

Building Executable Specifications using Model Based Design

26.04.2016

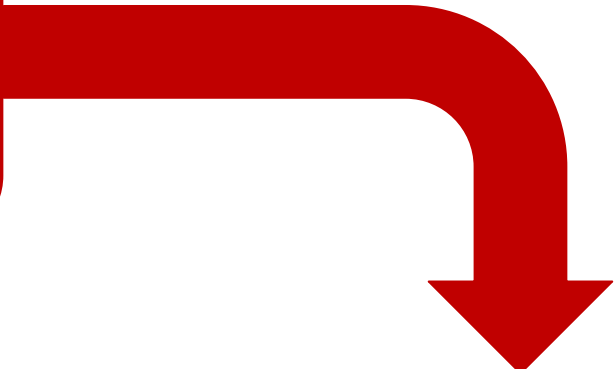
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AGENDA

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

OLD WORKFLOW

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

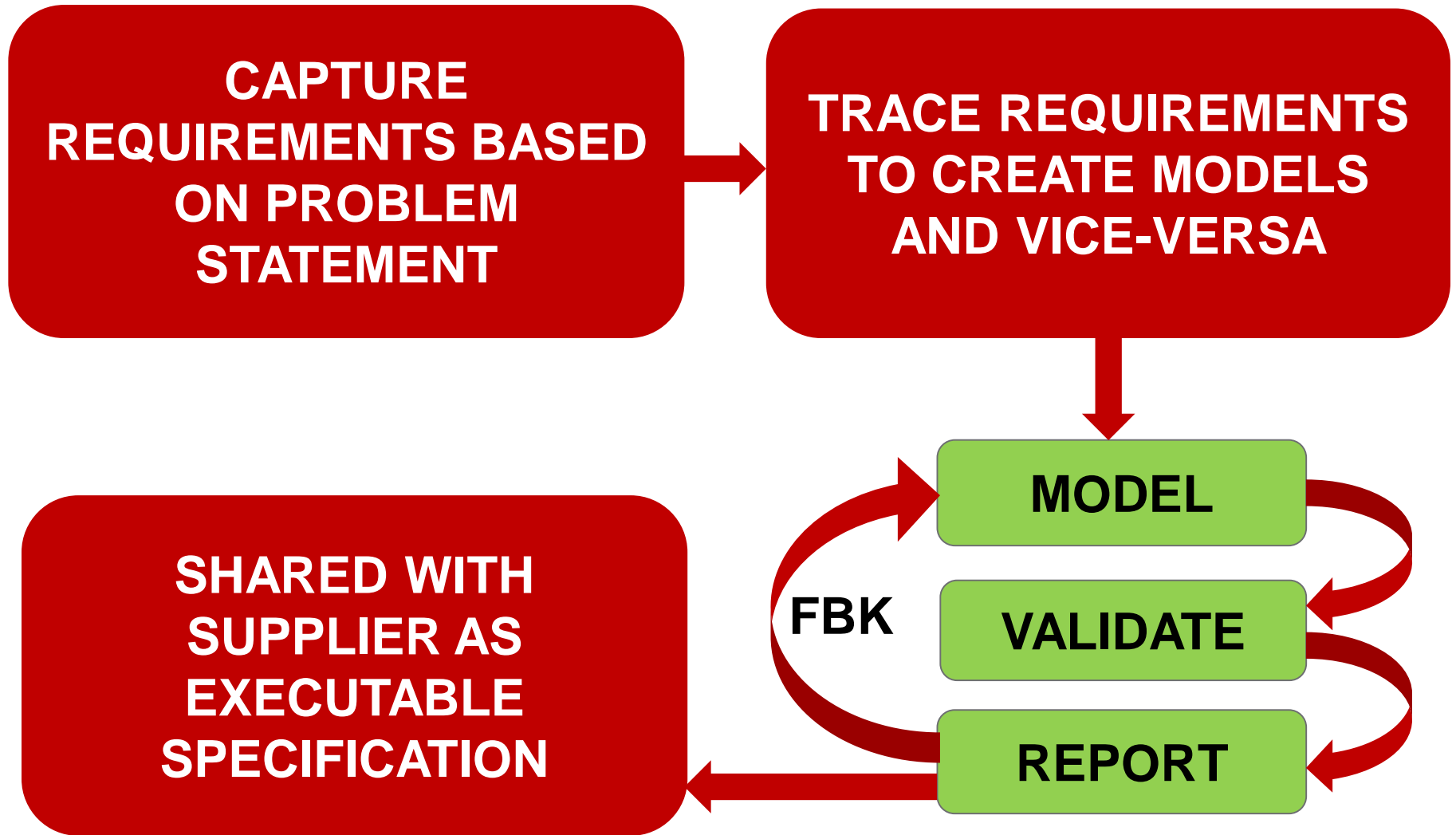


**GIVE THIS AS A
REQUIREMENT TO THE
SUPPLIER DIRECTLY**

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



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

REQUIREMENT TRACEABILITY AND MODELLING

2 SCOPE

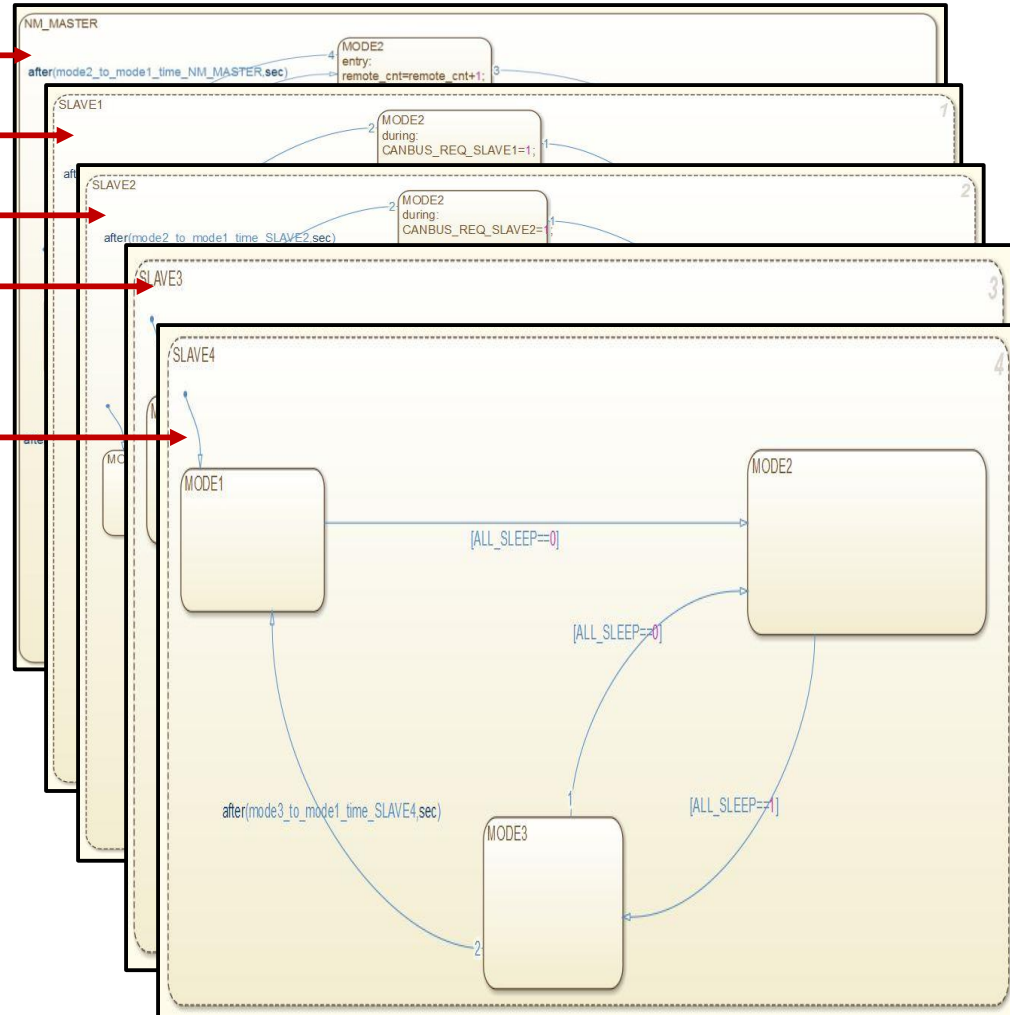
This document describes the CAN wakeup strategy in which certain nodes (here being ECUs) are required to be functionally active with communication after IGN OFF.

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.

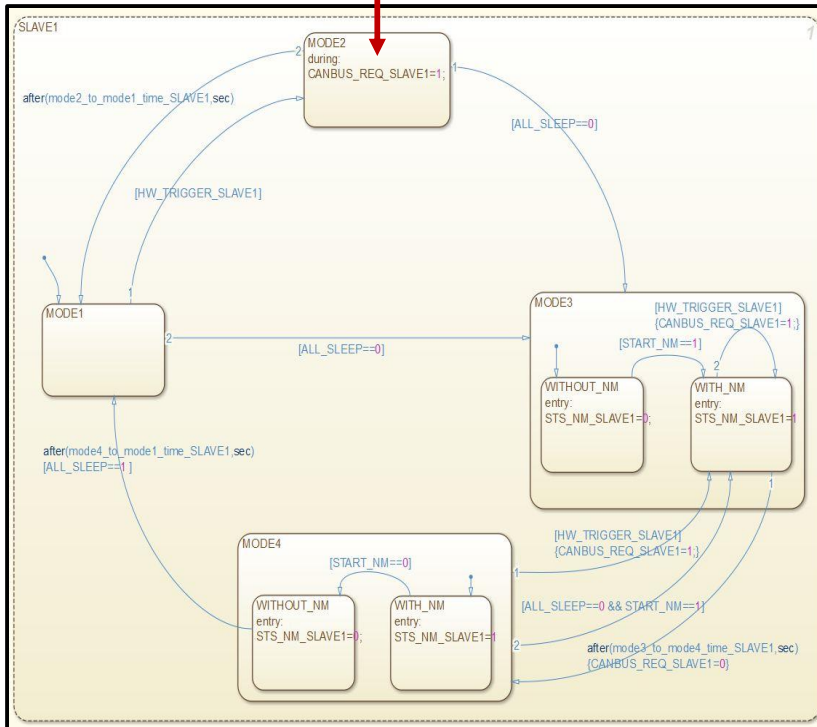
For proceeding with the logic to be implemented consider the following ECUs:

1. NM_MASTER
2. SLAVE1
3. SLAVE2
4. SLAVE3
5. SLAVE4

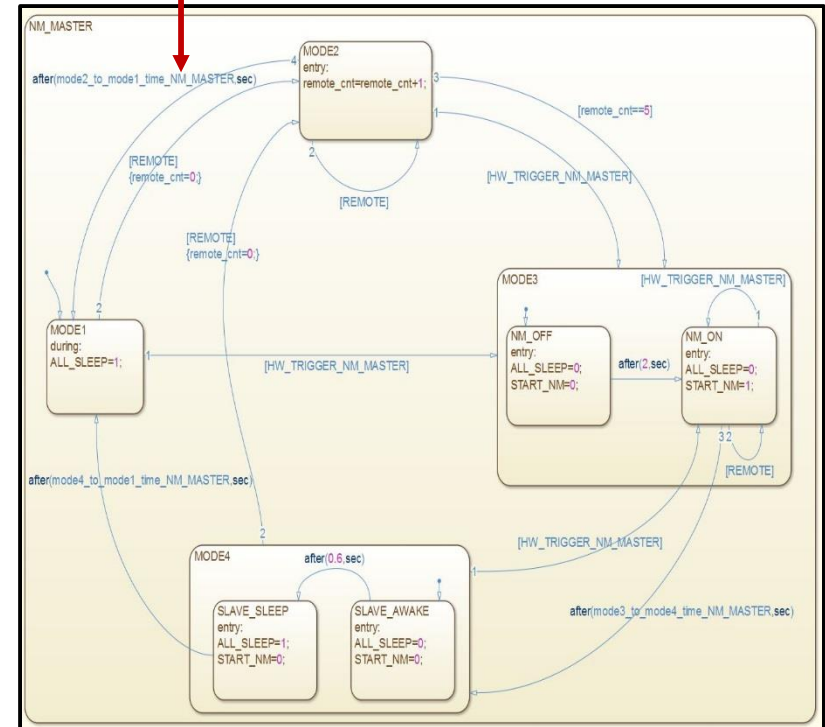


REQUIREMENT TRACEABILITY AND MODELLING

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



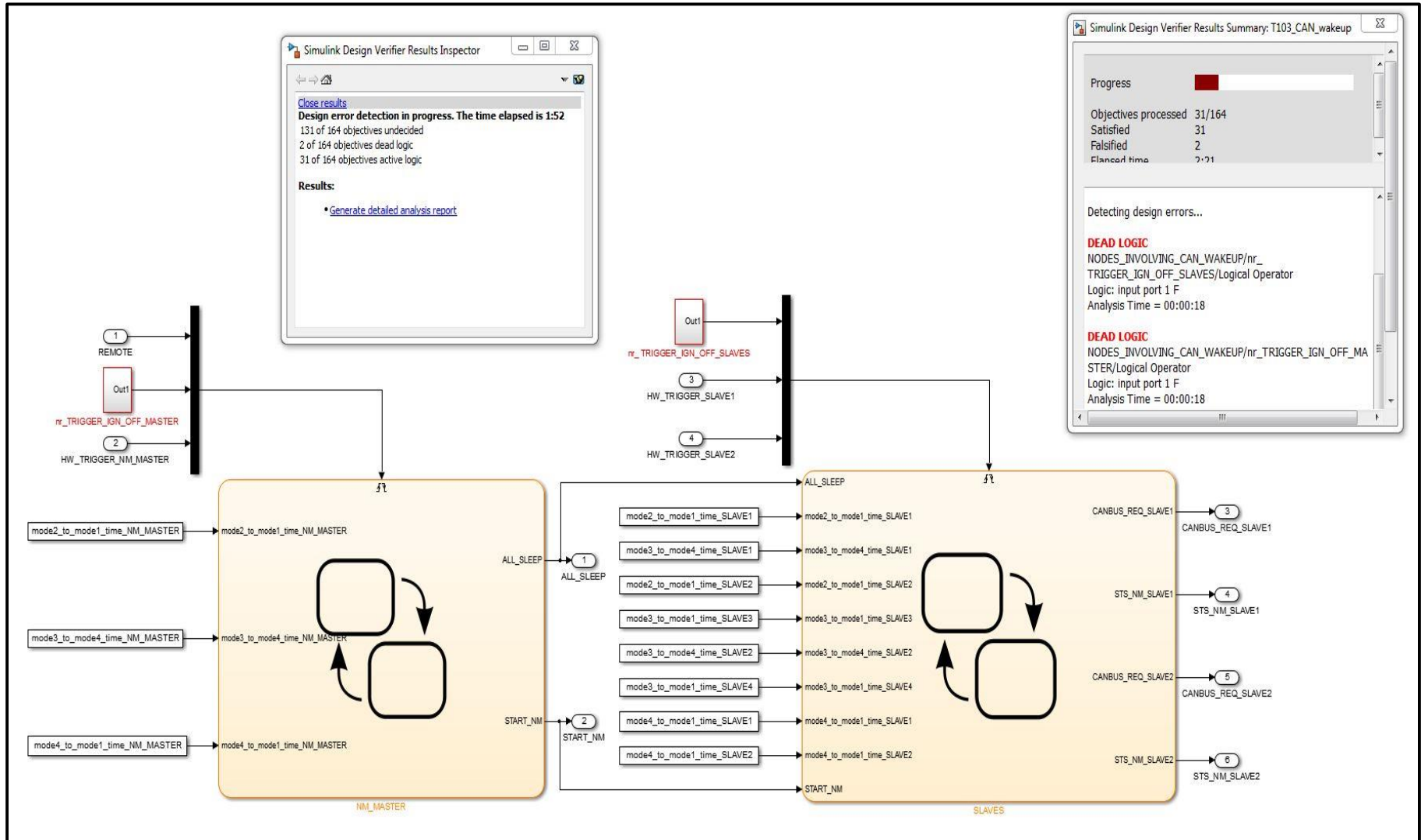
If the NM_MASTER gets less than 5 REMOTE triggers then after a calibratable time it should come back to MODE1.



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**

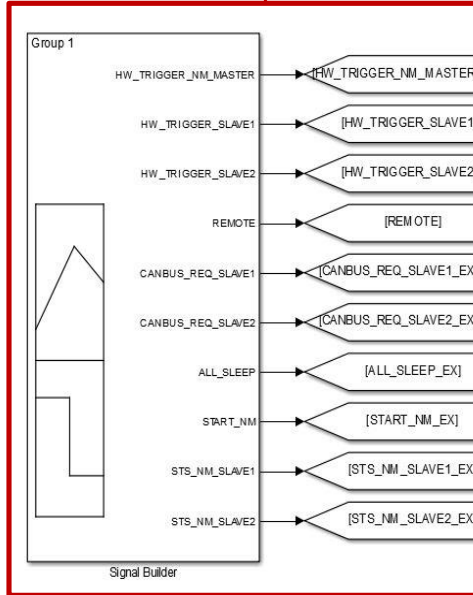
DESIGN ERROR DETECTION



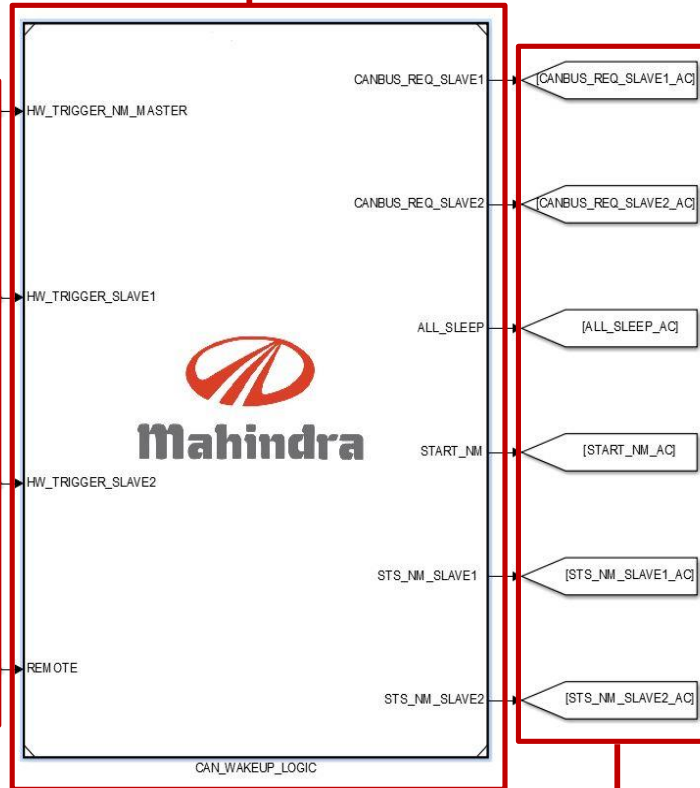
SIGNAL BUILDER

EXCEL SHEET HAVING ALL AND EXPECTED OUTPUTS

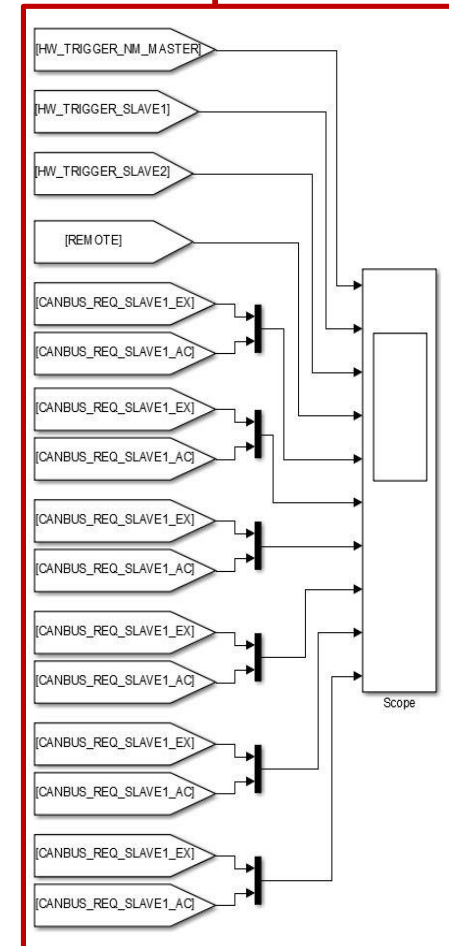
IMPORT ALL USING SIGNAL BUILDER



HARNES MODEL



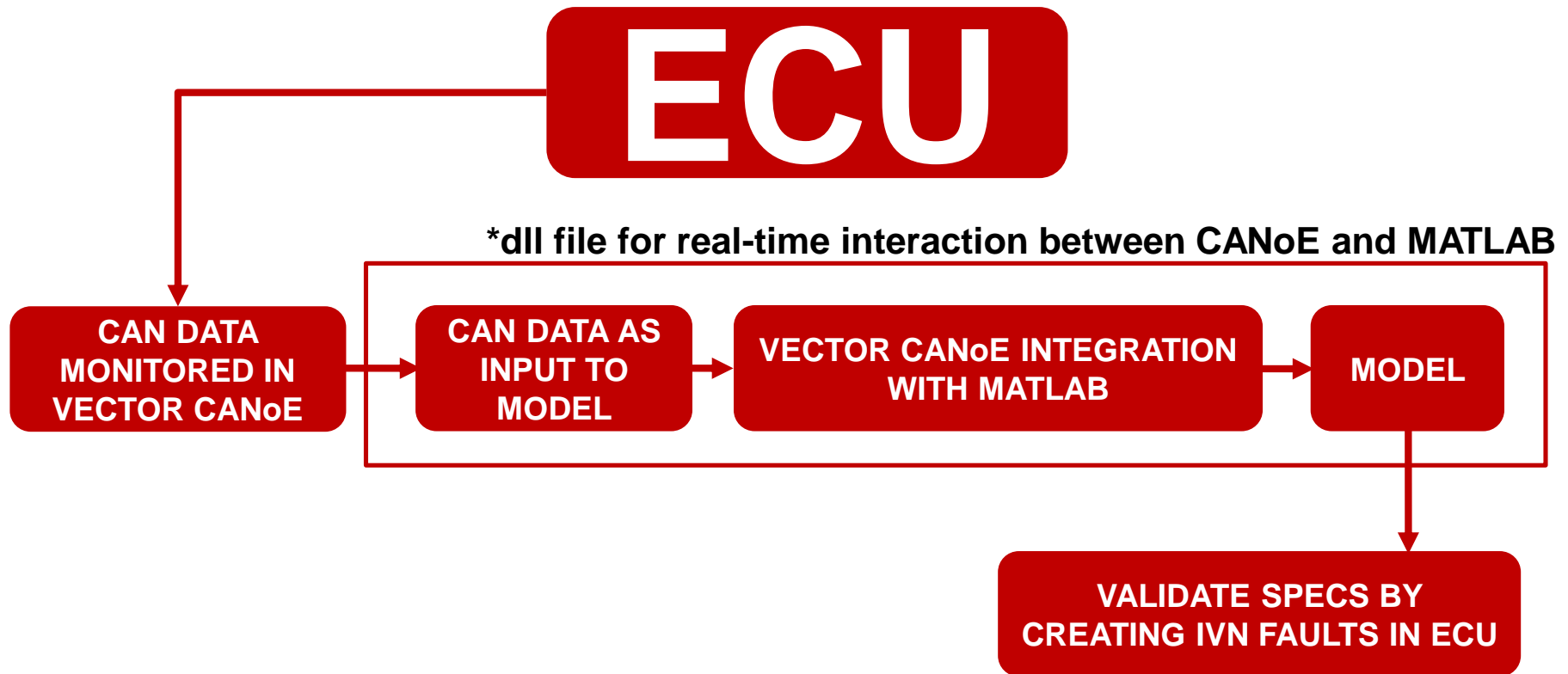
INPUTS AND EXPECTED / ACTUAL OUTPUTS COMPARISON



INPUTS

ACTUAL OUTPUTS

HARDWARE-IN-LOOP



RESULTS

PROBLEM	TARGET ACHIEVED
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

?????

THANK YOU

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