Experience Report: Developing Off-Highway and Commercial Vehicles ECUs with AUTOSAR

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Overview

- AUTOSAR Support for Commercial Vehicle Industry - The First Steps
- Commercial Vehicle ECU Development with AUTOSAR - Experiences
- Vector’s Engagement
- Suggestions for AUTOSAR Group
AUTOSAR Support for Commercial Vehicle Industry - The First Steps

- **Commercial Vehicle Industry:**

  - OEMs and suppliers who are members of, but not limited to, SAE J1939, Association of Equipment Manufacturers (AEM), AEF and others

    - Commercial Trucks (light, medium, and heavy duty)
    - Bus
    - Trailers
    - Agriculture Machines and Equipment
    - Forestry Machines and Equipment
    - Construction Machines and Equipment
AUTOSAR Support for Commercial Vehicle Industry - The First Steps

- AUTOSAR 3.x
  - No support for J1939 protocol in AUTOSAR

- First step:
  - AUTOSAR 4.0.x
  - Targeted the integration of “off-the-shelf” J1939 ECUs into an AUTOSAR network
    - J1939 Transport Protocol (SAE J1939-21)
**AUTOSAR Support for Commercial Vehicle Industry - The First Steps**

- **Major step forward:**
  - AUTOSAR 4.1.x and later
  - Development of J1939 compatible ECUs with “static addresses” based on AUTOSAR architecture
    - J1939 Diagnostics (SAE J1939-73)
    - J1939 Request Management (SAE J1939-21)
    - J1939 Network Management (SAE J1939-81)
AUTOSAR Support for Commercial Vehicle Industry - The First Steps

Steps ahead:

- Development of J1939 compatible ECUs with “Dynamic addresses” based on AUTOSAR architecture
  - Construction Machines and Equipment
  - Heavy Duty Trucks
AUTOSAR Support for Commercial Vehicle Industry - The First Steps

- Support for ISOBUS (ISO11783) compatible ECUs based on AUTOSAR architecture
  - Agriculture and Forestry Machines and Equipment
  - Interconnectivity between implements and vehicles “from different manufacturers”.

![Image of tractors and agricultural equipment]
Commercial Vehicle ECU Development with AUTOSAR - Experiences

Some Commercial Vehicle OEMs Perspective

AUTOSAR Methodology

- Seamless Top-Down System Engineering approach

Software Component Description
SW functionality of the vehicle is defined as a system of SWCs.

System Description
... and mapped to ECUs.

Extract of System Description
An extract is created for each ECU.

ECU Configuration Description (ECUC)
The ECU is configured in detail.
Some Commercial Vehicle OEM Perspective

- AUTOSAR Application Architecture
  - Focus on feature and application development
  - Reuse of Software

- AUTOSAR Basic Software Architecture
  - Expandable BSW Architecture
  - Standardized BSW and Interfaces
Commercial Vehicle ECU Development with AUTOSAR - Experiences

Some Commercial Vehicle OEM Perspective

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“One Common Standard”
Commercial Vehicle ECU Development with AUTOSAR - Experiences

Common Challenges

Introduction of AUTOSAR to Commercial Vehicle and Automotive Industry is challenging, but possible

- Establish processes supporting AUTOSAR Workflow
- Application software components architecture
- ECU Resources Management
- Measurement and Calibration
- Mastering increasing variants
- Post Build
- Functional Safety
- Security
- Multi-Core
- Car2X Technologies
- New High Speed Networks
Commercial Vehicle ECU Development with AUTOSAR - Experiences

Commercial Vehicle OEM Challenges

- Full J1939 Dynamic Communication
- J1939 Diagnostics Configuration
Full J1939 Dynamic Communication

- Handling dynamically assigned addresses at runtime
  - Support for “Arbitrary Address Capable” ECUs
  - “Service Configurable” address ECUs
  - “Command Configurable” address ECUs
  - Name Management
Full J1939 Dynamic Communication

- ISOBUS (ISO11783)
  - For Example: Extended TP and Fast Packet TP

- ISOBUS extensions to J1939
  - For Example: DM1 only sent when DTCs are active (No heartbeat)
J1939 Diagnostics Configuration

- Diagnostic extract in the System Template does not cover J1939
  - For Example: Expanded Freeze Frame description

- Support for additional Diagnostic Services DMx

- Legislative OBD via J1939
  - WWH-OBD DM36 – DM57

- Other solutions are required
Commercial Vehicle ECU Development with AUTOSAR - Experiences

J1939 Diagnostics Configuration

Current Solution for J1939 Diagnostic Messages

- Legacy Network Database (Network-Oriented)
  - Can support both AUTOSAR and legacy systems

- Challenging to manage remaining content of ECU Extract separately

![Diagram of J1939 Diagnostics Configuration]

- Legacy J1939 Database files
- DBC (Contains communication information needed for the ECU)
- Conversion Tool
- .arxml (ECU Extract of System Description)
- BSW Authoring Tool
- .xml (BSW module configuration header and source files)
- .xml (ECU Configuration Description)
- .xml (Service Components)
- .xml (Service Mapping)
- .xml (Atomsics)
- .xml (Compositions)
- .xml (Data Mapping)
- .xml (ECU Composition)
- .xml (Communication)
- .xml (J1939 Diagnostics Messages (DMx))
J1939 Diagnostics Configuration

Current Solution for J1939 DTC

- ODX for configuration of DEM module for J1939
  - Complex to model diagnostic in general
  - Potential incompatibility between ODX file inputs due to flexibility of open diagnostics exchange format specification
Challenging to adopt AUTOSAR Methodology

Software Component Description

System Description

Extract of System Description

ECU Configuration Description (ECUC)
Vector’s Engagement

- Support discussions and collaboration with North American commercial vehicle OEMs and suppliers to contribute to the improvement of J1939 standard in AUTOSAR.
Suggestions for AUTOSAR Group

- AUTOSAR is a Global Standard
  - Encourage and motivate global WP participation

- Lead the way and collaborate with NA commercial vehicle OEMs (Regional WP, subgroup of WP-I)
  - Discuss BSW concepts, bug fixes
    - Support concepts of extending AUTOSAR BSW
  - Discuss application interfaces
    - Create an Explanation of Application Interfaces for Commercial Vehicle Applications
Thank you for your attention!

Questions?