Building Executable Specifications using Model Based Design


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AGENDA

- OLD WORKFLOW
- PROBLEM STATEMENT
- NEW WORKFLOW
- RESULTS ACHIEVED
OLD WORKFLOW

DO A COMPLETE ANALYSIS OF WHAT IS REQUIRED AND DOCUMENT THEM MANUALLY

GIVE THIS AS A REQUIREMENT TO THE SUPPLIER DIRECTLY
PROBLEM STATEMENT

- Communication gap as most of our suppliers are from North-East Asia
- Huge development time
- Delay in software deliveries
- Numerous software bugs
NEW WORKFLOW

1. **CAPTURE REQUIREMENTS BASED ON PROBLEM STATEMENT**
2. **TRACE REQUIREMENTS TO CREATE MODELS AND VICE-VERSAA**
3. **MODEL**
4. **VALIDATE**
5. **REPORT**
6. **SHARED WITH SUPPLIER AS EXECUTABLE SPECIFICATION**

**FBK**
CAPTURE REQUIREMENTS

➢ Communication gap as most of our suppliers are from North-East Asia

→ VAST TEXTUAL CONTENT, NEED FOR MAKING IT MORE ILLUSTRATIVE

➢ Huge development time
➢ Delay in software deliveries
➢ Numerous software bugs

MAKE THE SPECIFICATION VISIBLE AND EXECUTABLE
2 SCOPE

This document describes the CAN wakeup strategy in which certain nodes (here being ECUs) are required to be functionally active with communication after IGN OFF.

3 CAN Wakeup

There are two concepts involved for wakeup communication: NM MASTER and SLAVE. NM MASTER node is the one that initiates communication on the detection of pre-defined triggers. Based on these triggers the NM MASTER node would initialize and send CAN messages on CAN port to other nodes in network. SLAVE node is the one which on receiving a wakeup message performs the activities intended.

For proceeding with the logic to be implemented consider the following ECUs:

1. NM MASTER
2. SLAVE1
3. SLAVE2
4. SLAVE3
5. SLAVE4
**REQUIREMENT TRACEABILITY AND MODELLING**

**CANBUS_REQ_XXX**: This signal would be transmitted by any node that requires CAN Bus to be alive.

If the NM_MASTER gets less than 5 REMOTE triggers then after a calibratable time it should come back to MODE1.
VALIDATION

- Design Error detection using Simulink Design Verifier
- Test case generation and validation using excel sheet / signal builder
- Coverage analysis
- Creating Hardware-In-Loop environment for actual ECU testing
SIGNAL BUILDER

EXCEL SHEET HAVING ALL AND EXPECTED OUTPUTS
IMPORT ALL USING SIGNAL BUILDER

HARNESS MODEL

INPUTS AND EXPECTED / ACTUAL OUTPUTS COMPARISON

INPUTS
ACTUAL OUTPUTS

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CAN_WAKEUP_LOGIC

CANBUS_REQ_SLAVE1

CANBUS_REQ_SLAVE2

[REMOTE]

HW_TRIGGER_SLAVE1

Hw_TRIGGER_SLAVE2

[F8_TRIGGER_SLAVE1]

[F8_TRIGGER_SLAVE2]

[REMOTE]

CANBUS_REQ_SLAVE1_EX

CANBUS_REQ_SLAVE2_EX

[ALL_SLEEP_EX]

[ALL_SLEEP_EX]

[REMOTE]

REMOTE

START_NM

[START_NM_EX]

[REMOTE]

STS_NM_SLAVE1

STS_NM_SLAVE2

[REMOTE]

[REMOTE]

Scopa
HARDWARE-IN-LOOP

*dll file for real-time interaction between CANoE and MATLAB
## RESULTS

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>TARGET ACHIEVED</th>
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| Communication gap as most of our suppliers are from North-East Asia | → Visibility and readability of specs improved drastically  
                           → Real time simulation of specs |
| Huge development time | → 40% reduction in development time and software deliveries |
| Delay in software deliveries | |
| Numerous software bugs | → Iterations of buggy software reduced to 80% |
TOOLS USED

- Simulink
- Stateflow
- Simulink Design Verifier
- Simulink Verification and Validation
- Vector CANoe Integration with MATLAB
- Report Generator
QUESTIONS
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