DECOMSYS::SIMTOOLS

**V Model**

- Requirements
- Functional Model
- Application Code
- Test
- Validation
- Verification

DECOMSYS
V and A Model

- Requirements
- Functional Model
- Application Code
- Test
- Validation
- Verification

A Model

- Architecture-Allocated Functional Model (AAFM)
- Virtual Prototype (VP)
- Middleware Code

DECOMSYS::SIMSYSTEM
DECOMSYS::DESIGNER
DECOMSYS::GENERATOR, DECOMSYS::OILEXPORTER
DECOMSYS::SIMTARGET
DECOMSYS::NODE
AAFM Simulation

Functional Application Task Simulation in Simulink/Stateflow

Time-Triggered Operating System Simulation
Simple FT-Com Simulation

Generic Communication without Time Delays

AM

Configuration Simulation Code Generation

FlexRay

Pedal ECU

Control ECU

Wheel ECU

0 100 200 300 400 500 600 700 800 900 1000us
Virtual Prototype

- FlexRay
- Pedal ECU
- Control ECU
- Wheel ECU

0       100     200     300     400     500      600     700    800     900    1000us

VP Simulation

- Functional Application Task Simulation in Simulink/Stateflow
- Time-Triggered Operating System Simulation
- FT-Com Simulation

- FlexRay TDMA+Schedule
- FTCOM Configuration
SIMSYSTEM Building Blocks

- **Cluster**: connection to XCDEF file
- **Signal Connectors**: signal transmission
- **Tasks**: time-triggered functional model
- **Hosts**: hosting Microprocessors

AAFM Example
Communication Fault Injection

Functional Application Task Simulation in Simulink/Stateflow

Time-Triggered Operating System Simulation

FT-Com Simulation

Simulation-Based Communication Fault Injection

How the application reacts on communication faults?

- Simulation based fault injection
  - Spontaneous injection of communication faults during simulation
    - Uses Graphical User Interfaces
  - Fault scenario modelling in Matlab/Simulink
    - Modelling interfaces to FlexRay simulation core
Source Code Generation

Rational
- Application code generation for each Host
- Task bodies generated from SIMSYSTEM Task blocks
- Interfacing with FTCom source code and OIL task calls
- Supporting Rapid Prototyping and HIL
- Supporting prediction code generation
- Upload of binary to target hardware
- Start and stop the application on target hardware

Source Code Generation

Supported code generators
- Real-Time Workshop
  - SIMTARGET<...,Linux>
    - DECOMSYS Prototyping Platform with Linux based OS
    - Customer specific platforms
    - dSPACE RTI FlexRay Blockset Integration
- Real-Time Workshop Embedded Coder
  - SIMTARGET<...,TimeCore>
    - Compatible with TimeCore production software
- Target Link
  - SIMTARGET planned on customer request
Source Code Generation Example

**Architectural Model (AM)**

DESIGNER Generator OILEXPORTER

Virtual Prototype (VP)

**TimeCore**

Architectural Model (AM)

DESIGNER Generator OILEXPORTER

Virtual Prototype (VP)

**Customer ECU Hardware**

Source Code Generation Example

**FlexRay Restbus-Simulation**

Physical Process

ECU

TT-Os

I/O CAN CAN I/O CAN

FTCom

FlexRay

Task1

Task2

Supplier 1

Supplier 2

Supplier 3

Supplier 4
MB FlexRay Development

Summary

- Designing multi ECU models
- Critical role of communication subsystem
- Virtual prototyping including communication
- Model based fault injection and simulation
- Cost efficient prototypes
- Early identification of erroneous distributed system behaviour
- Communication system evaluation and training
- Code generation interfaces
- Easy configuration of rest system simulation

Thank you for your attention!

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