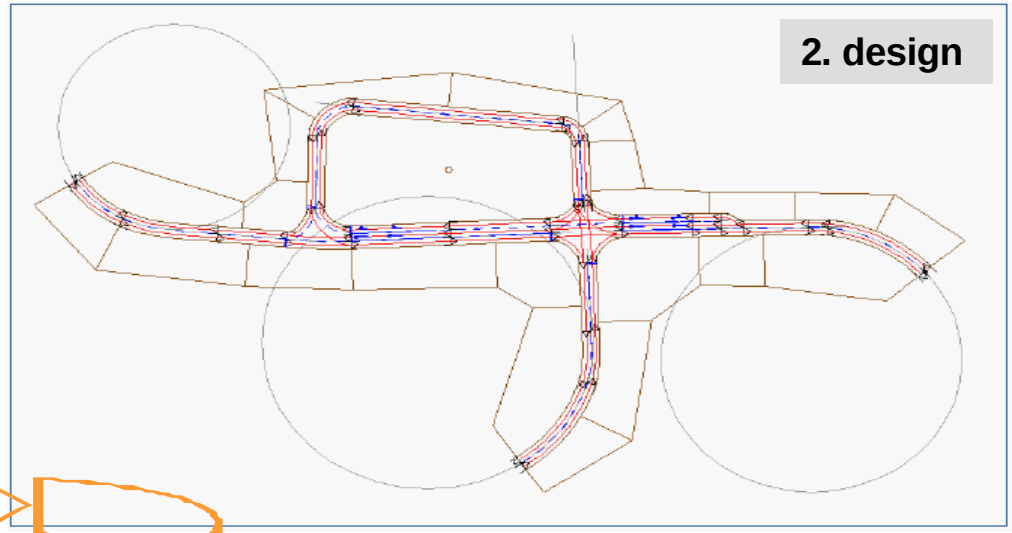


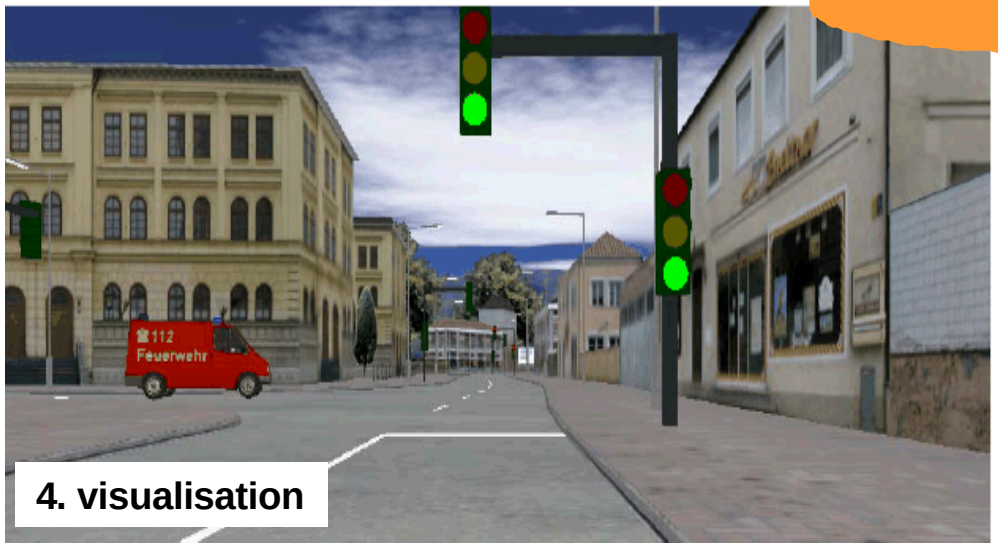
Automotive Systems
Integration Platforms

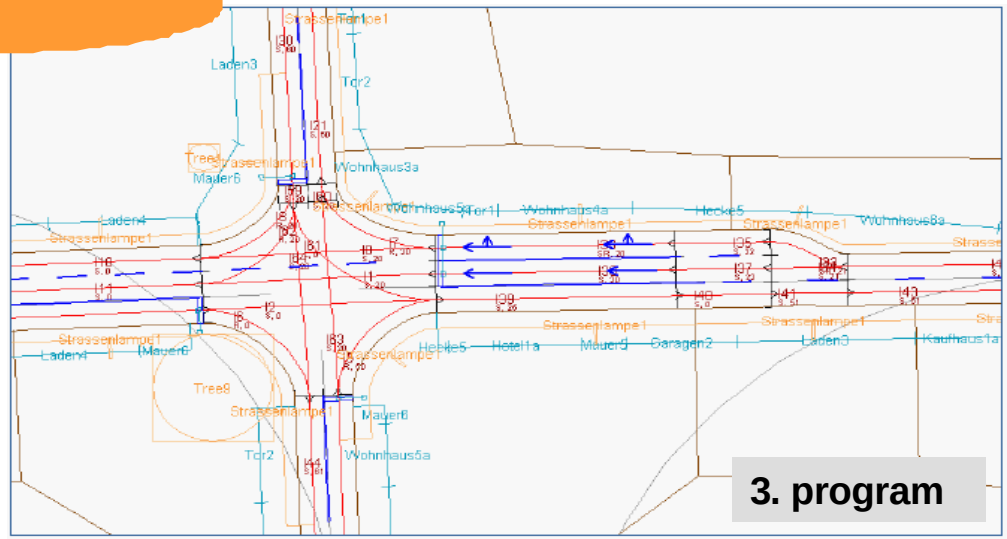
CRUSADER

SILAB traffic simulation, tool based development process





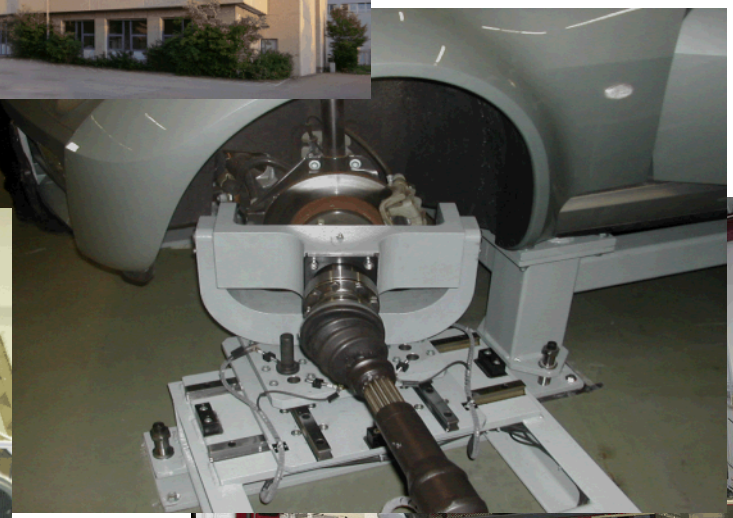




CRUSADER

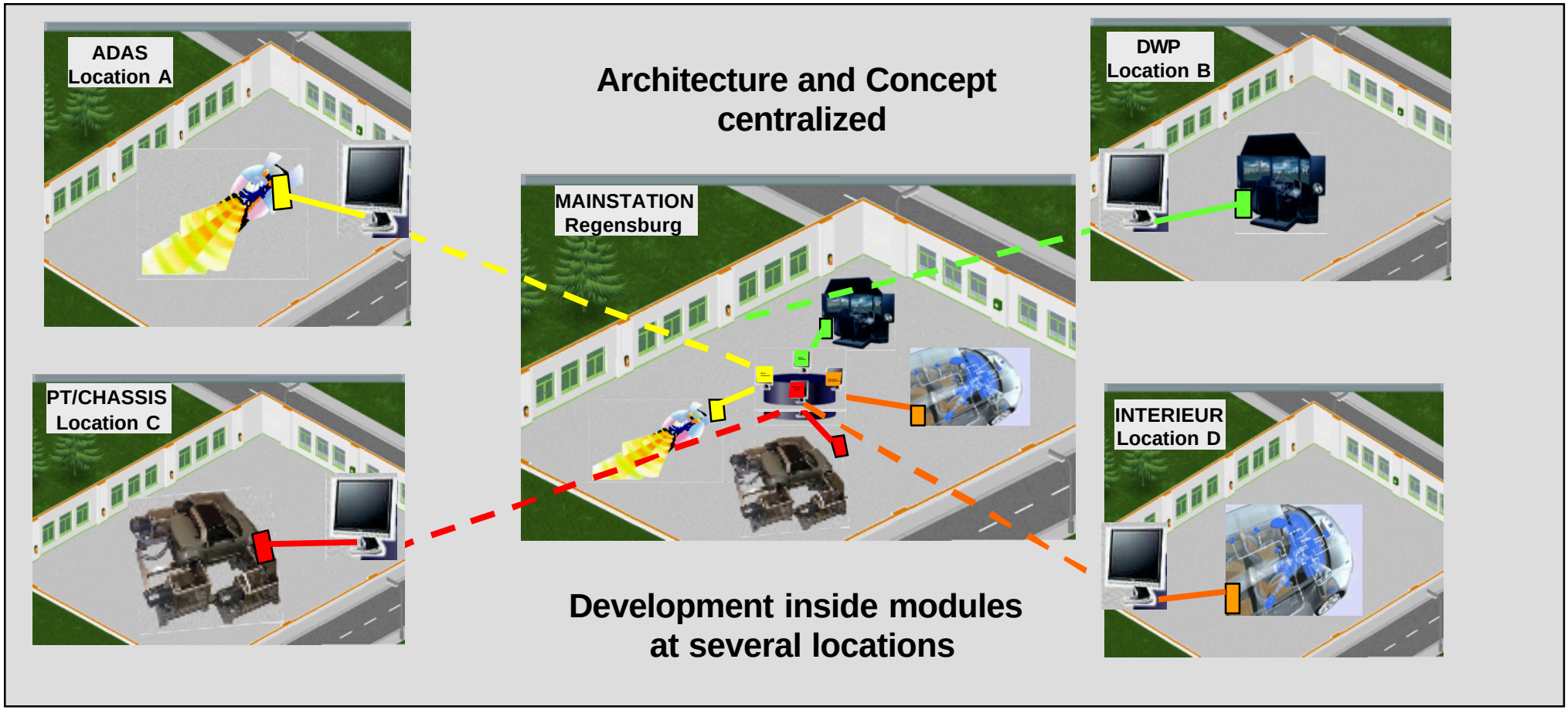
Pics CRUSADER components, Powertrain testcenter Regensburg, Germany

located at Regensburg,
Siemensstrasse 12
powertrain testcenter



Complete Vehicle Integration Facility CRUSADER

The modular deployment in future

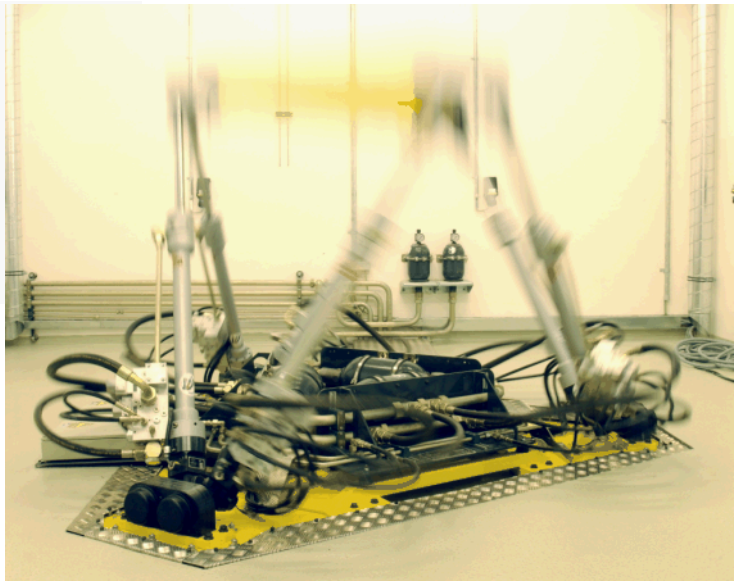


Partners (1)

Simtec Systems, Braunschweig, Germany

simtec® Systems

HEXaDRIVE® six-degrees-of-freedom



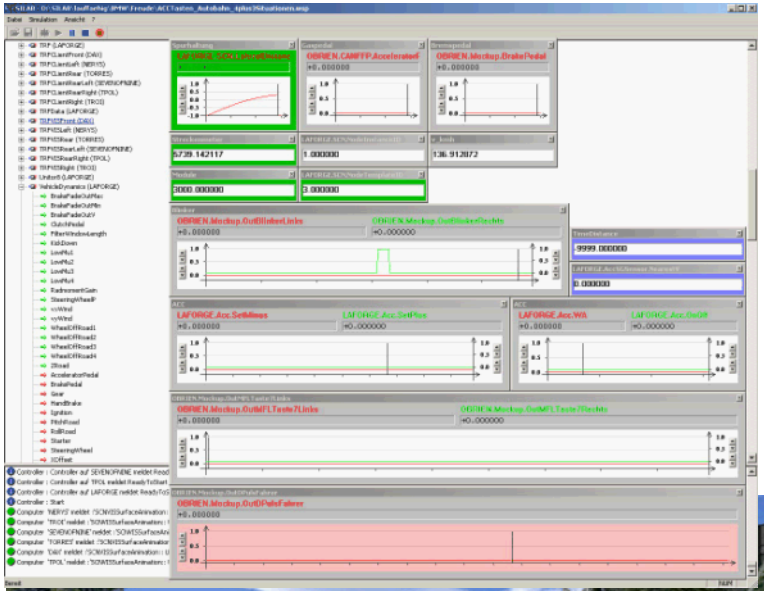
Realization of VW Golf mockup integration
on dynamic driving simulator

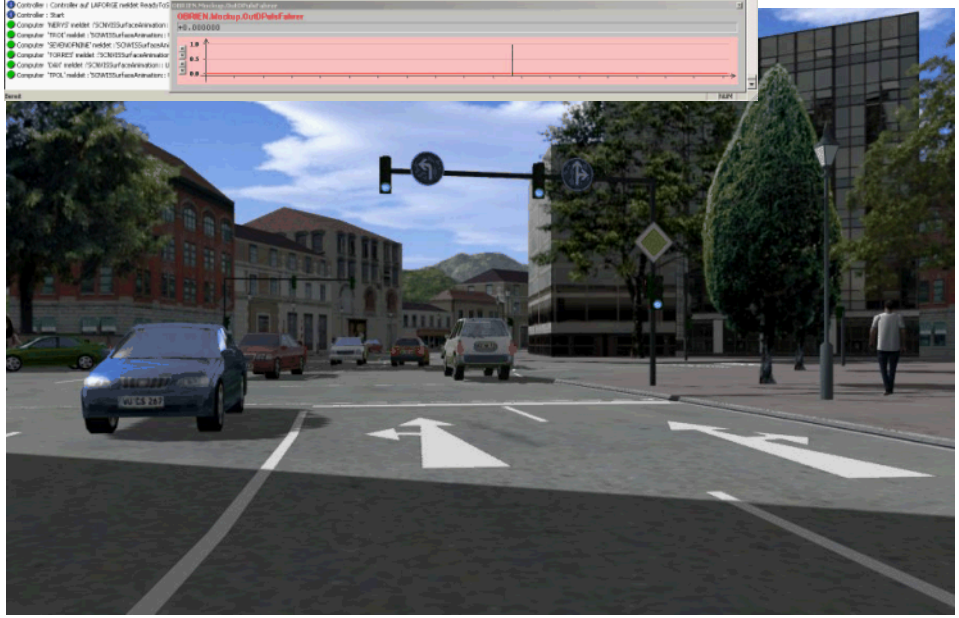
Hall 1, Booth 1652, Mr. B.Kaufmann

Continental

Partners (2)

IZVW, Center for Traffic Sciences, Würzburg, Germany





Center for Traffic Sciences, Würzburg

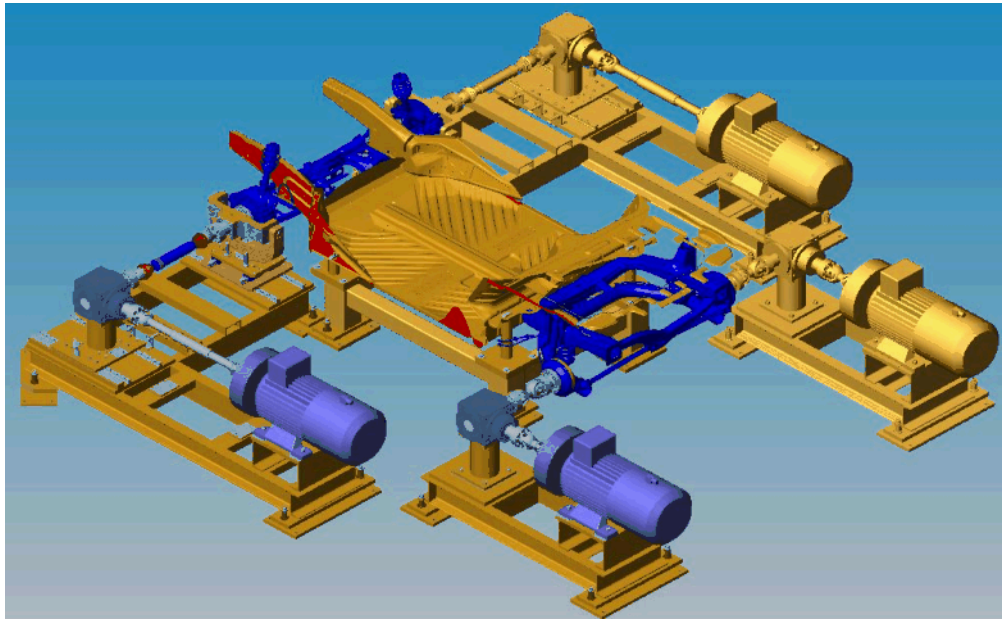
Methodology and Traffic Sciences, Prof. Dr. Krüger

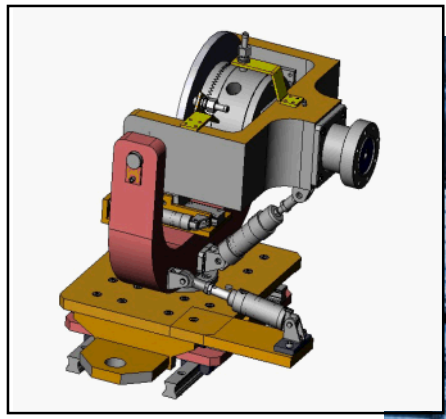
SILAB tooling:

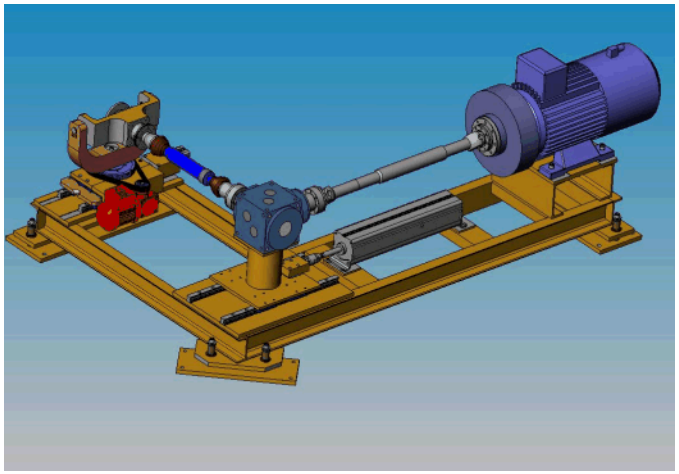
Provision of traffic scenarios and environment simulation

Partners (3)

Dürr, Assembly Products GmbH, Püttlingen, Germany







x-dynodrive testbench

drivetrain testbench adaption
provision of realtime behaviour

Hall 1, Booth 1850

DÜRR

Continental

CRUSADER

Summary Main Use Cases, only a snapshot.....

- **vehicle dynamics**
  - optimization of transmission- and engine control for different driving scenarios
  - test different types of vehicles by changing the models or the simulation parameters
- **hybrid drivetrains**
  - verify energy- and loadmanagment
  - repetition of reference traffic scenarios to validate different hybrid approaches/drivetrains
- **assisting systems**
  - simulate object data and verify the vehicle behaviour of new assisting funtionalities
  - usability studies of assisting functionalities, e.q. HMI design
- **commonly**
  - closed loop control makes it possible to run fully automated test cases (without driver)
  - fault insertion for power- and signal lines

CRUSADER

Summary Business Case

- Realization of a complete vehicle system test bench which will be completed with an environment- and traffic simulation
- based on new modular deployment which represents a grouping of functionalities
- one single test bench for every module (driver workplace, drivetrain bench,....), to be connected together as a complete test system or can be operated as single-user testbench too

Reduction of integration effort by testing with CRUSADER

Satisfying our customers !

CRUSADER

a broad range of system testing !

Thank you for your attention.