CANoe.DiVa: Automated Testing of Diagnostic Protocol Implementation and Integration in ECUs

Webinar 2017-04-06
Customer contact concerning the Vector Diagnostic Solution and related tools:
- CANdelaStudio / ODXStudio
- CANoe.DiVa
- Indigo
- vFlash

Presenter

Helmut Frank

Business Development Manager Diagnostics

Email: helmut.frank@vector.com
Agenda

Information

- Overview
  - Features
  - Summary
  - More Information
The Mission

automated
test run
test generation

CANoe.DiVa
documented
reproducible

data driven

diagnostic tests

broad and detailed
The Objectives

- **Bus access:** Communication
- **Transport protocol (CAN):** ISO network layer, parameters, timings, Flow Controls,…
- **Diagnostic „communication“:** Timings, message format, request/response dependencies
- **Diagnostic „exchange“:** Supported services and sub-functions, data content, state dependencies,…

**CANoe/CANalyzer**

**CANoe.DiVa**
Supported Protocols

- ISO 14229 Unified Diagnostic Services (UDS): 2006/2013
- ISO 15765 Diagnostics on CAN
- ISO 14230 Keyword Protocol 2000 (KWP)
- ISO 15031/J1979 On Board Diagnostics (OBD)
- ISO 27145 World-wide harmonized OBD (WWH-OBD)

- GMW3110 (including GM Node Verification Procedures)

- Various manufacturer specific test extensions (e.g. for Daimler, GM, VW, FCA, ...)

# Automated Tests - Scalability of Automation

<table>
<thead>
<tr>
<th>Diagnostic Console</th>
<th>CAPL Browser</th>
<th>vTESTStudio</th>
<th>CANoe.DiVa</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagnostic Console" /></td>
<td><img src="image2.png" alt="CAPL Browser" /></td>
<td><img src="image3.png" alt="vTESTStudio" /></td>
<td><img src="image4.png" alt="CANoe.DiVa" /></td>
</tr>
<tr>
<td>test creation</td>
<td>editing CAPL</td>
<td>tool supported</td>
<td>generated</td>
</tr>
<tr>
<td>n/a</td>
<td>automated</td>
<td>automated</td>
<td>automated</td>
</tr>
<tr>
<td>interactive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>test execution</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8/24
Agenda

Information
Overview

Features
Summary
More Information
Overview

- Automated generation of a CANoe test based on a diagnostic specification
- User interface to configure tests
- Generation of a test specification
- Clear and detailed report of test results
- Support of test report analysis
- Requirement traceability
- Extensible test functionality
Features

Protocol Testing

- Diagnostic Message Flow
  - Physical, functional addressing and timing

- Diagnostic Protocol Format
  - Valid, Combined and Invalid Requests
  - Response (single, none, multiple)

- Data Type Checks
  - Check if the returned parameter value is within the specified (CDD/ODX) data type boundaries

- Sessions and Security Levels
  - Service execution in the different sessions and security levels
  - Session and security state transitions
Application Testing: Diagnostic Parameter

- Compare diagnostic parameters with CANoe system- or environment variables which may be connected/linked to ccp/xcp or a matlab model,…

- Passive parameter validation against
  - Diagnostic values (e.g. read/write)
  - Configured data ranges
  - Expectation values
  - CCP/XCP values
  - CANoe System Variables

- Active control of I/Os to validate diagnostic parameter content
  - CAN messages using CANoe rest bus simulation
  - HW I/Os via VT System channels
  - Any I/O using CANoe system variables
Features

Application Testing: Fault Memory

- Provoke network signal failures
  - Communication timeouts
  - Data consistency failures

- Provoke hardware failures using the VT System:
  - Short-circuits (Ground, UBat, Pins)
  - I/O failures (interruption, resistance, voltage)
  - Individual error settings

- Any other failures using user scripts
User Interface

Configure test runtime timings

Test flow
- Minimum request/request distance: 0 ms
- Minimum response/request distance: 0 ms
- Additional response tolerance before timeout: 0 ms
- Wait after Clear Diagnostic Information (0x14): 0 ms
- Wait after ECU Reset (0x11): 0 ms
- ECU resets on programming session entry or exit

No Response
- Wait after response timeout: 200 ms

Security
- Wait after invalid key: 0 ms
Features

Test Reporting

3.1.1 Test CaseID-492237BA: Valid_Request_WDBI_HardwareVersion_Write : Failed

Send a valid WDBI request. The successful execution is verified using the corresponding RDBI service.

Comments

Date       Author                      Description                                      Classification Action D/Va
12.04.2011 VECTOR The Write service is correctly specified. The ECU does not seem to support the DID 0xF-150 ECU Issue To delete
15:01:33

Test Case begin: 2011.02.28 18:08:10 (logging timestamp 6543249)
Test Case end: 2011.02.28 18:08:10 (logging timestamp 6752249)

Test Case Sequence

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Test Step</th>
<th>Description</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>6545240</td>
<td>Read1</td>
<td>Read out stored data in order to write it back at the end of this test case. (HardwareVersion_Read)</td>
<td>PASS</td>
</tr>
<tr>
<td>6752232</td>
<td>Read1</td>
<td>Positive response received as expected.</td>
<td>PASS</td>
</tr>
</tbody>
</table>

Test Case Results

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Count</th>
<th>Error</th>
<th>Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>A2</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>
Test Result Analysis

- Compare test runs
- Different Views on the test report
  - Result (Pass/Fail)
  - Service
  - ECU State
  - Issue Classification/Comment
  - Requirements
- Identify error situations by combining Views
- Comment and classify test results
- Get one-page summary reports
- Forward and archive a complete test report or an excerpt
Features

Requirements Tracking

- Link CANoe.DiVa tests with test- or specification requirements (automatically and manually)

- Documentation of requirements within test cases/results via prose, document references or links (e.g. DOORS, html)

- Requirement View for test analysis: In which tests is a requirement verified?

- Requirement Overview to document the verification result
System Conditions

- Define non-diagnostic system states to enable diagnostic features
  - e.g. “3rd Gear Selected” or “Engine Running”

- System Conditions can be assigned to DTCs or Services

- Once assigned System Conditions are created automatically during test runtime

- Define System Conditions by a sequence of the following actions
  - Setting of System Variable
  - Setting a Bus Message
  - Waiting Time
  - User Interaction
  - Clamp Control
  - VT System I/O Stimulation
  - CAPL Code call
Features

Software Download Test

**Supported Download Tests***

- Valid Flashing
- Overvoltage and under voltage tests
- Cancel data transfer (stop transmission or clamp reset)
  - Check that valid flashing is possible afterwards

- Additional flash tests available for selected OEM extensions

* With Vector vFlash
Agenda

Information
Overview
Features

Summary

More Information
Summary

Benefits

- Significant savings of time and effort
- Further quality improvement of the ECU Software
- All development stages supported
- Excellent test coverage
- Efficient, generation-based approach
- Automated tests without user interaction
- User-defined tests allow tailoring
- Widely used by OEMs and suppliers already with a proven record of success
- Continuously enhanced features through implementation of customers’ requirements
Vector YouTube Channel

Please find a set of engineering videos at the following link:
https://www.youtube.com/playlist?list=PLLKv-zcGiHJH3Oo6pqVbm36BR97YZH7vo
For more information about Vector and our products please visit

www.vector.com

Author:
Simon Müller, Helmut Frank
Vector Informatik GmbH