

# Modelica Association

Hubertus Tummescheit

Modelon & Modelica Association Board

# What is the Modelica Association?

- The Modelica Association is a non-profit, non-governmental organization with the aim of developing and promoting system modeling and simulation.
- The Modelica Association organizes activities through largely independent projects:
  - The Modelica Language Project develops the Modelica modeling language
  - The Modelica Library projects develops open source Modelica Libraries
  - The FMI Project develops the Functional Mockup Interface (FMI) Standard
  - The SSP project develops the System Structure and Parameterization future standard (not yet released).
  - One further project is under consideration
- All standards by the MA are completely open and available for free!

# Modelica Project News

# Modelica Language and Libraries

- Latest release of Modelica Language Specification, version 3.4, May 15th, 2017
  - Incremental improvements to make Modelica-models fully portable between tools, with identical results!
- Latest release of Modelica Standard Library, version 3.2.2, April 12, 2016. Next release in Q2 2018
  - Mostly bugfixes and improvements to cross-tool testing
- Structured process for change proposals and standard maintenance

# FMI Project

Active development in working groups, planned features for FMI 2.1:

- **Ports and Icons:**  
Help the user to build consistent systems from FMUs and render the systems more intuitively with better representation of structured ports (for instance busses and physical connectors) in the modelDescription.xml.
- **Array variables:**  
Allow FMUs to communicate multi-dimensional variables and change their sizes using structural parameters.
- **Clocks and Hybrid Co-Simulation**  
Introduces clocks for synchronization of variables changes across FMUs. Allows co-simulation with events.
- **Binary Data Type:**  
Adds an opaque binary data type to FMU variables to allow, for instance, efficiently exchanging of complex sensor data.
- **Intermediate Output Values:**  
Allow access of intermediate output values between communication time points from the FMU to disclose relevant subsystem behavior for analysis or advanced co-simulation master algorithms.
- **Source code FMUs:**  
Adding more information to the modelDescription.xml file to improve automatic import of source code FMUs

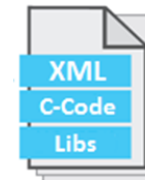
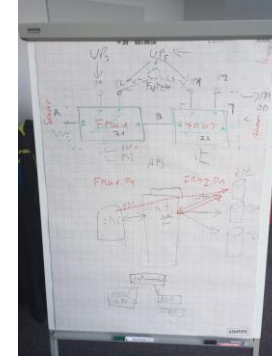
# System Structure and Parameterization (SSP) Project

- FMI deals with a single model, SSP deals with the system structure.
- SSP will allow the reuse and sharing of system architectures
- Under development in Modelica Association since 2014
- Release candidate planned for February 2018

# Brief Description:

## System Structure and Parameterization (SSP)

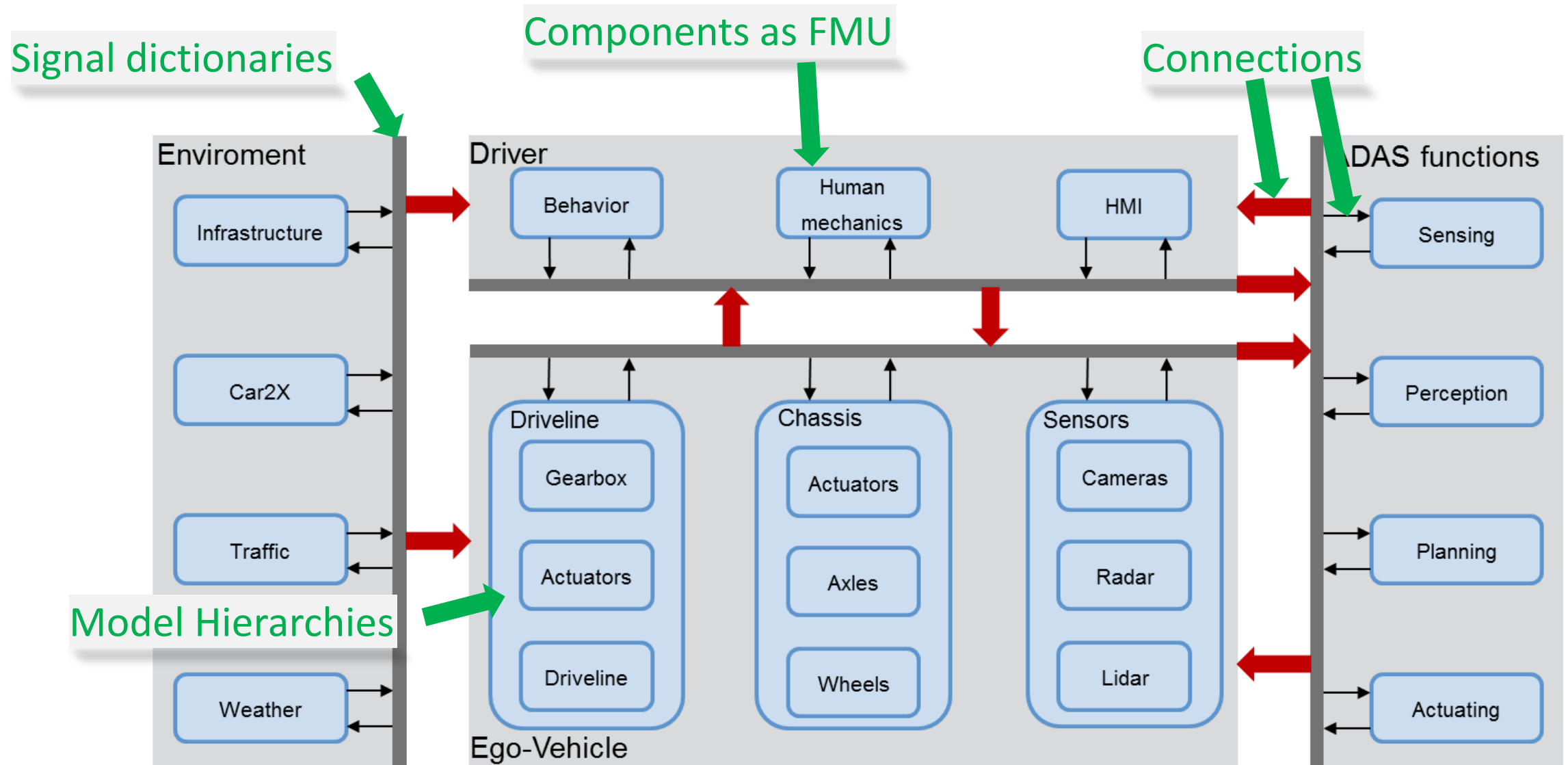
- Separate Modelica Association Project that complements FMI-Standard to description of complete Systems for easy exchange
- Project started 2014 in Lund during Modelica Design Meeting (after joint presentation of BMW, Bosch, ZF)
- Main Features:
  - Tool independent specification for describing hierarchical system structures consisting of several FMUs (or proprietary models)
  - Tool independent specification for parameterization of systems
  - Tool independent specification of an API for parameter / FMU access from any data sources and for GUIs of authoring / integration / simulation tools
  - Fully compatible to FMI standard
  - First simple techniques for variant handling (collecting variants in one exchange file)



\*.SSP



# Usage of SSP in defining Simulation Architecture for ADAS





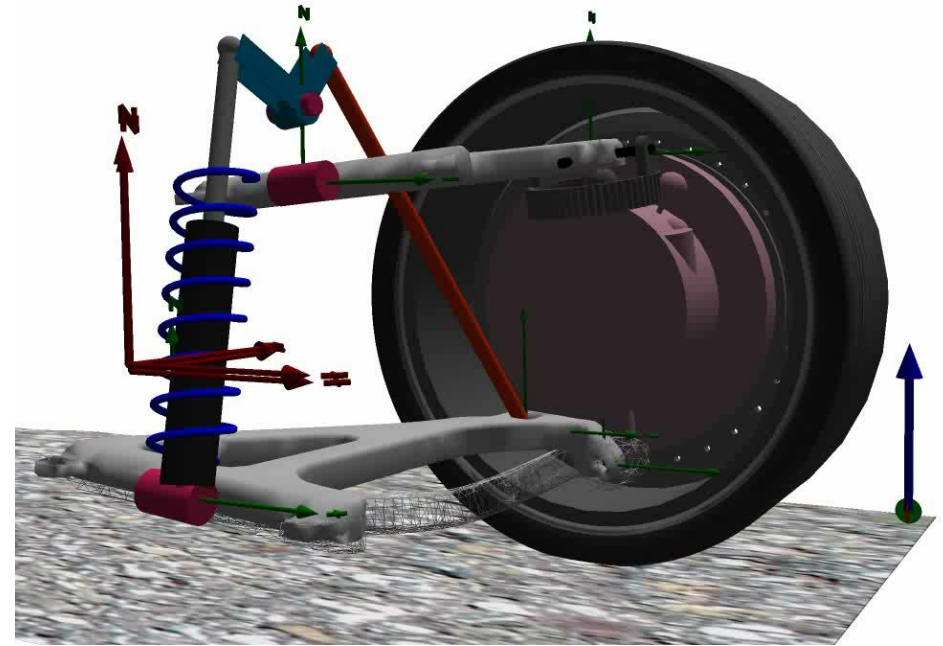
# PDE for Systems

New Project proposal

# Examples

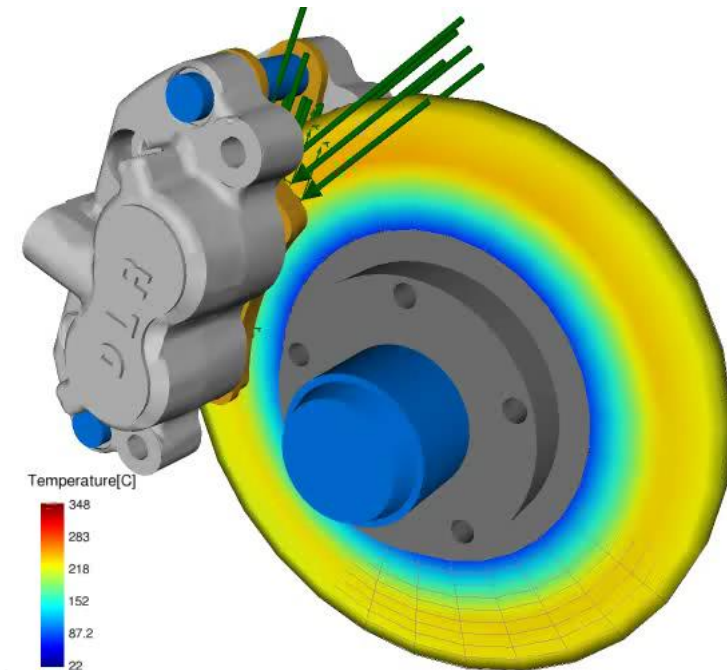
## ➤ Automotive suspension (mechanics)

- Monitor dynamic load accumulation of e.g. lower A-arm in operation
- Predict fatigue online with real life data in Electronic Control Unit (ECU)



## ➤ Brake (heat transfer domain)

- Estimate disc, pad and e.g. hydraulic fluid temperature online in ECU
- control cooperative operation with redundant actuators, e.g. electric drives, magnet track brake, ... accordingly (brake blending)



# Project Draft: PDE for Systems

## • Ideas

- Standardized format for the export / exchange of PDE models
  - Exploit FMI experiences and network
  - PDE -FMUs and/or parameterization of PDE's for co-simulation and/or model exchange
  - Option to introduce spatially distributed loads
  - Option to protect know-how by providing only DLL, no data
- Generic interface with respect to physical domain  
Mechanics, heat transfer, electro-magnetics, fluid-mechanics, Fluid-Structure-Int., ...
- Real time capability is an important aspect, but not mandatory in general
- Development driven by collection of use cases
- Consortium planned with industrial users, PDE tool vendors (FEM, FD, CFD, ..), system simulation tool vendors and University/research organizations
- Specification to be published under same open source license as FMI ([CC-BY-SA](#))