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

Webinar 2018-04-19
Customer contact concerning the Vector Diagnostic Solution and related tools:

- CANdelaStudio / ODXStudio
- CANoe.DiVa
- Indigo
- vFlash
Agenda

Information

- **Overview**
  - Features
  - CANoe.DiVa 10.0 News
  - Summary
  - More Information
The Mission

automated
test run
test generation
documented
reproducible
data driven
diagnostic tests

CANoe.DiVa

broad and detailed
Overview

The Tool

- CANdelaStudio
  Diagnostic Authoring Tool
- CDD
- ODX
  ECU Specification
- Configurator
- CANoe.DiVa
- Runtime Library
- Report Analyzer
- Generator
- CANoe
  XML/CAPL
  Test Feature Set
- CANoe
  HTML/XML
  Test Report
- ECU
  System under Test
  Test Module
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, ...

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**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, ...)

Overview
### 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>test creation</td>
<td>n/a</td>
<td>tool supported</td>
<td>generated</td>
</tr>
<tr>
<td>interactive</td>
<td>editing CAPL</td>
<td>automated</td>
<td>automated</td>
</tr>
<tr>
<td>test execution</td>
<td>automated</td>
<td>automated</td>
<td></td>
</tr>
</tbody>
</table>

**Overview**
Agenda

Information
Overview

Features
CANoe.DiVa 10.0 News
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
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
Application Testing: Fault Memory

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

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

- Any other failures using user scripts
# User Interface

![User Interface Image]

**Features**

### Test Timings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum request/request distance</td>
<td>0 ms</td>
</tr>
<tr>
<td>Minimum response/request distance</td>
<td>0 ms</td>
</tr>
<tr>
<td>Additional response tolerance before timeout</td>
<td>0 ms</td>
</tr>
<tr>
<td>Wait after Clear Diagnostic Information (0x10)</td>
<td>0 ms</td>
</tr>
<tr>
<td>Wait after ECUReset (0x11)</td>
<td>0 ms</td>
</tr>
<tr>
<td>ECU resets on programming session entry/exit</td>
<td>0 ms</td>
</tr>
</tbody>
</table>

### No Response

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait after response timeout</td>
<td>200 ms</td>
</tr>
</tbody>
</table>

### Security

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait after invalid key</td>
<td>0 ms</td>
</tr>
</tbody>
</table>
Test Reporting

3.1.1 Test Case ID: 492237BA: Valid Request WDBI HardwareVersion_Write: Failed

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

Comments

Date: 12.04.2011
Author: VECTOR

The Write service is correctly specified. The ECU does not seem to support the DID 0xF150

Test Case begin: 2011.02.28 18:06:10 (logging timestamp 6543249)
Test Case end: 2011.02.28 18:06:10 (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>6543240</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>6752249</td>
<td>Read1</td>
<td>Positive response received as expected.</td>
<td>PASS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step</th>
<th>Test Case ID</th>
<th>Test Case Name</th>
<th>Test Case Description</th>
<th>Status</th>
<th>Status Value</th>
<th>Error Code</th>
<th>Severity</th>
<th>Status Code</th>
<th>Status Value</th>
<th>Error Code</th>
<th>Severity</th>
<th>Status Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31</td>
<td>Test Case 1</td>
<td>Test Case 1 Description</td>
<td>Passed</td>
<td>0</td>
<td>0</td>
<td>Low</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</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
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
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
Software Download Tests

**Added in CANoe.DiVa 10.0**
- Erase Memory Errors
  - Clamp reset during EraseMemory
  - Cancel sequence after EraseMemory
  - Skip erase
- Data Transfer
  - Transmit wrong CRC
  - Transmit wrong Signature
- Skip writing Fingerprint

**Already existing in CANoe.DiVa 4.0**
- Valid Flash execution
- Valid Flash execution at min. and max. voltage
- Errors during transfer data
  - Cancel by clamp reset
  - Cancel by stop transmission
Support of vTESTstudio requirement/trace item exchange format
CANoe.DiVa 10.0 News

Requirements & Traceability

- [https://vector.com/vi_downloadcenter_en.html](https://vector.com/vi_downloadcenter_en.html)

**Download-Center**

The terms and conditions for the use of Vector’s website shall apply, in particular section 6 regarding download of software.

- **IBM ROM Connection Utility 1.2.1 for vTESTstudio**
  - Date: 2017-12-20
  - Size: 14.5 MB
- **Polarion ALM Connection Utility 1.2.0 for vTESTstudio**
  - Date: 2017-11-23
  - Size: 13.9 MB
- **PTC Integrity Connection Utility 1.2.0 for vTESTstudio**
  - Date: 2017-11-23
  - Size: 14.1 MB
- **DOORS AddIn 2.2.0 for vTESTstudio**
  - Date: 2017-05-24
  - Size: 50.9 MB

AddIn for DOORS to connect to vTESTstudio or to CANoe.DiVa.
Minimum required versions: vTESTstudio 2.1.46 SP3 and CANoe.DiVa 10.0 or higher

**MD5 checksum**: f4f0748a99b0c59c4dbd484725554b64
Process related to IBM DOORS classic

- Track test coverage from system requirements to test reports

- Traceability in CANoe.DiVa can be achieved by either linking requirements or test specifications from DOORS

- Test execution results are imported back to DOORS corresponding objects

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**IBM DOORS classic**

- **DOORS objects** (requirements or test specifications)
  - Object 1: pass
  - Object 2: pass
  - Object 3: fail
  - Object 4: pass

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**Trace Item Format**

- Generate executable test unit

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**CANoe**

- Execute test unit in CANoe

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**CANoe.DiVa**

- Link test cases to requirements

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**CANoe.DiVa**

- Import test execution results

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**CANoe.DiVa**

- XML Report

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**CANoe.DiVa**

- Add test resources
  - External Requirements
  - Generate executable test unit
Step 1: Export Trace Items from DOORS

- Export objects from a DOORS module by a plug-in into trace item exchange file
- Objects can be system requirements or test specification
- Trace items are structured in hierarchical folders based on hierarchy in DOORS module
Step 2: Import Trace Items into CANoe.DiVa Project

Import trace item exchange file
Step 3: Link Trace Items to Test Results
Step 4: Import Test Report into DOORS

- Import XML report with trace item links into DOORS

- Test execution results are stored as attribute in DOORS objects (requirements or test specifications)

- Mapping of test report information to DOORS attributes configurable
Application Testing

- Configure multiple DTC set criteria per DTC

- Excel Import/Export of DTC and diagnostic parameter information
  - Edit DTC or diagnostic parameter attributes in Excel
  - Copy/Paste and import spec info from existing Excel tables
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Summary

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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
Please find a set of engineering videos at the following link:
https://www.youtube.com/playlist?list=PLLKv-zcGiHJH3Oo6pqVbm36BR97YZH7vo

Currently 11 short videos explaining individual use cases and related tool features.
For more information about Vector and our products please visit

www.vector.com

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