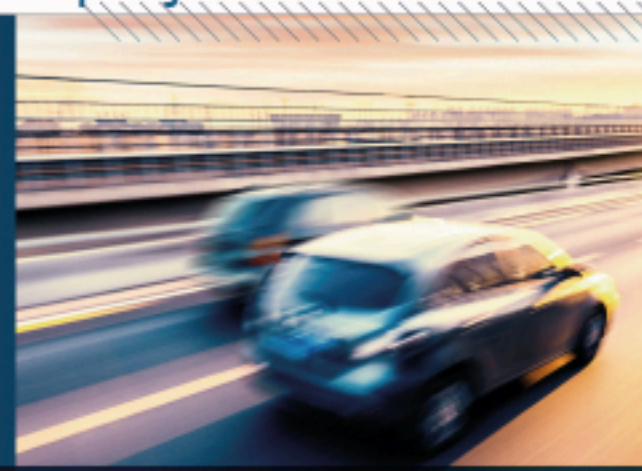


Testing and Safeguarding – Stand 17

HARDWARE-IN-THE-LOOP SIMULATION

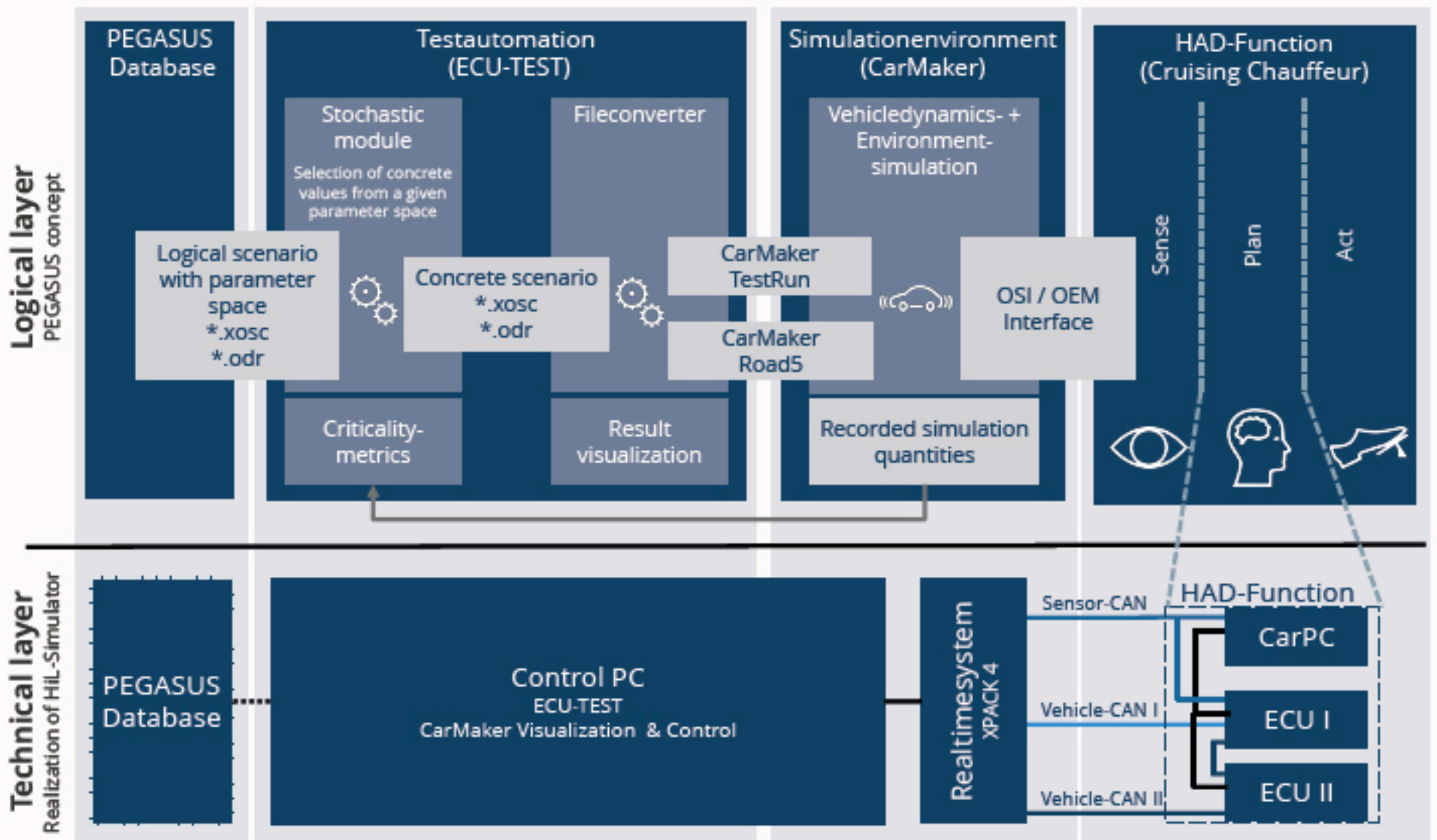


Realization of the PEGASUS tool chain in a hardware-in-the-loop simulation environment.

How is a highly automated driving function tested in a HiL-environment?

Logical layer: Logical scenarios are processed into concrete scenarios within the stochastic module in ECU-TEST. The concrete scenario in the form of OpenSCENARIO and OpenDRIVE files is then converted to the formats TestRun and ROAD5 and executed on the HiL test bench under real-time conditions. The behaviour of the HAF function is evaluated and displayed by means of criticality metrics within ECU-TEST.

Technical Layer: Exemplary structure of the hardware-in-the-loop simulator. The structure consists of an XPACK4 real-time system, several control units and CarPCs, as well as a simulation control PC. The real-time system communicates via CAN with the ECUs and CarPCs on which the HAF function is executed. The real-time system is remotely controlled by means of the simulation control PC on which the CarMaker visualization is displayed and ECU-TEST is executed.



What is the essence of a hardware-in-the-loop environment?

Compared to the software-in-the-loop environment, sensors, ECUs and actuators are part of the system to be tested. This extends the system-under-test to hardware components and their influence on the system, such as poorer performance due to limited computing power or limited storage space. Furthermore, the communication between the hardware components is part of the test. Effects such as loss of messages, time delays in transmission or limited value ranges of signals are automatically taken into account.

Depending on the design of the HiL test bench, an almost complete test of all hardware components of the HAF system, from sensors to ECUs up to actuators is possible. The difference between HiL tests and real driving tests can thus be reduced to a minimum. In comparison to the SiL environment, the dependency on simulation models is reduced, especially the sensor models with the integration of real sensors.

