CESAMES
Centre d'Excellence Sur l'Architecture, le Management et l'Economie des Systèmes

PSA PEUGEOT CITROËN
Direction Technique et Industrielle

Involving AUTOSAR rules for mechatronic systems design

Use Case: Approach for an Electronic Stability Control System

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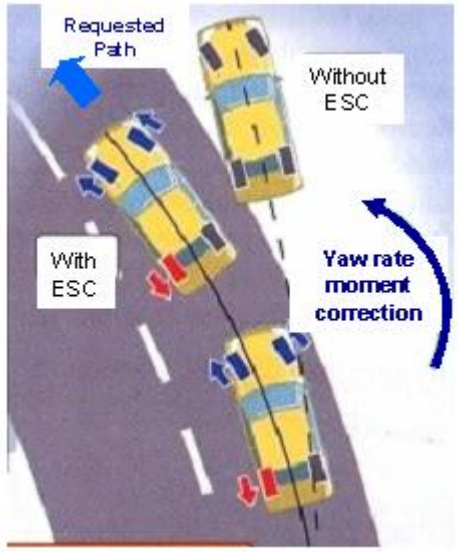
*ESC: Electronic Stability Control
*AUTOSAR: AUTomotive Open Software ARchitecture

Overview about Electronic Stability System

- The aim is to prevent under-steering or over-steering
  - yaw rate moment correction,
    e.g. control of hydraulic braking force individually on each wheel,
  - according deviation between :
    - path requested by the driver,
    - estimated current path of the car.

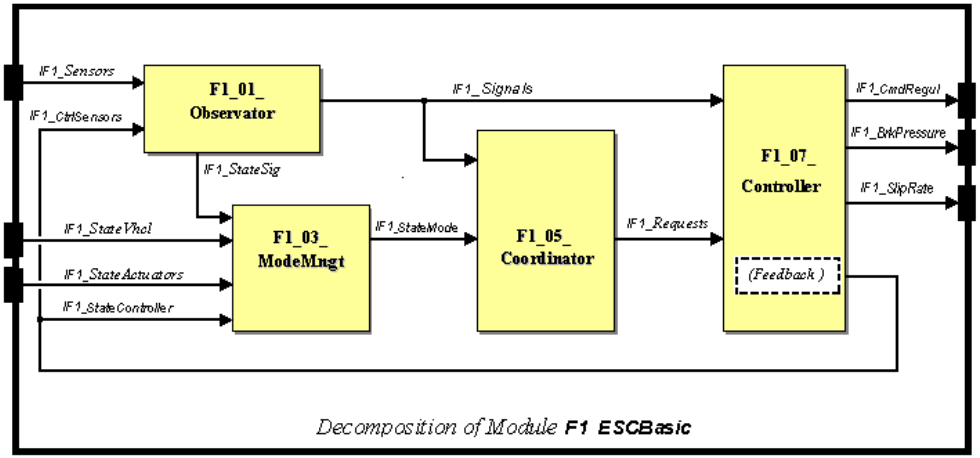


- The car is kept safe within physical limits.

Mode-Based Design approach

The application software is made of 4 sub-systems :

- Observator,
- Coordinator,
- Controller,
- Mode Management.

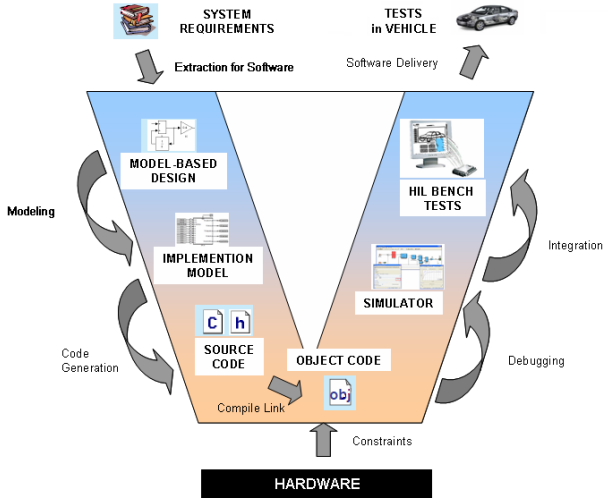


- Main interfaces are :
  - (In): inertial unit, wheel speed, steering wheel angle,
  - (Out): request of brake pressure on each wheel.

Current V-Cycle for developing Software

From model-based design

… to hardware in the loop tests



- Risks on co-design :
  - Misunderstanding about interfaces,
  - No static parameters, no timing features,
  - Coding deviation between partners' tools,
  - Need of an hardware platform for testing,
  - Duplicated scripts for separated validation.
- The software development plan is linked to partner's project and the hardware platform.

AUTOSAR : Short introductions

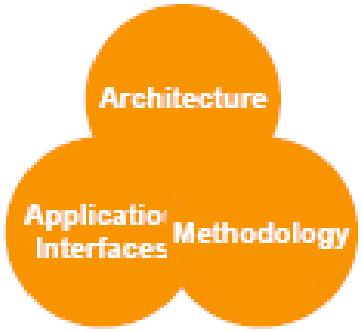
- A worldwide development partnership,

  Formally signed on in July, 2003

- Managing complexity by exchangeability and reuse

  of software components between :

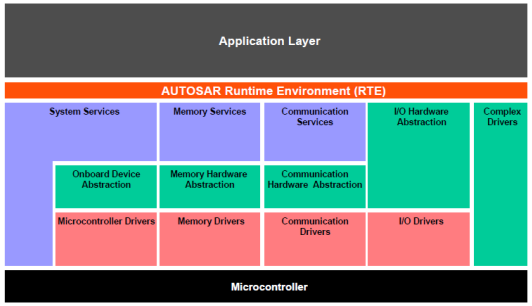
  - Manufacturer's applications,
  - Supplier's solutions,
  - Vehicle platform



- Main working topics on
  - Architecture for electronic control unit,
  - Methodology e.g. tools, exchange format and templates,
  - Application interfaces for typical applications.

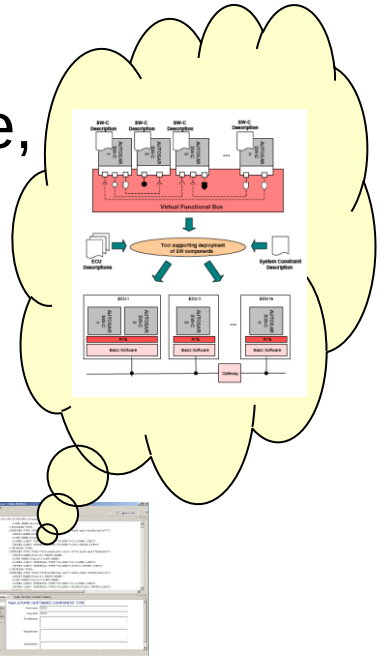
AUTOSAR : Architecture

- Layered Software Architecture :
  - Application Layer
  - Basic Software Modules
  - Real Time Environment –RTE-
- Real-Time Environment –RTE- :
  - Communication mechanisms,
  - Realization of standard Library function.
- Hardware and Application Software become widely independent from each other.



AUTOSAR : Methodology

- New kind of tool available on the market :
  AUTOSAR Authoring Tool -AAT-
  - from functional view to hardware topology one,
  - ‘xml’ exchange format between tools,
  - Templates for descriptions.
- Progressive compatibilities
  of conventional tools with AUTOSAR

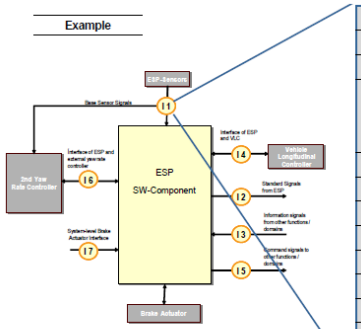


AUTOSAR : Application Interfaces

- This delivery is :
  - agreed between all the partners,
  - applicable for all typical automotive application

    Powertrain, Chassis or Body Domains, Passive Safety, HMI
- Each interface contains :
  - Port interface: producer, receivers,
  - Attributes:

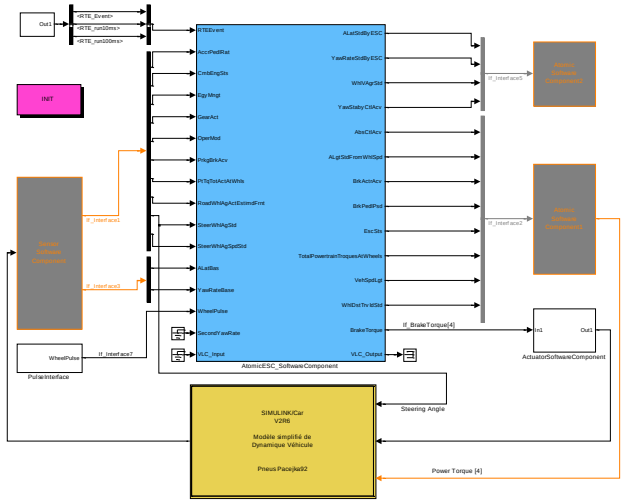
    core, conditional or optional,
  - Naming convention,
  - Description and remarks,
  - Data element field: type, resolution , physical limits,



Data Type Name	LongAccBase
…	
Data Type Name	**YawRateBase**
Description	Yaw rate measured along vehicle z- axis (i.e. compensated for orientation). Coordinate system according to ISO 8855
Data Type	S16
Integer Range	-32768..+32767
Physical Range	-2,8595..+2,8594
Physical Offset	0
Unit	rad/sec
…	….
Remarks	….
…	
Data Type Name	RollRateBase

Model-based Design with AUTOSAR rules

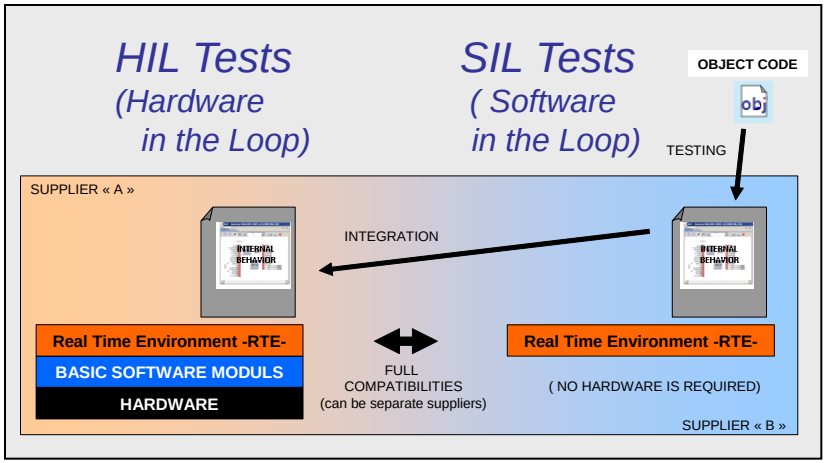
- Encapsulation of SW-Component,
  e.g. use of standardized description:
  - sender/receiver port interfaces
    with RAM Access via RTE routines
  - Real Time Events :
    Periodic, Triggered, Call Function



- Import of internal behaviours,
- Design shared by all partners of the project,
  by using a xml description readable by an AAT editor

Control check before integration

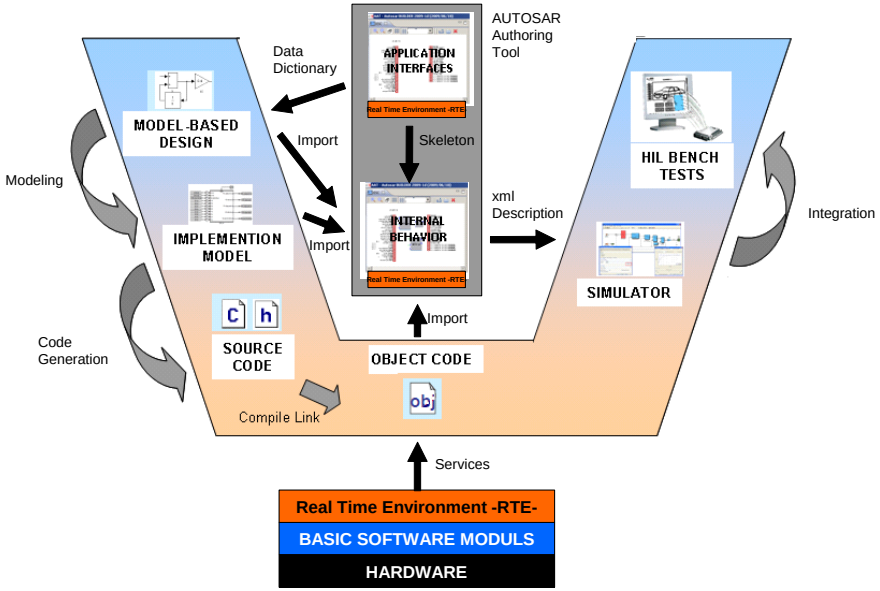
- Software in the loop tests with a RTE :
  - Static tests :
    - Right allocation of each section
    - Coherence of SW-component
  - Dynamic tests :
    - Scheduling of runnables
    - SW metrics



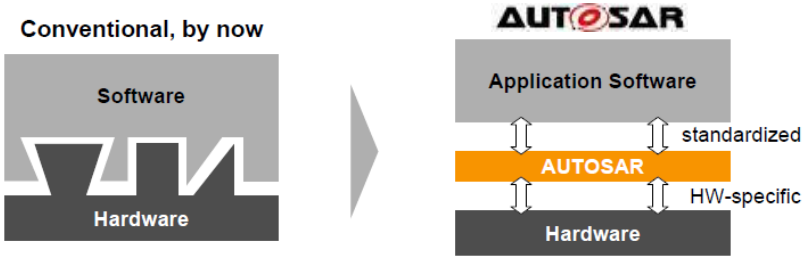
- RTE of all partners are fully compatible:
  - Compliance tests of basic software,
  - Tool's compatibilities

V-Cycle including AUTOSAR approach

- A skeleton is introduced early in the project
  - Ports interfaces including
    - Functional needs
    - RTE constraints
  - RTE Environment,
    - Abstraction of hardware layer
- Testing could be performed w/o hardware platform



Conclusions



- Software exchangeability has already started :
  - standardized and shared ‘like-skeleton’ models,
  - covering of all typical Automotive Applications.
- Usual tools become fully compatible
  - Exchanges through the xml description.
- AUTOSAR introduces :
  - a continuous but standardized software development plan,
  - shared by all main automotive partners.
- A model-based design guideline has to be established at project level between all partners.

Many thanks for your attention

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Some Links :

AUTOSAR www.autosar.org

The MathWorks www.mathworks.com/nn8/autosar

geensys www.geensys.com