Accelerating GTM Software Development Integration and Test using Virtual Hardware ECUs

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Agenda

- Virtual Hardware ECU introduction

- Increasing GTM software development efficiency

- Comprehensive solution for GTM based software development and test
Virtual Hardware ECU introduction
What is a Virtual Prototype?

Fast model of a microcontroller (MCU) or system-on-chip (SoC) that can execute an unmodified binary executable.

Example NXP MPC5777M
Start HW/SW Development Early
Better than Hardware – available earlier, easier to use for debug!

Experience from Automotive Semi and Tier1/OEM SW Teams

• Pre-silicon Dual OS (AUTOSAR & Linux) + Hypervisor bring up.
• Complex driver and communication
  – GTM, CAN, Ethernet communication, vision accelerators/sub-systems, …
• Algorithm flow from Matlab/Simulink to embedded software

SW development 9-12 months earlier

• Faster Debug
• Non Intrusive
• Deterministic
• HW/SW Correlation
• OS aware
What is a Virtual Hardware ECU?

Fast model of the ECU Hardware with the benefits of virtual prototypes

Debug, Analyze & Test

Software

ECU Hardware

Infotainment ECU

ADAS ECU

Powertrain ECU

ASIC
Hardware-in-the-Loop

Project Timeline

**MIL**
- Plant Model
- Control Model

**SIL**
- Plant Model
- Control Model
- Control SW

**HIL**
- Plant Model
- Control SW

**HIL Limitations:**
- Access due to limited number of HIL systems (cost and access)
- Limited visibility and controllability
- Hard to deploy in regression
- Complex to set up, share, maintain and archive

**EFFORT & TIME GAP**

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Virtual Hardware-in-the-Loop
Start Before Test Benches are Available

Project Timeline

Automotive tool ecosystem support includes Matlab/Simulink, SABER, Vector CANoe, ...
SW Development Early & Increased Testing Throughput

From Virtual SoCs to Virtual Hardware ECU(s) with Virtualizer and Automotive VDKs

Start early & accelerate development

- When SoC evaluation boards or ECU HW boards are not available
- 12-18 months earlier
- Easier and more efficient debug

Start earlier, test faster and better

- Frontload test development
- System SW testing
- Fault & coverage testing
- Regression

Early Software Development

Debug, Analysis and Test Tools

Software

Virtual HW ECU

Plant Model & Analog

Developers & Test Teams

Increase Testing Throughput

HW Availability
Significantly Increase Test Throughput

Test More and Faster – Higher Software Quality Earlier, at Every Development Milestone

Using HIL

Using vHIL

Further Acceleration through Parallelization

80% reduction
Application Example to vFMEA

Actual Results

- Increased test coverage 200 to 900 tests
- Testing effort reduced from 3 man/months to 2 man weeks
- Reusable, safer and distributed access
- Faster analysis of result and change iteration
Increasing GTM software development efficiency
Challenges

• Understanding and debugging GTM software efficiently

• Getting the right visibility into GTM itself for debug, analysis and coverage

• Getting visibility in the context of other processor core and debuggers

• Stimulating the GTM – stimulus, fault injection and associated analysis

MCU Virtual Prototypes and Virtual Hardware ECUs accelerate and simplify GTM based development!
Integrated and Comprehensive GTM Debug, Tracing and Analysis

• Visibility
  – MCS Function Tracing
  – MCS Instruction Tracing
  – MCS core register and GTM config register tracing
  – MCS Memory access tracing

• Integrated and comprehensive
  – Integrated GTM “internals” tracing in unified console.
  – Viewing and Debugging in context of mainline MCU SW execution.
  – Interactive and offline
Synchronized Debugging

3rd Party Software Debuggers

GTM advanced visibility

Multi-MCS Channel Debugging

Memory Views

GTM Config Register Interactivity

Multi-MCS Core Register View

Dissassembly View

Virtualizer Simulation Scripting

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GTM MCS Code Coverage

- Non-Intrusive Code Coverage for high level language MCS software
- No code modifications needed in MCS code
- Industry standard LCOV Reports
- Per or multi MCS channel coverage reports
Testing and Understanding GTM System Impact

*scripting framework for fault injection, signal stimulus and analysis.*

- Scriptable waveform generation for repeatable stimulus scenarios.
- Inject faults into input stimulus or output signals to establish system impact.
- Custom analysis or debugging to investigate
  - Verify data processing
  - Investigate race conditions
  - Playback of “field” issues through the GTM Reference model in MCU VDK.
Comprehensive solution for GTM based software development and test
The most comprehensive Virtual Hardware ECU Solution
Synopsys Solution from Modeling to Test Bench Deployment

- CoE VDKs
- Semi VDKs
- IP Models

- VDKs
  - Scripting
  - HW/SW Debug and Analysis
  - Virtual Prototype
  - Co-Simulation & External Connectivity

- Developers & Test Teams

- Development Deployment

- Methodology & services

- Virtualizer
  - VDK Extension

- Virtual Hardware ECU Test Bench

- Debug, Analysis and Test Tools
- Software
- Virtual HW ECU
- Plant Model & Analog

Virtual Hardware ECU

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Integrated Environment to Efficiently Develop and Test GTM Software

Synopsys VDK analysis/Debug

Virtual Prototypes from
- Infineon
- NXP
- Renesas

Synopsys MCLI Virtual Prototypes

Reference Model

Automotive Electronics

Product Information

Generic Timer Module (GTM) IP

Synopsys VDK synchronized multicore debugging for MCS cores

Execute unmodified GTM binary code on the reference Model

Synopsys VDK analysis/Debug

Synopsys VDK simulation probes

Synopsys VDK unified model debug tracing

Virtual Prototypes from
- Infineon
- NXP
- Renesas

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Synopsys VDK unified model debug tracing
Summary

• New approaches are needed to start development earlier and increase testing throughput for GTM based designs

• Virtual prototypes and Virtual Hardware ECUs deliver key benefits – earlier availability and faster testing throughput

• Synopsys has the most comprehensive solution in the market specifically tailored for GTM development
  – Tools enhancing GTM debug visibility and control
  – Full MCU models from companies such as NXP, Infineon and Renesas
  – Proven deployment for more than 10 years
  – Financially stable, long term vision and recognized industry leader