Application of DDS on modular Hardware-in-the-loop test benches at Audi

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Topics

► Rapidly increasing Requirements for Testing

► Overview Hardware-in-the-loop-Testing

► Next generation modular HIL test benches
  ► Goals
  ► Challenges
  ► Ideas

► Why DDS?

► Application at Audi: Theory meets practice
Topics

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Rapidly increasing Requirements for Testing

Functions

Complexity

Quality

Integration and Test

Efficiency

Changing Requirements for Testing

Example: Audi connect Challenges

- Integration of Smartphones with different platforms
- IT-Backend
- Integration of external partners
- Integration of Call-Centers
- Development of End2End services
- Establishing of new processes along the event chain

During the last century, cars were completely interconnected internally. In this century cars will be seamlessly interconnected with the Internet, the owner, the infrastructure and other vehicles.

Source:
Ricky Hudi: “Trends und zukünftige Herausforderungen der E/E-Entwicklung”
18. Internationalen Fachkongress "Fortschritte in der Automobil-Elektronik"

Topics

► Challenges of vehicle development

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► Conclusion
Overview Hardware-in-the-Loop

System under Test

Simulation computer

Simulation of Sensors

Model

Measuring of reactions
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Overview and History

**Stage 1:** Separation of
- Computation nodes and
- ECUs

**Stage 2:**
- Modular Simulink models

**Stage 3:** Bus-based test benches
- Multiple suppliers
- Abstraction for users
Goal
Modularization and bus based test benches

Audi started the project: modular HIL next generation
Basic ideas of the mHIL NG project

► Best-in-Class approach

► Modular and scalable platform

► Standardized bus system and middleware

► Logical abstraction of test stand
Main challenges of modularization

- **Diversity**
- **Complexity**
- **User Interaction**
- **Scalability**
- **Abstraction and flexibility**
Logical architecture

HIL-Operation
- Manager
- Control Station
- Tester
  - Experimental Software
  - Testautomation
- Tablet
- Smartphone

HIL-Interface
- Test bench manager

HIL-Modules
- Sensors
- Vendor A
  - Data logger
- Vendor B
  - ECU
- Vendor C
  - ECU
- Central Analysis Service

VU-Modules
- Sensor Simulation
- Driver Simulation
- Traffic Simulation
- Road Simulation
Physical architecture
Test Bench Manager (PSM)

HIL-Bus

Module Application

Glue-Code

PSM

DDS
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Why Audi has chosen RTI DDS?

► Key requirements for Audi HIL-Bus middleware technology
  ► Open standard
  ► Real-time capable
  ► Scalable
  ► Field proven to be reliable

► Why RTI DDS?
  ► Based on OMG DDS standard
  ► Real-time capable and data-centric
  ► Compatible with standard Ethernet hardware and protocols
  ► Highly decoupled modular development capabilities
  ► Plug and play capable
  ► Established in aerospace and military
  ► Open license model
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Application at Audi: Theory meets practice
Demonstrator

Vehicle Simulation

Test Automation

Experimental Software

TopView-Simulation

Sim.-Framework

Sim.-Framework

Sim.-Framework

Sim.-Framework

HIL-Bus

HIL-Bus

HIL-Bus

HIL-Bus

HIL-Bus (Ethernet)

Web-Server

Environment Simulation Control

C2X-Simulation

Traffic Simulation

Experimental Software

HIL-Bus

HIL-Bus

HIL-Bus

HIL-Bus

HIL-Bus
Integration of DDS-Interface

HIL-Bus

HIL-Module

Distributed abstraction layer (testbench manager) including HIL-Bus Interface

Glue Code

Proprietary Software
Thank you for your attention.