System Architecture Design Environment for Highly Complicated Mission-Critical Systems

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System Architecture Design
Environment for Highly Complicated Mission-Critical Systems

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Issues to Develop Mission-Critical Systems

Market Requirement

- More and more functionality & Higher Reliability to meet consumer’s expectations
- Releasing products early to respond market

Difficulties of development

- Need to verify complicated and large size of system
  - Software verification
    - Actual HW is not ready (under development)
  - Shorten development time

It is getting difficult to keep high reliability.
How to develop mission-critical systems we can rely on?
For Example, Automotive ...

Power Train Control
- Gasoline Engines
- Diesel Engines
- Hybrid Engines
- Transmissions
- ...

Body Control
- Lights
- Door open/close
- Power windows
- Wipers
- Air conditioners
- Audio systems
- Dashboards
- Air bag systems
- ...

Safety Control
- Anti-lock brake systems
- Brake assist systems
- ...

Multi-media
- Car navigation systems
- Lane Keeping Assist Systems
- Parking Support Systems
- Pre-crash safety systems
- Forward distance warning Systems
- ...

40-100 ECUs (Electric Control Units) are in one car
Model-Based Development (MBD) for ECU Design

Tools, and availability of the models and data is crucial to adopt MBD for ECU development in the automotive related companies.
It Is NOT Easy to Improve the Availability of Models for MBD

Models for ECU design have a 3D space of
- Abstraction Level
- Tools
- Target Devices

There are many variations of models required for ECU design, and development of models takes time and cost.

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(1) MILS : Model In the Loop Simulation
SILS : Software In the loop Simulation
PILS : Processor In the Loop Simulation
HILS : Hardware In the Loop Simulation
“A Whole Vehicle (in Virtual)” in the wCloud

Whole vehicle simulation (verification)

- Car makers
  - Supply ECU/Parts models
  - Verification

- ECU makers
  - Supply microcontroller models
  - Verification

- Parts makers
  - Supply ECU/Parts models
  - Verification

- Semiconductor makers
  - Supply microcontroller models
  - Verification

- Semiconductor makers
  - Supply ECU/Parts models
  - Verification
What is wCloud?

wCloud (workshop cloud):
Aiming to achieve efficient, low cost, shorter development and transfer of knowledge of design/manufacturing by creating a workshop for design/manufacturing technologies in the cloud including following features.

- **Cloud’s IaaS (Infrastructure as a Service) function**: Achieving decrease of TCO (Total Cost of Ownership) and shorter TAT (Turn around time). Developers use necessary resources only when they are required (without owning them).

- **TaaS (Tool as a Service) function**: Achieving decrease of TCO and shorter TAT. Developers use necessary CAD/CAE tools only when they are required (without owning them).

- **Repository function**: Achieving efficient development, decrease of TCO, and shorter TAT. Store design data (models) and Input/output data those are required by CAD/CAE tool execution. And developers share the data.

- **Marketplace function**: Achieving efficient development by easily access for necessary tool/model/data. By improve availability of tool/model/data which is attained by promoting developers of tool/model/data to provide them.

- **wCloud works with SNS (Social Network Service) function**: Achieving transfer knowledge of design/manufacturing by promoting communication inside communities for each application/tool/model.
“A Whole Vehicle (in Virtual) in the wCloud

Whole vehicle simulation (verification)

Tool Repository

Model Repository

Data Repository

- Supply ECU/Parts models
- Verification

- Supply microcontroller models
- Verification

Car makers

ECU makers

Parts makers

Semiconductor makers

Semiconductor makers
"A Whole Vehicle (in Virtual)" in the wCloud

Whole vehicle simulation (verification)

Car makers

Semiconductor makers

ECU makers

Parts makers

Models
- Microcontrollers, Sensor/accumulators, plant models

Model repository management
- User authorization, access control
- Data repository, version control

Tools
- OSS Tools
- Commercial Tools

Tool repository management
- SW package management tools

TaaS(*2)

IaaS(*1) service

Data
- Simulation input data and output data

Data repository management
- User authorization, access control
- Data repository

Supply ECU/Parts models
- Verification

Supply microcontroller models
- Verification

(*1): IaaS: Infrastructure As A Service
(*2): TaaS: Tool As A Service
Tool Federation

System Model

Controller Model

Sensor/Actuator and Plant Model

Mechanical Model

Software Control Model

ASIC Model

Mechanical Model

Actuator/Sensor Model

Target

Processor

H/W

Mechanical parts

Simulator

Transactional simulator

Circuit simulator

Physical simulator

System model simulation may consist of different kinds of simulator
Tool Federation
- Example: Power Window System (demo) -

Plant model (and H/W)
- H/W
- Motor, Mechanical Parts

Matlab/Simulink

Controller model
- Microcontroller (V850 (Renesas electronics)) runs object code.

Tools are interfaced at the microcontroller’s pin.

Demo is sped up by 30 times from the actual simulation speed.
The website was opened by ISIT in September 2012.

The workshopcloud is in trial phase (available for internal users only).

Working on to open to the public in 2013.

- **Workshops**
  - **Repositories**
    - Tool repository
    - Model repository
    - Data repository
  - **Application Templates**
    - Automotive
    - HPC
A Flow to Use Tools/Models/Data in the wCloud

Step 0: Authentication

IDE (Eclipse+wCloud plugin)

IDE (*2)

Tool repository (Installed on VM (*1))

Tool 1 (ngspice)
Tool 2 (HSpice)
Tool 3 (OpenModelica)
Tool 4 (Matlab/Simulink)
Tool n

Tool 1
Tool 2
Tool 3
Tool 4
Tool n

Model repository (Repository management)

Model 1
Model 2
Model 3
Model 4
Model n

Model 1
Model 2
Model 3
Model 4
Model n

Data repository (Database management)

Data 1
Data 2
Data 3
Data 4
Data n

Input user design

Execution control
• Start/cancel/stop

Step 3: setup input

Step 2: setup tool

Setup tool's execution environment

Step 4: execute tool

• Manage VM resource
• Collect information of amount used of IaaS, tool, model, data

Step 5: get result

• Refer execution result
• Refer amount fee

Web browser

*1: VM: Virtual Machine
*2: IDE: Integrated Development Environment
### Tools for the wCloud

- Tools from OSS (Open Source Software) and tools from academia.

<table>
<thead>
<tr>
<th>Category</th>
<th>Tool</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modelica Simulators</strong></td>
<td>OpenModelica</td>
<td>Modelica simulators. (Modelica is a language to model physical systems)</td>
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<tr>
<td></td>
<td>Jmodelica</td>
<td></td>
</tr>
<tr>
<td><strong>SystemC simulators</strong></td>
<td>OSCI SystemC</td>
<td>A transaction level simulator.</td>
</tr>
<tr>
<td><strong>Architecture Simulators</strong></td>
<td>Redefis</td>
<td>C Compiler, Simulator, debugger, and profiler for dynamic reconfigurable processors developed by ISIT.</td>
</tr>
<tr>
<td></td>
<td>SFQ-LSRDP</td>
<td>A simulator for Large scale reconfigurable datapath processors developed by Kyushu univ.</td>
</tr>
<tr>
<td><strong>Compilers</strong></td>
<td>(TBA)</td>
<td></td>
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<tr>
<td><strong>EDA tools</strong></td>
<td>ngspice</td>
<td>A circuit level simulator.</td>
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<td></td>
<td>3D EDA tool</td>
<td>A Place &amp; Routing tool for 3D IC developed by Honda research and Kyushu univ.</td>
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<tr>
<td><strong>Analysis tools</strong></td>
<td>R</td>
<td>A statistical analysis tool.</td>
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wCloud Enables Virtual Design Environment for Highly Complicated Mission Critical Systems