Using FMI/ SSP for Development of Autonomous Driving

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MOTION AND MOBILITY

dSPACE

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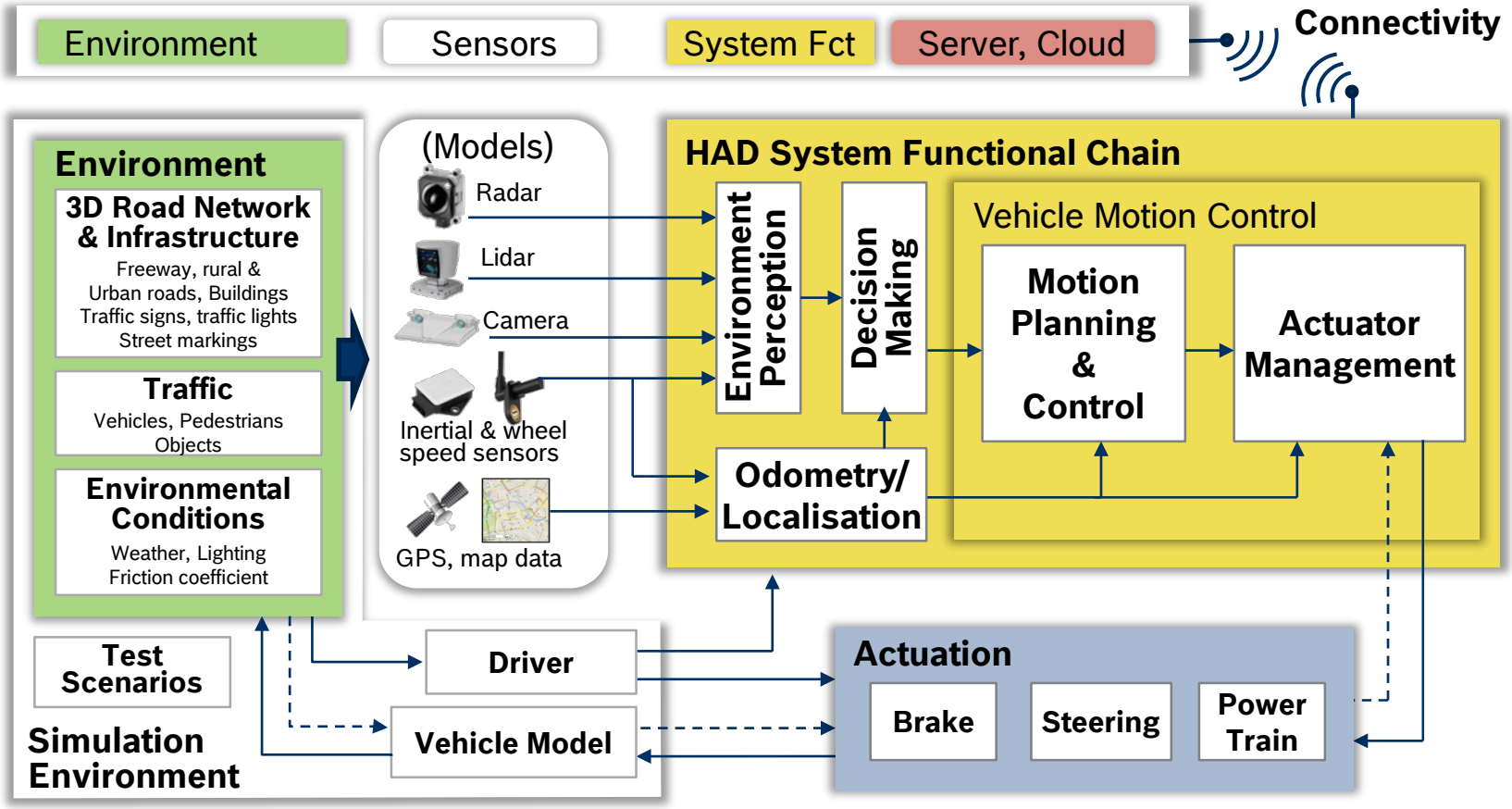
Motivation I

- Autonomous Driving is a Megatrend for the automotive industry
- Intensive cooperation of companies is mandatory
- Simulation is essential for efficient development and future homologation of products
- Platforms and interchange standards are needed and decided upon in the very near term (< 1-2 years).
- Great chance for further FMI impact, however limited time horizon for needed evolution…

Motivation II

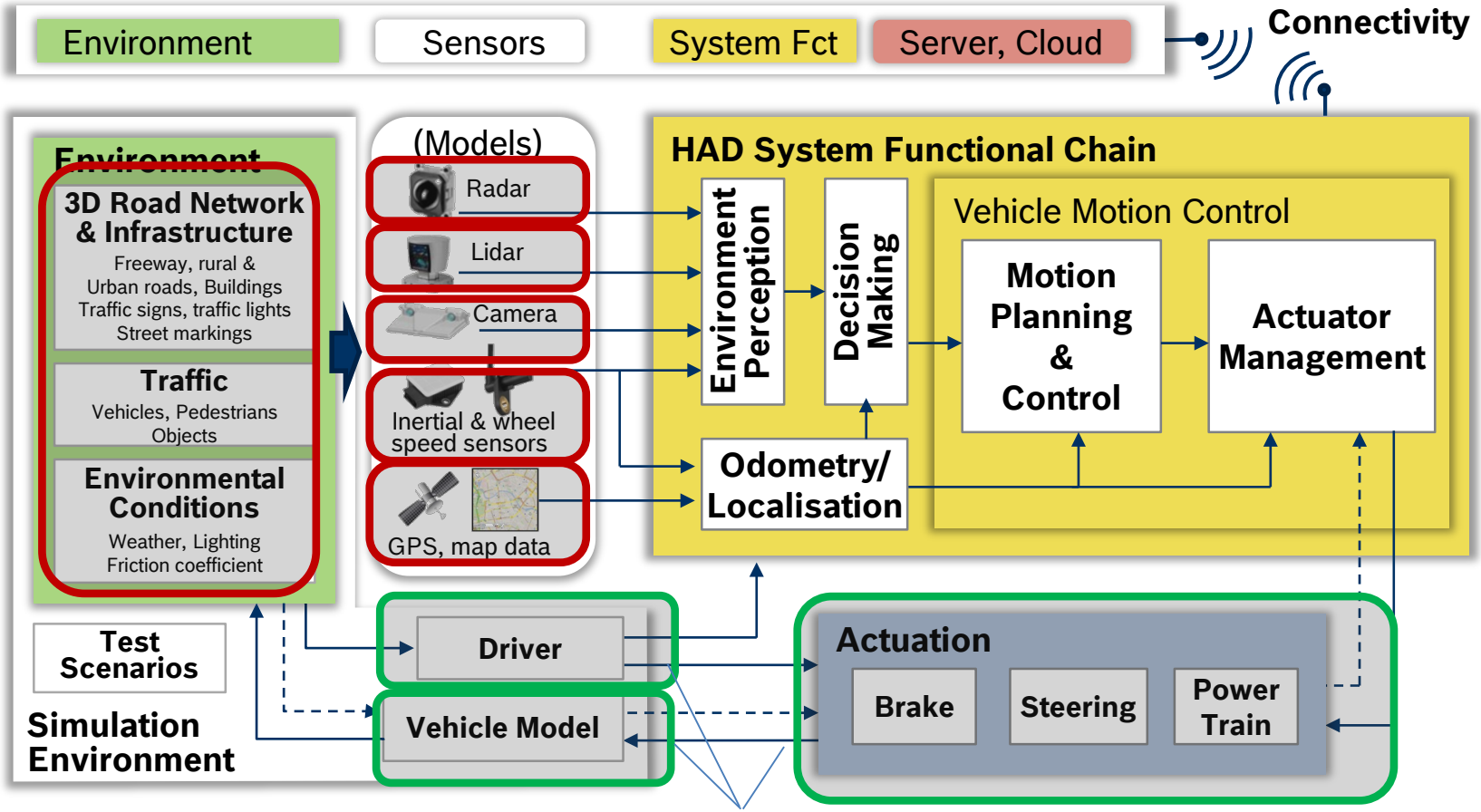


- HAD & Connected System Simulation Environment

HAD:
Highly Automated Driving

Motivation II

FMI provides insufficient datatypes for sensors

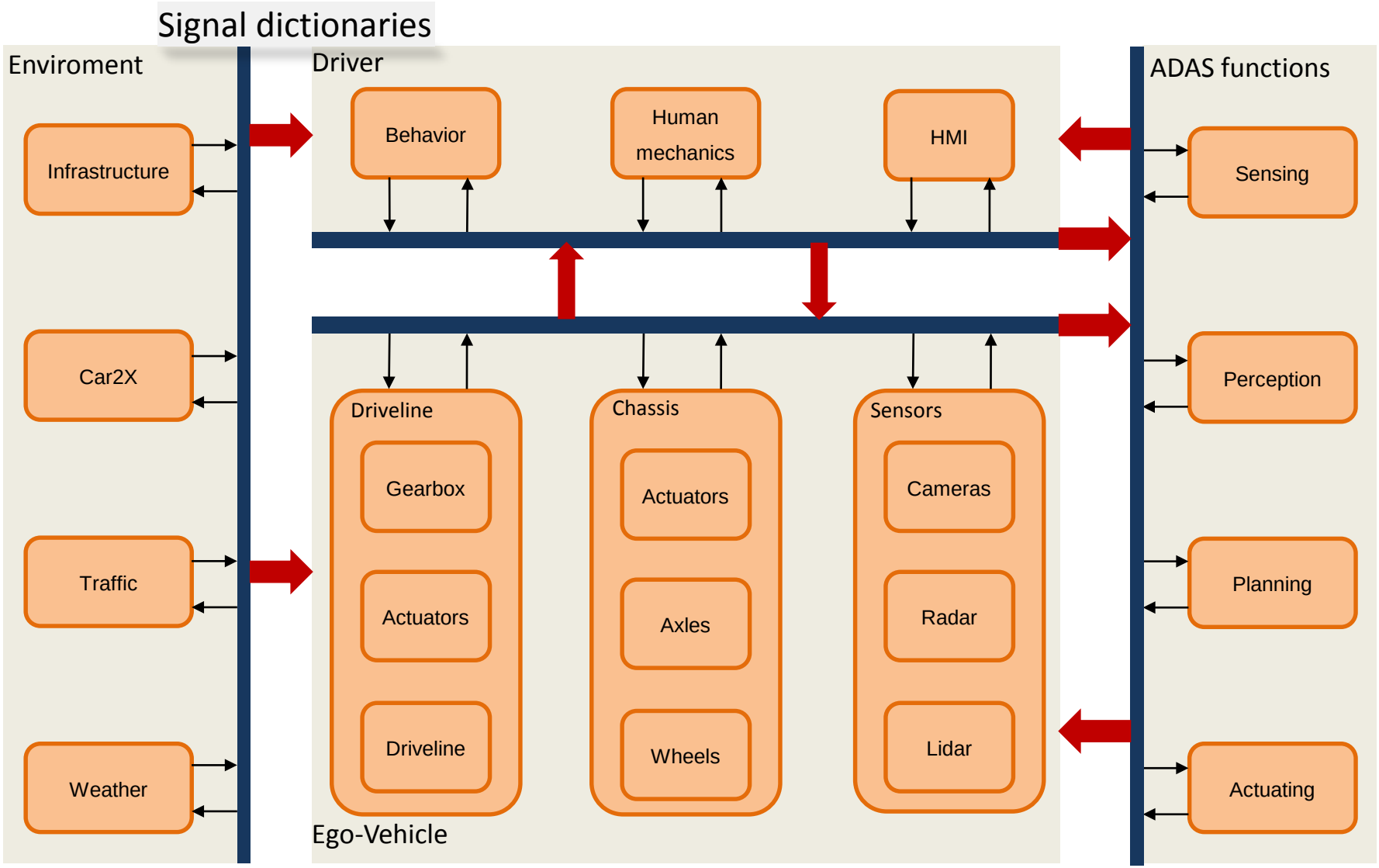


FMI Co Simulation ✔

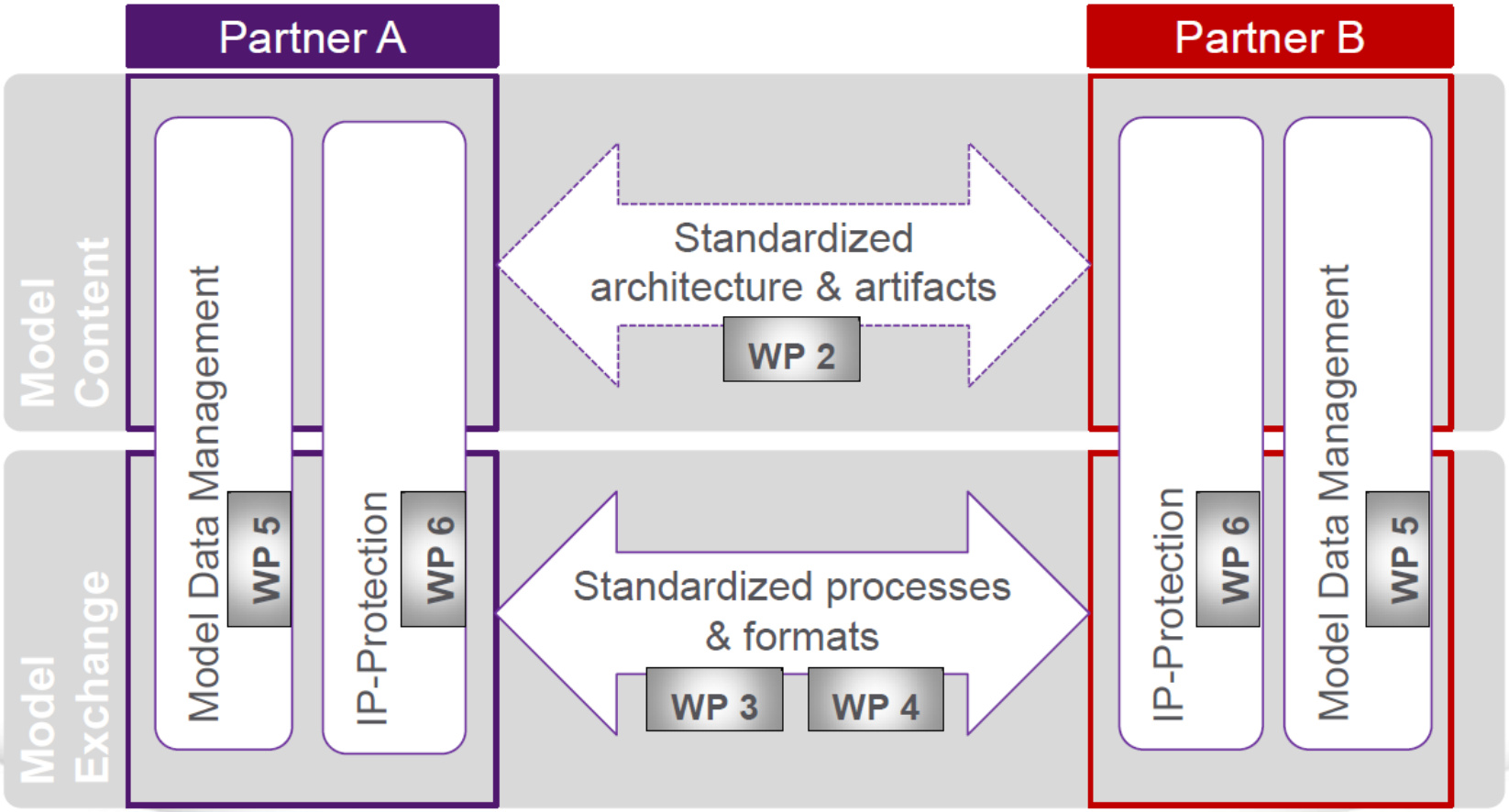
HAD:
Highly Automated Driving

- HAD & Connected System Simulation Environment

Usage of SSP in defining Simulation Architecture for ADAS in ZF



SmartSE solutions in SE Collaborations



Usage of FMI / SSP for Autonomous Driving

- Motivation:
  - AD system models require integration of environment simulation, sensor models, AD algorithm components with driving dynamics
  - Sampled systems, requiring complex data types (object lists, reflex lists, …) with dynamic sizing and large scalar content (>> 10000 scalars)
  - Complex connectivity, exchange of connected systems between platforms
- Requirements:
  - Extension of FMI with more interface data types:
    - Opaque binary data types (e.g. length-terminated, MIME-Type tagged)
    - Better: Integration of proper Interface Description Language
    - Not needed: Use of those data types as continuous variables in ADEs
  - Extension of SSP with matching connector types.
- Activities:
  - SmartSE: Unification of driver models, common driver model interfaces
  - FMI + Open Simulation Interface as sensor model interface standard

Requirements to FMI / SSP

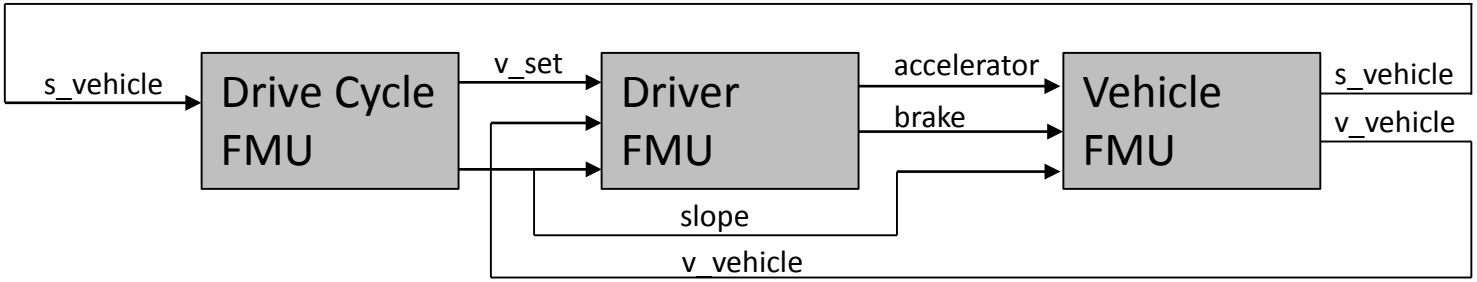
- Better support in FMI (2.1?) for sampled data systems in FMI for Model exchange or hybrid Co-Simulation include sensor, controller and ECU-SW models in system simulation.
- Improve Standard compliance of FMI supporting tools by extended cross-checking in order to fulfill requirements to support homologation
- SSP Standard must be compatible / convertable to ASAM Standard used for ECU-SW description

Conclusions

- Standards are essential for cross-company development and simulation of HAD systems
- A few major points are presented here
  - Standards for sensor interfaces → Extension of FMI standard
  - Standards for connection and parametrization of FMUs → SSP
  - Shared good practice / usage hints for FMI, co-simulation
  - Approach for cross divisional specification, creation and maintenance of standardized models

Backup

Driver Model as Example



- FMUs from 5 different companies combined to “System Model”
- For each FMU different variants used (6 cycle- , 4 driver-, 3 vehicle-FMU variants)
- In sum 72 FMU-combinations created and simulated on dSPACE VEOS platform
- Results:
  - All FMU combinations can be simulated
  - All driver FMUs allow to follow velocity profiles like EUDC, FTP75, WLTC, …
  - For seamless exchange between companies, FMU interface specification must be very accurate and ideally machine readable
  - Template FMUs according to proposal from Modelica SSP project could be helpful:
    - Template FMUs could be generated from “System Model”
    - Template FMUs should be importable in modelling tools to transport interface