Bitte decken Sie die schraffierte Fläche mit einem Bild ab.

Testing Automotive Ethernet Systems – The AUTOSAR way

2014 Ethernet & IP @ Automotive Technology Day, Detroit, Oct 2014

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Motivation

Iterative integration of ECUs into complete system at OEM

• Component-Testing
• Conformance Testing

• Integration Testing
• Acceptance Testing
• Toolchain Verification

• (RB)-Simulation
• Functional Testing
• (Network)-Timing Analysis
• System validation

• End of Line Testing

Iterative integration process to verify configuration process (toolchains) and to assure consistency of designed system and network but:

› All ECUs have to be available with valid configuration and correct implementation of BSW + RTE

› Costly redesign of system/network at a late phase of the development process in case of inconsistencies

Test System which is configurable according to AUTOSAR system configurations and capable to simulate virtual ECUs according to their (Ethernet) Bus behavior is needed
Outline

- AUTOSAR Methodology
- Acceptance Testing
- ECU Validation with Restbus-Simulation
- System Validation and Rapid Prototyping
AUTOSAR Methodology:
Configuration process of ECUs

1. Description of Application SW Components
2. Integration of SWC into Virtual Functional Bus
3. Extract Ecu Information
4. Mapping of ASW Components on ECUs
5. Configuration of Basic Software per ECU
6. Generation of Run Time Environment (RTE) per ECU
7. Integration of ECUs into System
 › Long “feedback loop” if inconsistencies exist in the System Configuration!

 › Errors in Toolchain have to be considered as well

   ▪ Multiple steps have to be performed with different responsibilities (OEM, Tier1, Tier2) and separate Toolchains until functional validation on target platform is possible
Acceptance Testing:

Verification of BSW and RTE functionality

› Goal: Verification of AUTOSAR functionality visible on Application / Bus level

› Approach:
  › Use AUTOSAR Methodology for configuration of SUT
  › Design of basic communication sequences on application level

› Available for following areas:
  › Communication (Can, LIN, FlexRay)
  › Diagnostics
  › Memory Stack
  › Mode Management
  › RTE

› Current Limitations:
  › Coverage
  › Test of Tooling out of scope (partly addressed by application of methodology for configuration of SUT)
Acceptance Testing:
General Approach for Ethernet

› Design of basic Ethernet communication Sequences between Lower- and UpperTester SWC

› Input:
  - SWC descriptions modeling functionality
  - AUTOSAR System Description (EcuExtract) modeling communication

› Environment:
  - ECU Generation Tooling
  - Test System (e.g. PC based)
  - Test System Generation Tooling

› Benefits:
  - Testing ECU behavior on Application level (incl. RTE)
  - includes Generation Tooling
Acceptance Testing:
Service-oriented communication

- CAN (Broadcast): Information always available by cyclic transmission

- Ethernet (Point to Point): Information provided when explicitly requested - Client/Server or Publish/Subscribe
Acceptance Testing:
Test System configuration process

Test System initiates and evaluates “Test Sequences”

Example Sequences:
1. Basic SOME/IP - Sequences
2. Sending E2E protected signals over Ethernet & IP
ECU Validation with Restbus-Simulation:

Testing with Restbus-Simulation

› Allows functional testing of integrated SWCs on ECUs independent of other ECUs in the system

› Simulation of either all communication partners (Restbus) for specific DUT or communication behavior of 1 selected ECU

› Use AUTOSAR methodology for configuration of simulated ECU(s)
ECU Validation with Restbus-Simulation:

Test System configuration process

› Configuration of ECU and integration of SWC according to AUTOSAR methodology

› Test System (Restbus-Simulation) configured based on AUTOSAR system configuration

› Test System needs to support Automotive middleware communication
System Validation and Rapid Prototyping:
Simulation of Ethernet networks

› Virtual integration of all simulated ECUs for consistency checks on exchange formats (e.g. EcuExtract)
› Faster System Validation at design phase of the system

› Use AUTOSAR methodology for configuration of all simulated ECUs of the designed network
System Validation and Rapid Prototyping:
Rapid prototyping of Ethernet networks

- Can be used as exploration platform to obtain information on:
  - Expected load scenarios on Ethernet links for different network topologies
  - Network timing behavior
Summary

AUTOSAR defines methodology for Application development from system design to final generation of executables for ECUs applying a set of toolbased configuration and generation steps.

Toolchain and configuration process needs to be considered for Test and Validation of AUTOSAR systems from early development phases on.

For Ethernet systems where service oriented communciation paradigm implies bidirectional communication between Data Consumer and Provider all communication partners of the designed system have to be present for test and validation purposes.

Simulation of missing communication partners in early development phases resolves dependencies to availability of final target platforms.

Test System which is configurable by AUTOSAR system configurations simulating virtual ECUs according to their (Ethernet) Bus behavior is needed and can be applied for:

- Acceptance Testing on AUTOSAR BSW and RTE features
- ECU Validation with Restbus-Simulation
- System Validation and Rapid Prototyping of AUTOSAR Ethernet systems