Rapid Prototyping With EHOOKS
Rapid Prototyping With EHOOKS
Referent Information

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ETAS Automotive India Private Limited (Bangalore)

Technical Sales and Marketing
   Software Engineering

Education and Professional Experience
   MS Software Systems (BITS Pilani)
   BE Electronics and Communication (VTU)
   Software and System Developer, RBEI
Too Many Ideas, Too Little Time?

EHOOKS changes the rules
Rapid Prototyping With EHOOKS

Agenda

− What is EHOOKS?
− How does EHOOKS Work?
− What does EHOOKS Do?
− Summary
Increase speed and reduce cost of development:

EHOOKS gives you the ability to implement ECU software changes directly in the HEX & A2L files, independent from the ECU software development team.
Rapid Prototyping With EHOOKS
The Problem

Problems due to turnaround time, cost, development disruption, etc...

ECU Supplier
Software Development

OEM
Function Development

Customer Team

Function Development

Software Development

Standard Software
A2L
Hex

Modified Software
Hex'
A2L'

Modified Software
Hex'
A2L'

By means of
“Freischnitt”

Request Modification

Functions due to
turnaround time, cost, development disruption, etc...
Rapid Prototyping With EHOOKS
The EHOOKS Solution

**ECU Supplier**
Software Development

- EH Ready
- Standard
- Software
  - A2L
  - Hex

**OEM**
Function Development

**Immediate Modification by OEM**

- EHOOKS
- Modified
- Software
- Hex'
- A2L'

**OEM**
Software Development

- Modified
- Software
- Hex'
- A2L'

- Request
- Modification
- "Freischaltung"
- Immediate
- Modification
- by OEM
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Systems View

ECU Software Provider

- EHOOKS-PREP
  - A2L
  - Hex
  - EHOOKS ECU Software Delivery

EHHOOKS Hook Installer

- EHOOKS-DEV
  - A2L
  - Hex
  - A2L'
  - Hex'

- Hooks Needed

- .c Files

Instantly modify SW

Work with modified SW

- INCA
- ASCET
- INTECRIO

EHHOOKS Hook User
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Inserting the HOOKS: Overview

EHOOKS-DEV

- Locates writes to variables for hooking and functions for bypass
- Patches ECU software image with hook code and hook control characteristics
- Compiles and builds new ECU software
- Updates A2L file with information on hook control characteristics
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Inserting the HOOKS: Details

- **EHOOKS**
  - Hook Code 1
  - Hook Code 2
  - Hook Code 3
  - Hook Code 4

- **Code**
  - jmp Hook Code 1
  - jmp Hook Code 2
  - jmp Hook Code 3
  - jmp Hook Code 4

- **Hooked Hex File**

- **EHOOKS-DEV Embedded Tools**
  - Patch.asm
  - Hook.c
  - A2L (Fragment)

- **HighTec/GNU Tool Chain**

- **EHOOKS-DEV Merge Tools**
  - Hex File (Fragment)
  - Hooked A2L File
  - Hooked Hex File
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Hook Types

- ECU Value
- Value Used
- Hook Enable
- Bypass Value
- RP SW
- .c files

EHOOKS
- Stand-alone UI for hook configuration and SW build:

- Additional Simulink and ASCET integrations for on-target bypass
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EHOOKS Simulink Integration

- **Simulink Blockset provides:**
  - Simulink® driven configuration of EHOOKS
  - EHOOKS ECU read and write blocks allows Simulink® model to bypass ECU data
  - EHOOKS ECU trigger block controls execution of model code

- **Simulink System Target supports:**
  - Automated generation of “glue-code” connects Simulink®/RTW generated code to ECU infrastructure
  - Automated data-type conversion, logical ↔ physical
  - Automatic build integration with EHOOKS within Simulink®
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EHOOKS ASCET Integration

‘EHOOKS target’ provides seamless integration of EHOOKs into ASCET

• Map model elements to hooks
• Map ASCET processes to ECU tasks
• One-click build from ASCET

No change to the ASCET model
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Use-Case: Improved Calibration Efficiency

- **Problem:**
  - Sometimes input software values are unstable/noisy
  - Makes the job of calibration complicated / more time-consuming

- **Solution:**
  - Calibration engineer needs to stabilize input value to obtain a valid initial calibration
  - Use EHOOKS to bypass noisy signal with a constant or calibration hook
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Use-Case: Software testing

- **Problem:**
  - Software testing within the ECU; can be time-consuming to set up software input values via the external ECU interfaces

- **Solution:**
  - Use EHOOKS to bypass input values with a calibration hook to directly stimulate software with known test values

![Diagram showing ES590/ES591 and A2L']
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Use Case: Testing Safety-critical ECU software

Verifying ECU software according to ISO 26262 requires testing in a **target environment** whilst ensuring a high level of **controllability** and **observability** in the software.

**Testing safety-critical ECU software with EHOOKS**

- Testing is performed on the target ECU hardware using production software, access to the ECU is achieved using an ETAS ETK interface.
- Variables and functions can be directly manipulated allowing the targeted testing of critical functionality.
- Fault injection testing can be efficiently performed by simulating incorrect sensor data.
- Seamless integration into the INCA environment to allow for efficient control and observation.

**Important Note:** EHOOKS is not ISO26262 certified.
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Use-Case: On-target Bypass Rapid Prototyping

- **Problem:**
  - On-target prototyping enables efficient development and testing of new control functions in a realistic environment, but......
  - Obtaining supporting bypass hook infrastructure can cause development delay/distribution and add significant cost

- **Solution:**
  - Use EHOOKS to insert necessary internal bypass hooks and run prototype software directly on the ECU
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Use-Case: External Bypass Rapid Prototyping

Problem:
- Obtaining supporting bypass hook infrastructure can cause development delay/distribution and add significant cost

Solution:
- Use EHOOKS to directly insert external bypass hooks into ECU software
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Supported Use cases

- EHOOKS is a versatile tool that supports use cases throughout the ECU software development cycle:
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Summary

It takes just seconds to create the modified ECU software compared to waiting weeks or months for the ECU software supplier to supply changes.

Support for a wide range of hook types providing a flexible and scalable solution. Applicable to calibration, software testing, software development, and function development.

Reduced Costs
- Reduce downtime, cut required number of ECU software deliveries and get software ready for production faster.

Improved Efficiency
- Advanced hook insertion technology (Developed & sold with tier1 support) provides accurate and reliable results.

Improved Reliability
- EHOOKS is tightly integrated with ETAS market leading INCA and ETK tools.

Increased Flexibility
- Ability to increase frequency of testing/calibration enables higher quality production ECU SW.

Higher Quality
- Improved Efficiency
- Increased Flexibility
- Improved Reliability
- Reduced Costs
- System Integration

Benefits
‘At PSA, required software modifications are implemented (with EHOOKS) within the space of several hours....the previous procedure involving the ECU manufacturer took, in the best case, several days. The results are cost savings, time savings, and improved levels of quality due to extensive and early testing’

Eiji Hashigami – Honda R&D Automotive Centre

‘We have been able to shorten the time formerly required for source-code modifications by the ECU supplier for an ECU development project from several months to as little as a few days by adopting EHOOKS’
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Supported ECU platforms

- **Bosch:**
  - MEDC17
  - MDG1 PPC (MC)*
  - MDG1 AURIX (MC)**

- **Continental:**
  - CTCEMS
  - ESYS
  - AURIX (MC)

- **Delphi:**
  - ETC3 (HDD)*
  - DCM6**

- **Denso:** SH2, PPC**

- **Melco:** SH2

- **GM:** PPC (Classic & VLE)

- **Chrysler:** PPC**

- **ETAS:** FlexECU

- **Others:** AVL, MTU

*Beta release available
**Planned for 2014
(MC) - Multicore
……any Questions?