VECTOR

Automated Protocol Conformance/Compliance Testing with CANoe

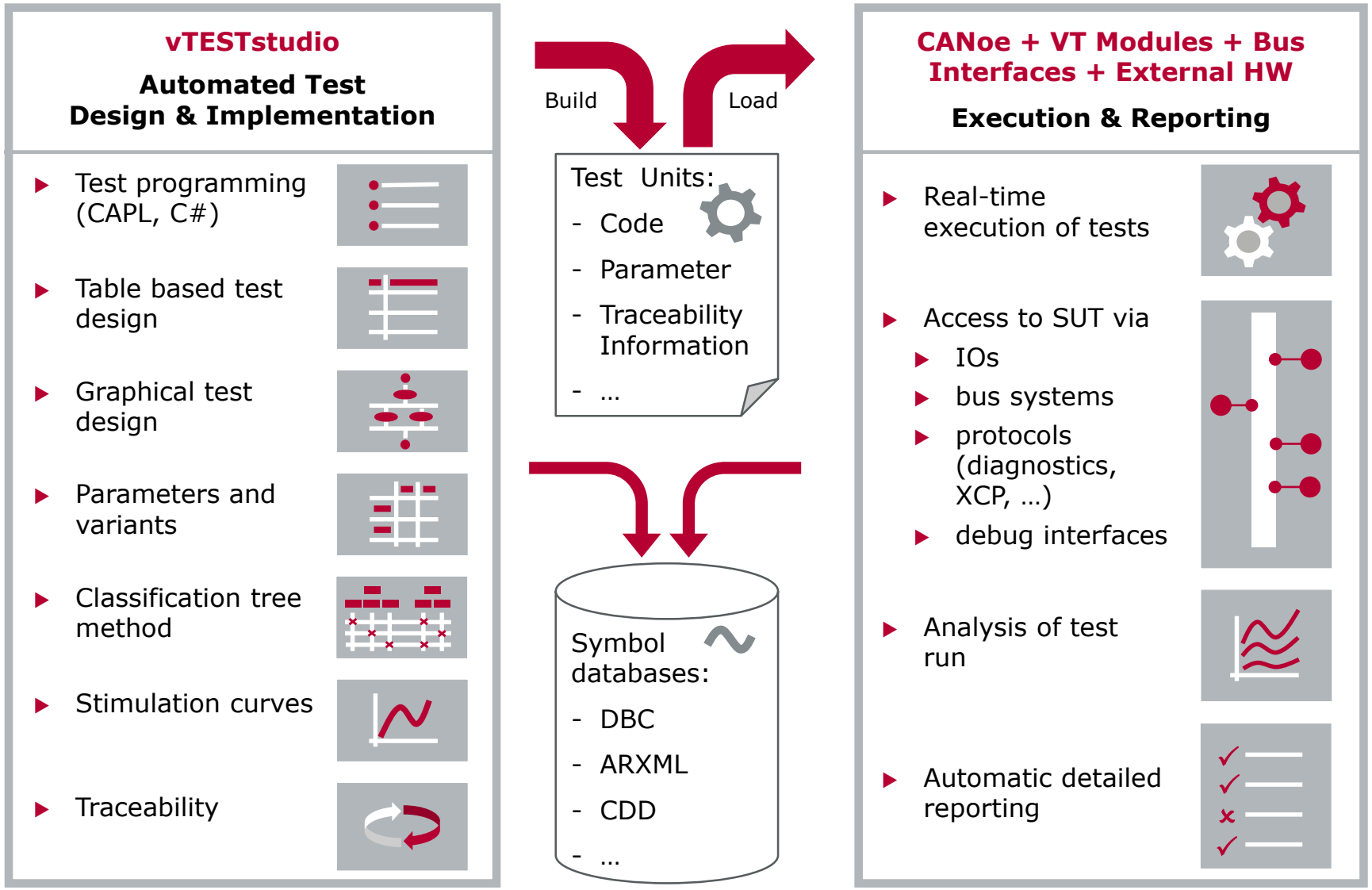
For Ethernet (TC8), J1939, LIN, Smart Charging Communications, Car2x, CANopen, and Diagnostics

V0.1 | 2019-06-24

Agenda

- **CANoe, vTESTstudio, Network Interfaces and the VT System**
  - CANoe.Ethernet (TC8)
  - CANoe.J1939 (J1939-82)
  - CANoe.LIN (LIN Slave)
  - CANoe.SCC (Smart Charging Communications)
  - CANoe.Car2x (Scenario Simulation)
  - CANoe.CANopen
  - CANoe.DiVa (Diagnostic Integration and Validation Assistant)
  - Application and hardware requirements

The Vector Testing Toolset



Agenda

CANoe, vTESTstudio, Network Interfaces and the VT System

- **CANoe.Ethernet (TC8)**

CANoe.J1939 (J1939-82)

CANoe.LIN (LIN Slave)

CANoe.SCC (Smart Charging Communications)

CANoe.Car2x (Scenario Simulation)

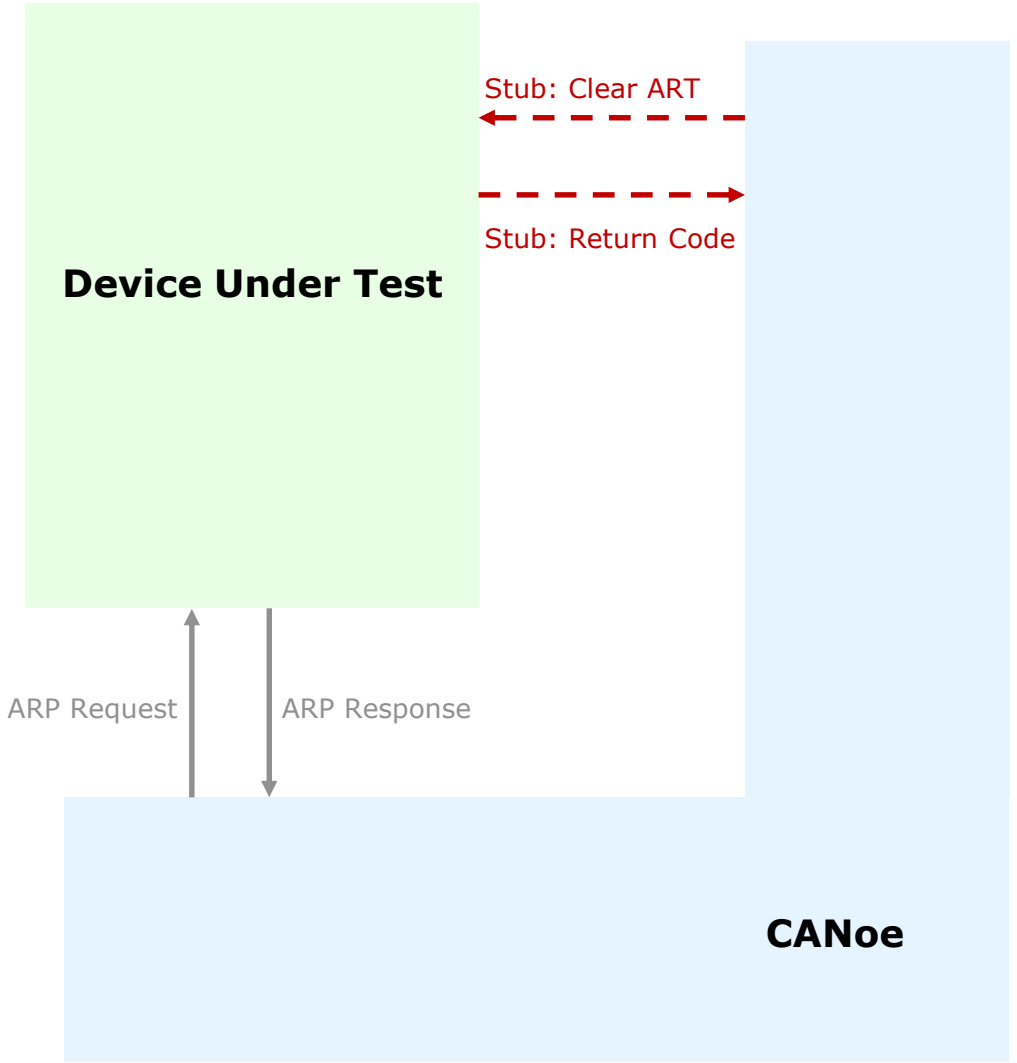
CANoe.CANopen

CANoe.DiVa (Diagnostic Integration and Validation Assistant)

Application and hardware requirements

Open Alliance Tech Committee 8 (TC8) Ethernet Conformance

- Test Procedure defined in vTESTstudio (required)
  - easily configurable via Test Parameters
  - easy selection of Test Cases
  - different Test Variants (must, may)
- Upper Tester Stub Functions
  - allows individual implementation
  - Autosar Testability Protocol as default implementation
  - sample of non-standard Service Primitives
- Includes a Golden Simulated Node
- Delivered as Demo with CANoe.Ethernet
  - allows continuous testing during development

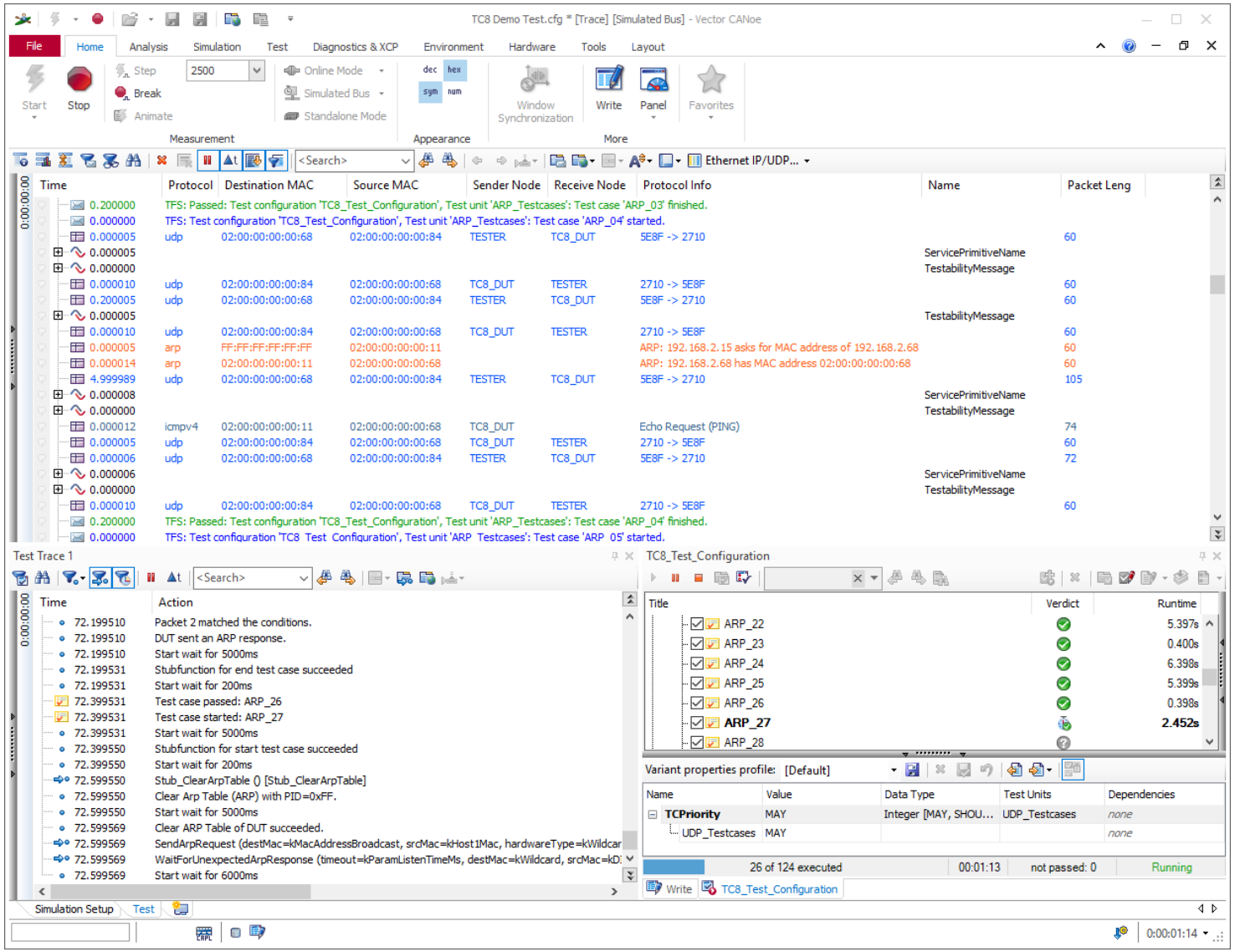


VECTOR

Current release of CANoe

	Test Group	CANoe 12.0 SP2
Layer 1	Physical Layer	partially
Layer 2	TC8 Switch Tests	✓
	TC11 Switch Tests	
	ARP (Address Resolution Protocol)	✓
Layer 3	ICMPv4	✓
	IPv4	✓
	Dynamic IPv4 Link Local Address	✓
Layer 4	UDP (User Datagram Protocol)	✓
	TCP (Transmission Control Protocol)	✓
Layer 7	DHCPv4	✓
	SOME/IP Server	✓
	SOME/IP ETS	✓

TC8 Example Configuration



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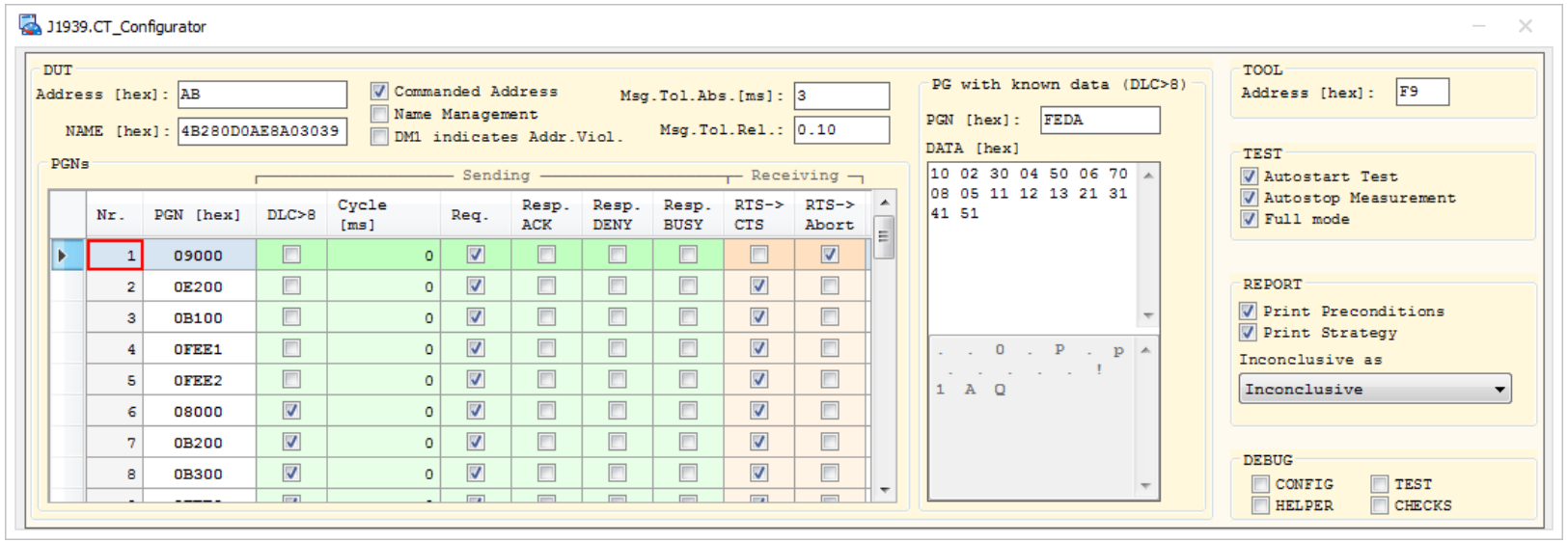
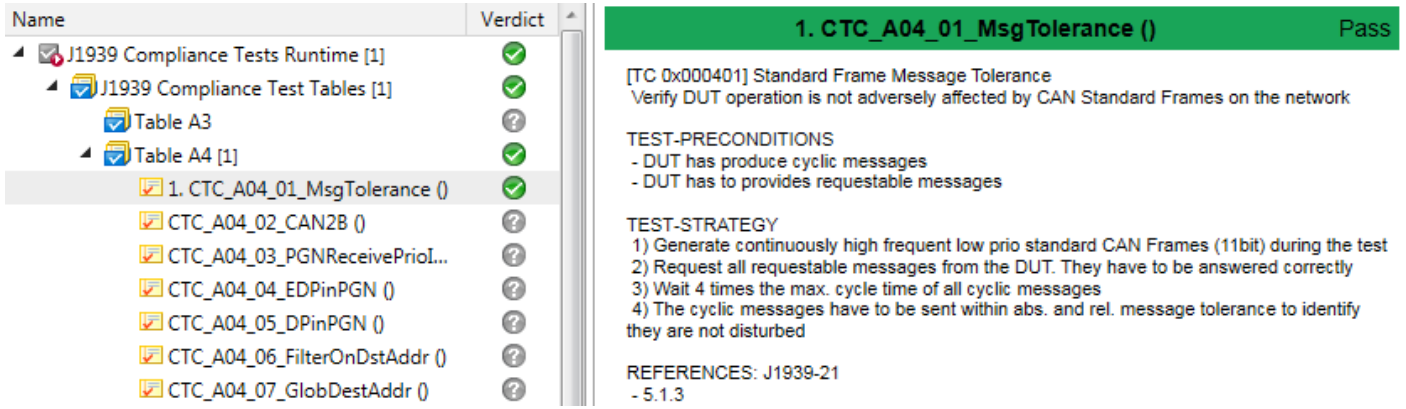
J1939-82 Compliance Test: 2008 and 2015 specification have been implemented

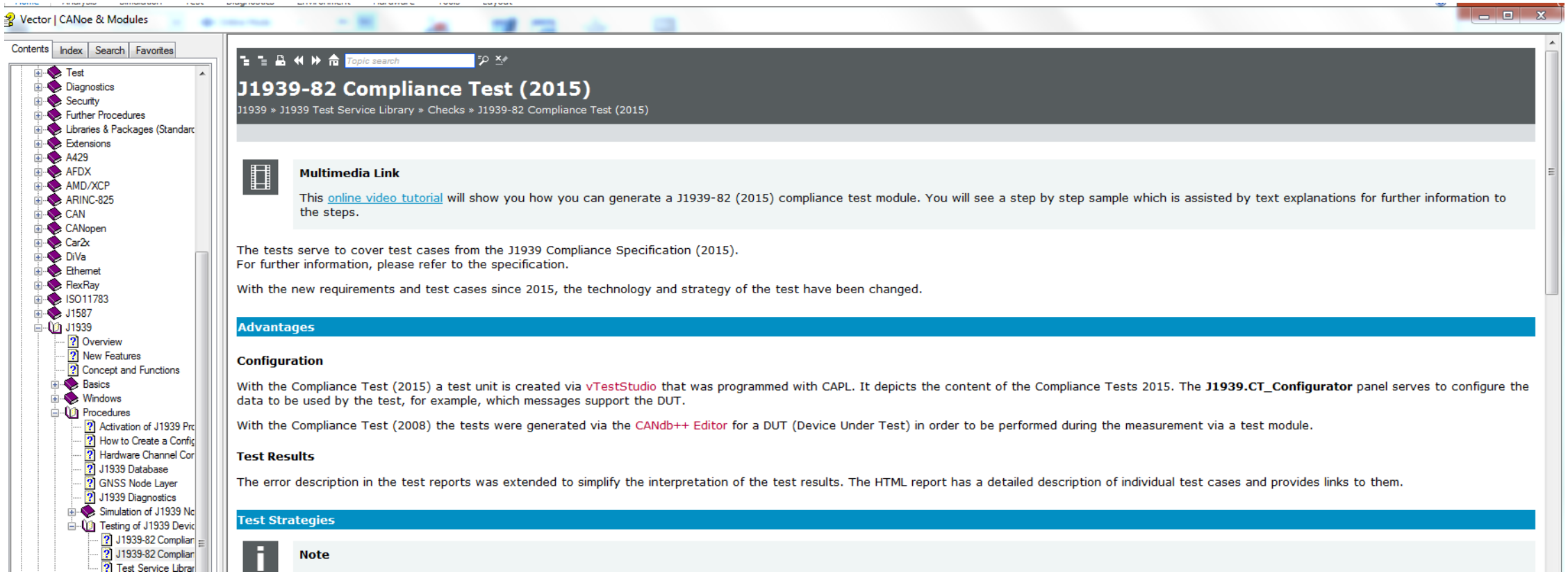
- Easy configuration with panel:



- Well structured report:



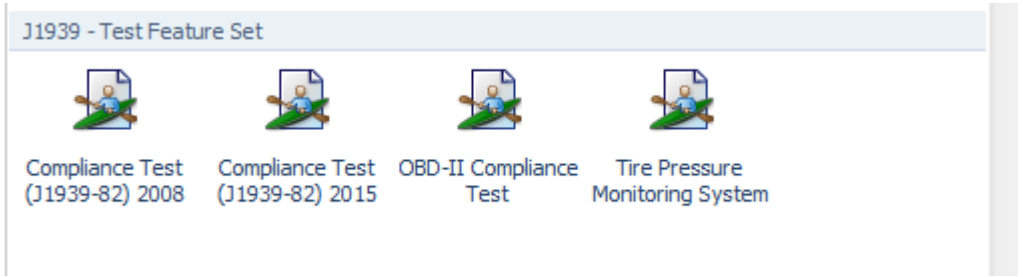
J1939 Compliance Test Help Page and Tutorial

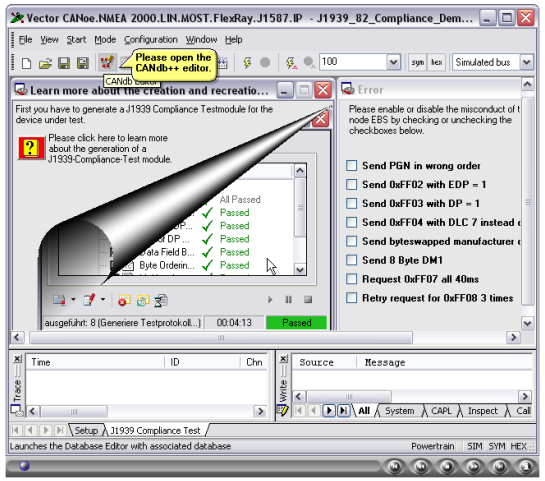


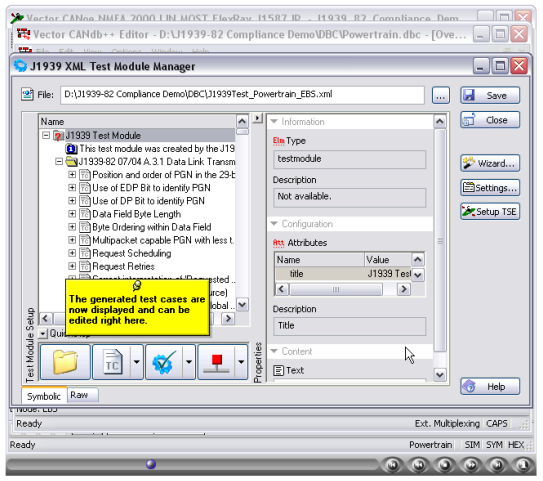
- J1939-82 Tables A3-A8 and A10 are implemented

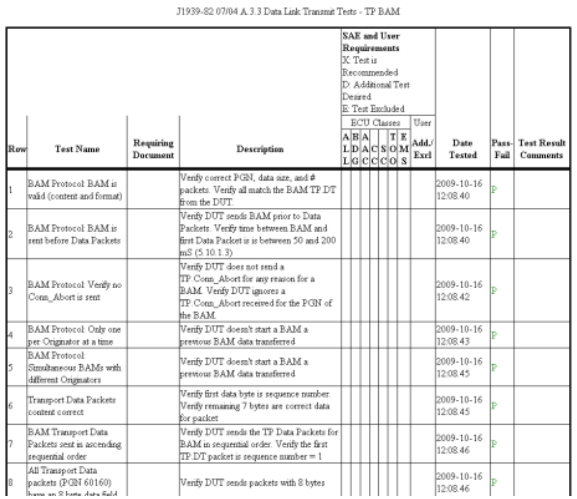
Test Feature Set (CANoe)

- J1939 Test Service Library
  - J1939 specific test functions and extensions
- J1939 XML Test Module Manager
  - Test Management
  - Configuration of test cases
  - Generation of compliance tests according to J1939-82
  - Step by step example how to create compliance tests









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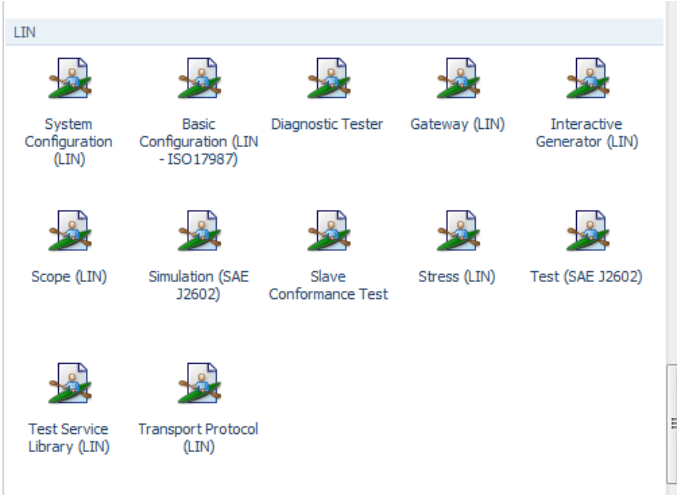
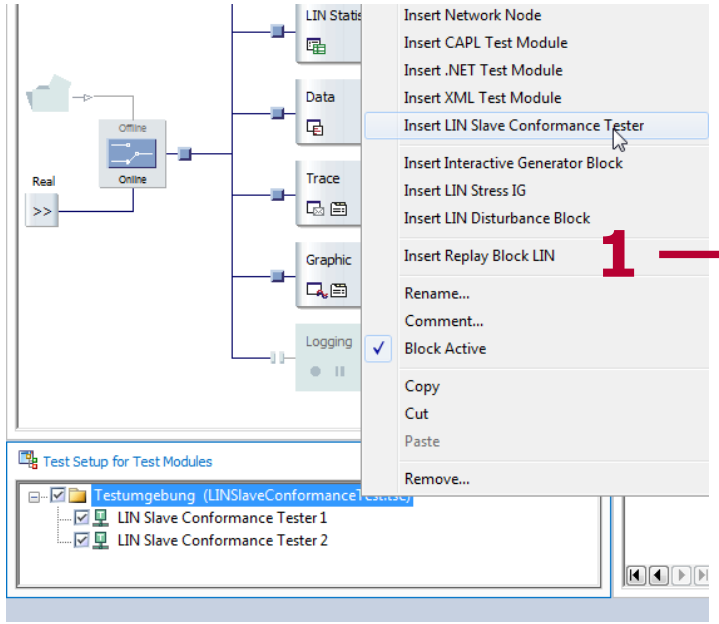
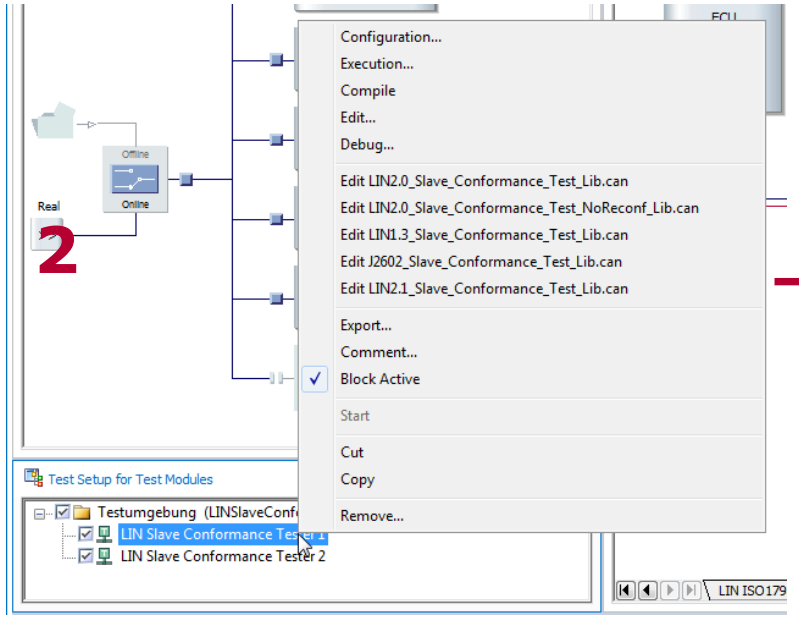
LIN Slave Conformance Tests

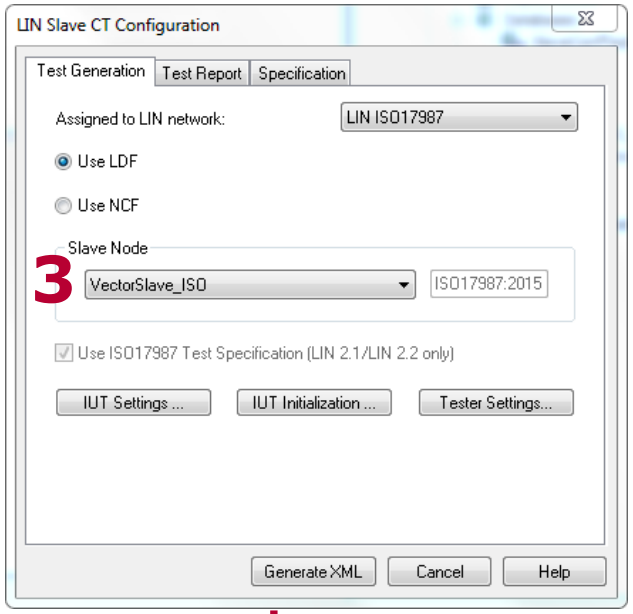
- Slave Conformance Test Module
  - Preconfigured XML test module can be added to the Test Setup
  - Automated conformance testing of any Slave in your Simulation Setup
  - Automatic configuration of conformance tests according to LDF (or optionally NCF)
  - Create a reference trace or logging by testing the simulated version of your Slave
  - Full support of the LIN1.3, LIN2.x and J2602 Slave conformance tests (Data Link Layer)
  - Optional hardware reset prior to each test case using VH1150 or VT System with a VT7001 (no extra configuration required)
  - All settings automatically saved with the configuration
  - Test cases can be repeated at any number of times
  - Detailed XML-report automatically translated to HTML

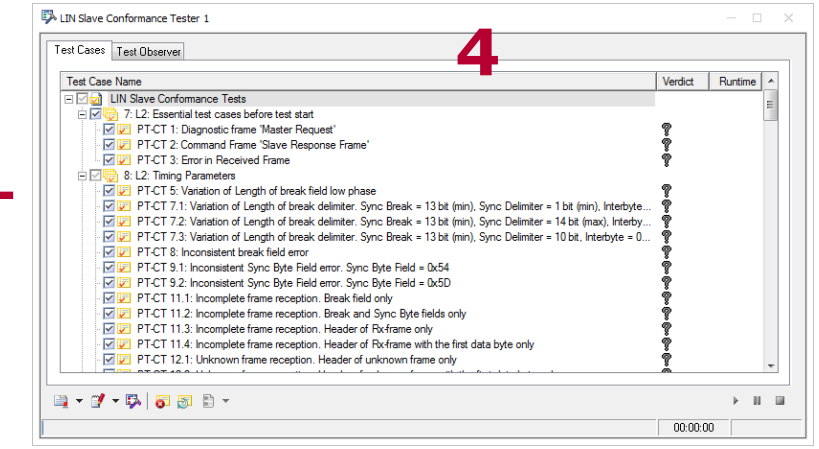


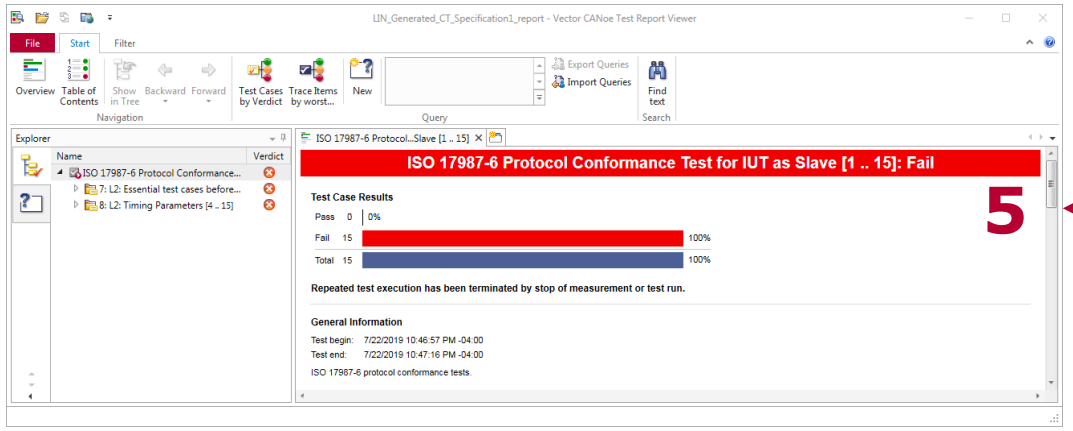
5 Steps to Insert a LIN Slave Conformance Tester





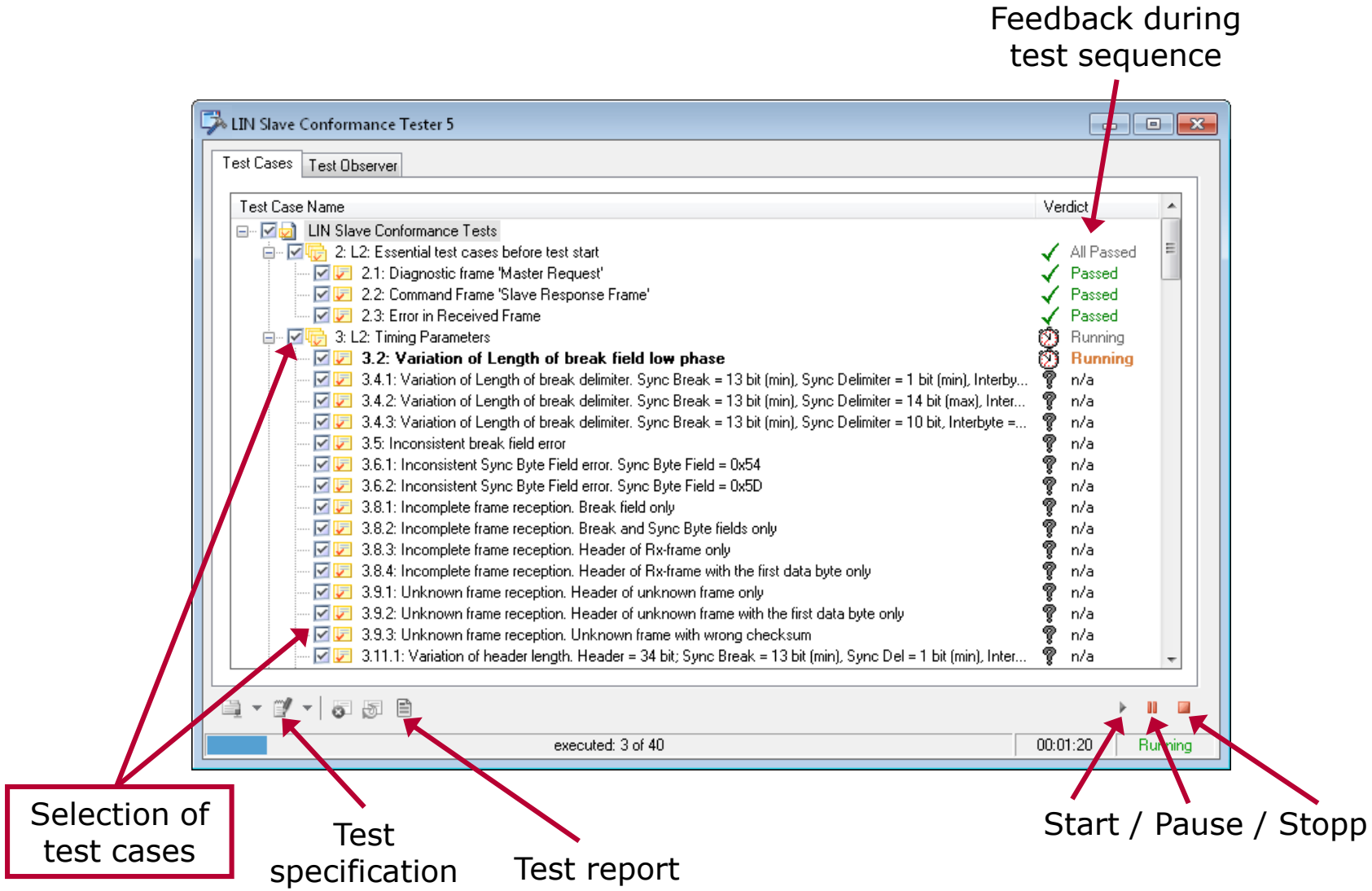






CANoe Test Report Viewer

LIN Slave Conformance Test Module (Number 4 in previous slide)



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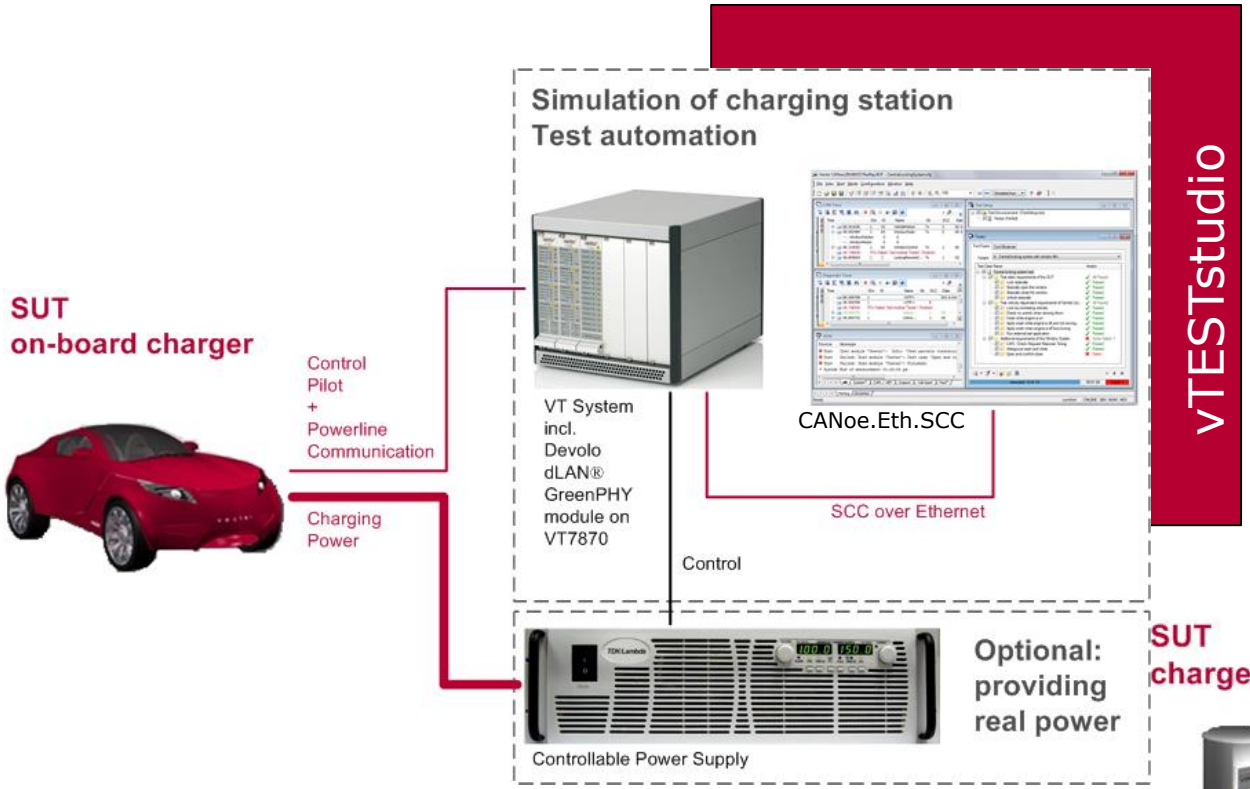
Features

- ISO15118 & DIN70121 (requires Option Ethernet)
  - Vehicle and charge point simulation
  - Analysis and monitoring
    - Man-in-the-middle and Offline analysis of the smart charging communication
    - Interpretation of the messages in the trace window
  - Support for SLAC and Vehicle2Grid protocols
  - Transport Layer Security (TLS) via Security Manager (only ISO 15118)
    - TLS communication with automatic encryption and decryption
    - Public Key Infrastructure (PKI) support and management of certificates

- GB/T 27930 (requires Option J1939)
  - Trace window analysis
    - Clear and compact presentation of the message flow
    - Interpretation of each individual GB/T 27930 message

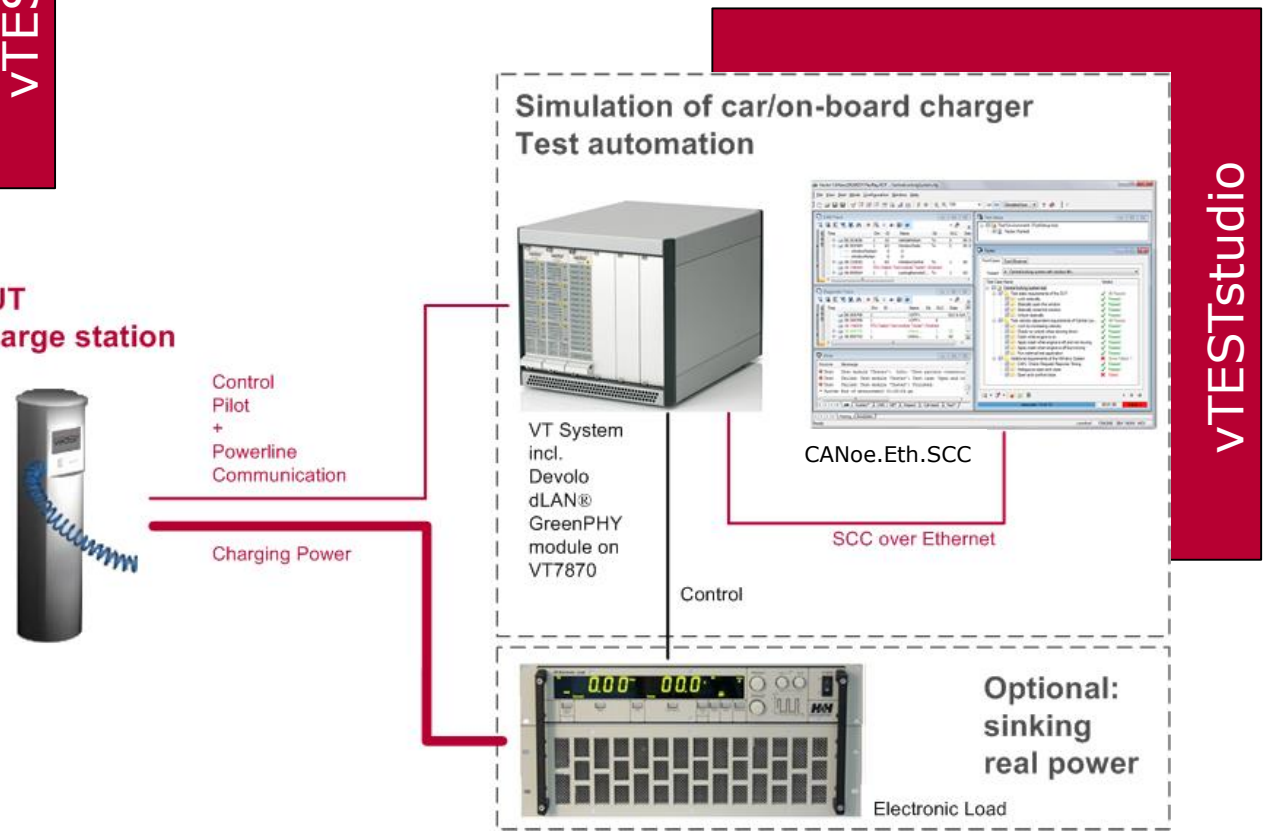
- CHAdemo (requires Option CAN)
  - Currently no special support

SCC Testing configurations



EV Test Configuration

EVSE Test Configuration



VECTOR

Smart Charging Communication Standards and Test Packages

Standard	Region	Connector	Standards
CCS (AC/DC)	US + EU	IEC 62196-2	IEC 61851 (PWM) ISO15118, DIN70121, SAE J2847 (Ethernet)
GB/T (DC)	China	GB/T 20234.3	GB/T 27930 (J1939)
CHAdeMO (DC)	Japan	CHAdeMO	CHAdeMo (CAN)

Standard	VT-Modules	Required CANoe Options	CANoe Test Packages*
CCS (AC/DC)	7900A 7870	Smart Charging Ethernet	CCS EV CCS EVSE (Next year)
GB/T (DC)	6104A/6204 2004A	Smart Charging J1939	GB/T EV (Next year) GB/T EVSE (Next year)
CHAdeMO (DC)	6104A/6204 2004A	Smart Charging (planned) CAN	CHAdeMO 2.0 EV (planned) CHAdeMO 2.0 EVSE (planned)

* vTESTstudio required

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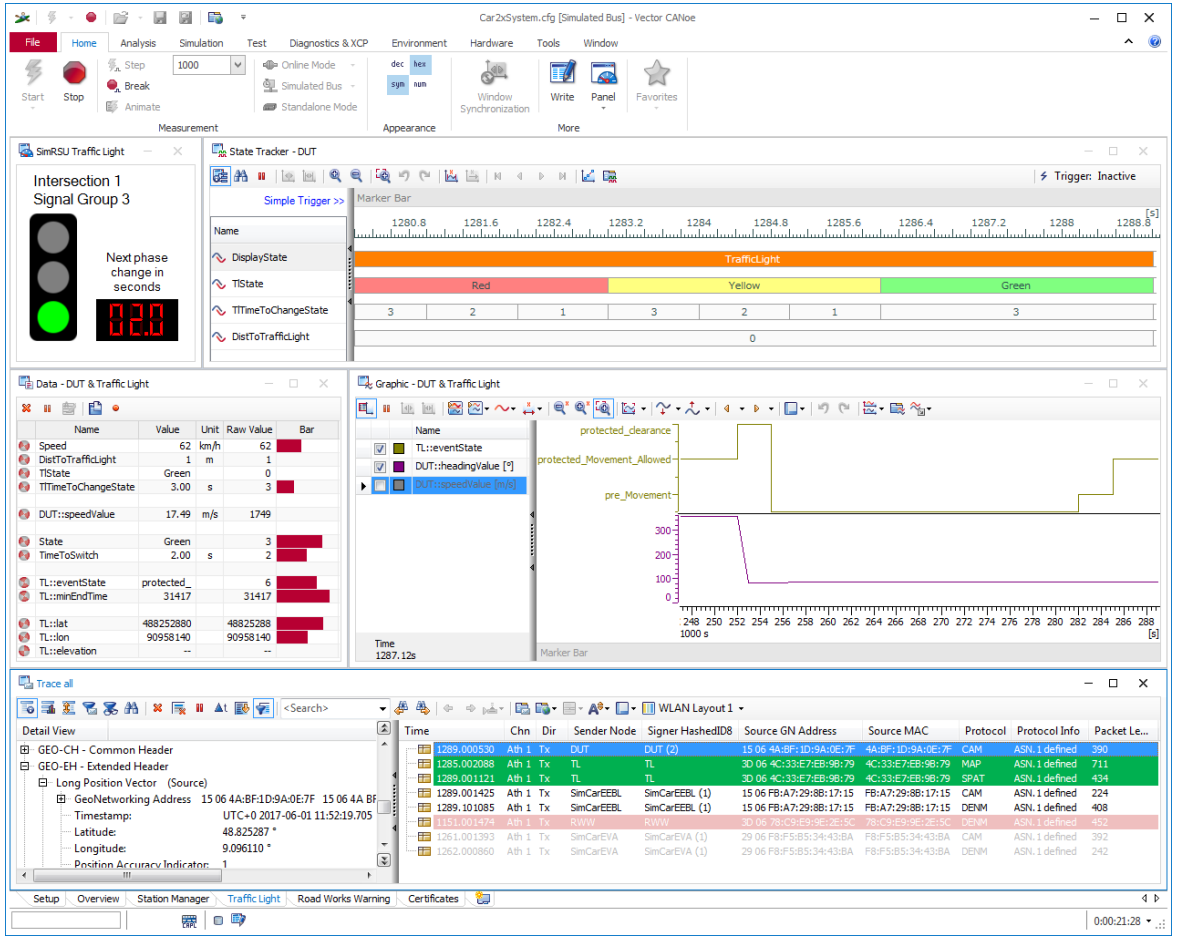
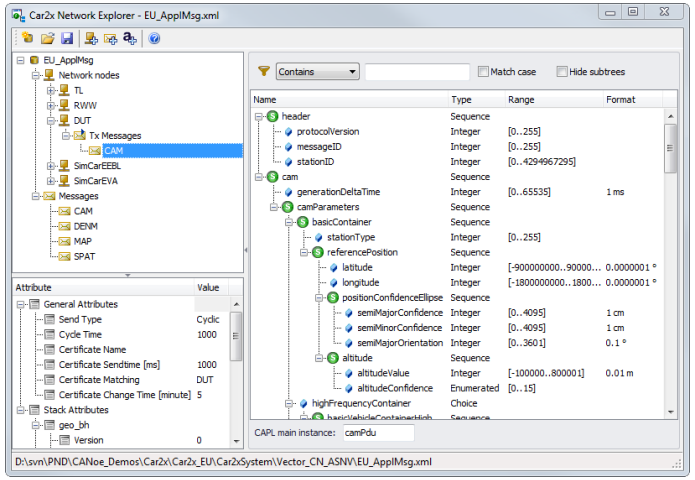
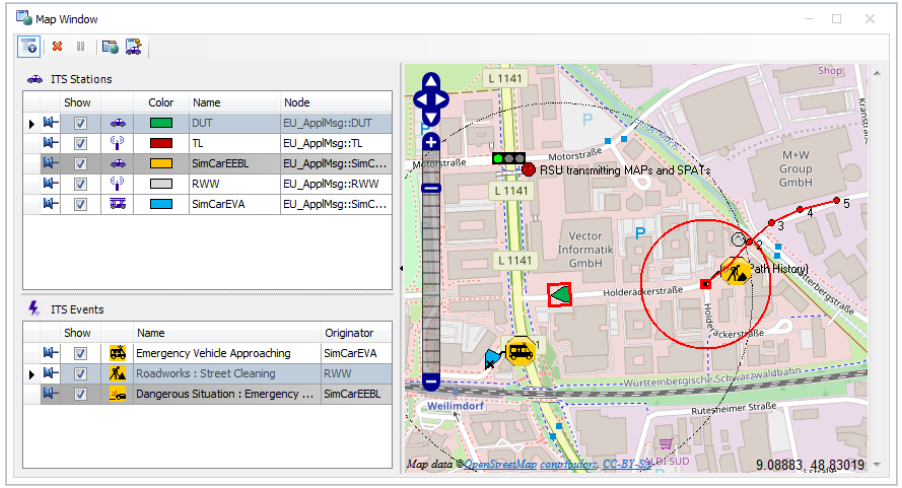
Analysis, Simulation and Test of V2X Communications







VECTOR

Simulation, analysis and test of C-V2X applications

- Quick and easy test case development with CANoe.Car2x scenario editor
  - Simulation of multiple vehicles and infrastructure elements (e.g. traffic light)
  - Generation of ITS frames following European or US standards (ETSI, WAVE/SAE)

- With Rohde & Schwarz Hardware

ROHDE&SCHWARZ

  - CMW500 for LTE-PC5 communication
  - SMBV100A for GNSS simulation

- Testing of DUT applications
  - CAN, Automotive Ethernet traffic

CANoe.Car2x with with Rohde and Schwarz Test Equipment

R&S®CMW500

Multi-technology (LTE, WCDMA, GSM and CDMA2000®) protocol tester with a layer 1 to layer 3 stack implementation

R&S®SMBV100A

Fully fledged GNSS simulator with GPS, Glonass, Galileo, BeiDou and QZSS/SBAS

Up to 24 satellites

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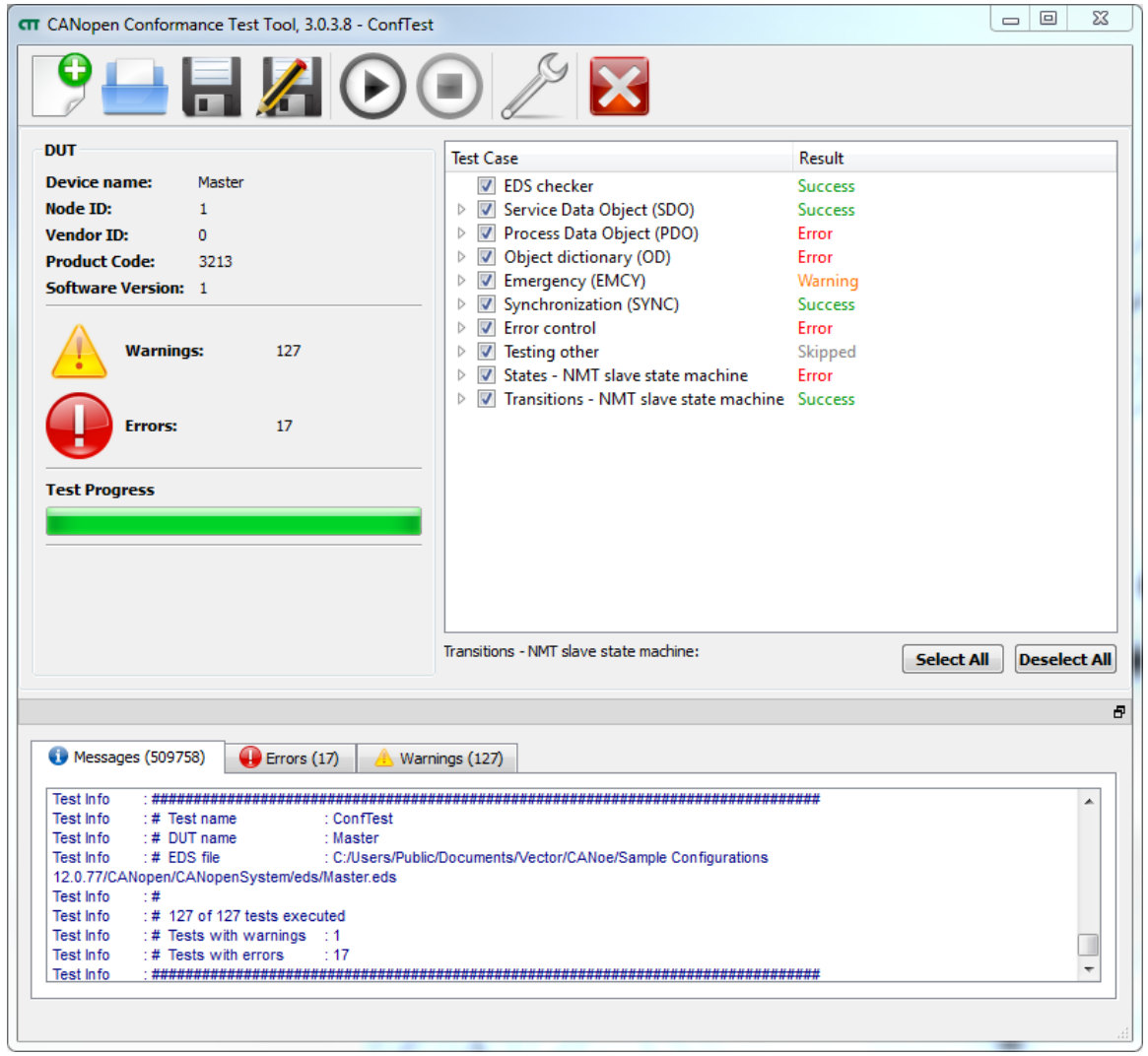
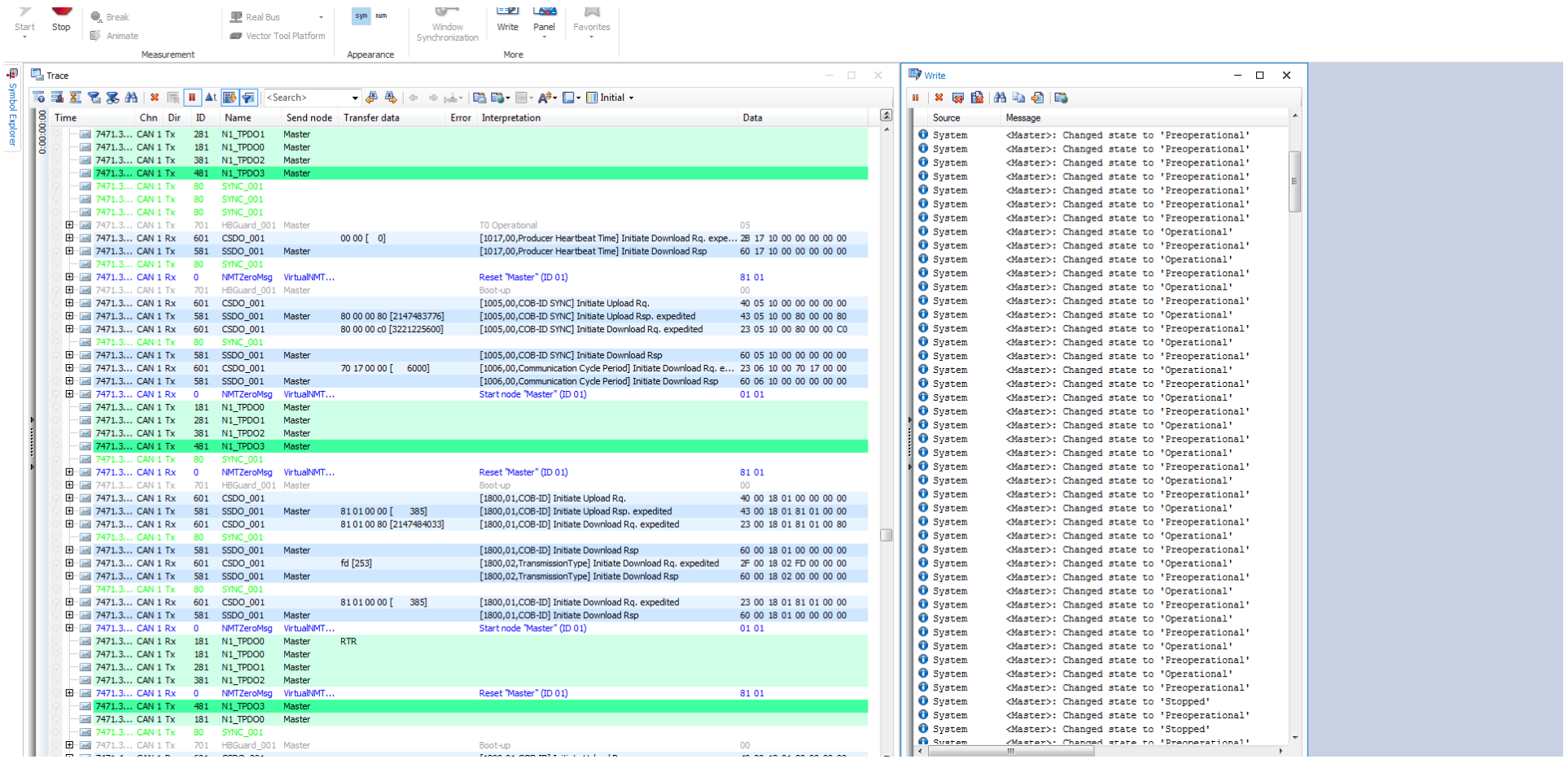
CiA CANopen Conformance Test Tool



CANoe during Conformance Test



CiA Test Report

ConfTest_11-07-2019_0001.log

```
11.07.19 : 09:42:30.888 : Test Info   : ### Prepare DUT for test ##########################################################
11.07.19 : 09:42:30.888 : Test Notice : Reset node (wait for 5000[ms])
11.07.19 : 09:42:30.888 : Test CAN    : CAN1  000 Tx SD  2  81 01
11.07.19 : 09:42:30.891 : Test CAN    : CAN1  701 Rx SD  1  00
11.07.19 : 09:42:30.891 : Test Notice : Bootup message received
11.07.19 : 09:42:30.891 : Test Notice : Restored default parameters via 1011h (wait for 500[ms])
11.07.19 : 09:42:30.891 : Test CAN    : CAN1  601 Tx SD  8  23 11 10 01 6C 6F 61 64
11.07.19 : 09:42:30.894 : Test CAN    : CAN1  581 Rx SD  8  60 11 10 01 00 00 00 00
11.07.19 : 09:42:30.894 : Test Notice : Reset node (wait for 5000[ms])
11.07.19 : 09:42:30.895 : Test CAN    : CAN1  000 Tx SD  2  81 01
11.07.19 : 09:42:30.898 : Test CAN    : CAN1  701 Rx SD  1  00
11.07.19 : 09:42:30.898 : Test Notice : Bootup message received
11.07.19 : 09:42:30.902 : Test Info   : ### Test case : 1.0  -  Test name : EDS checker ################################
11.07.19 : 09:42:30.902 : Test Info   : Check EDS file
11.07.19 : 09:42:30.908 : Test CAN    : CAN1  7FF Tx SD  6  01 01 00 00 00 00
11.07.19 : 09:42:31.030 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:31.230 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:31.430 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:31.630 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:31.830 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:32.030 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:32.230 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:32.430 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:32.630 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:32.830 : Test CAN    : CAN1  080 Rx SD  0
11.07.19 : 09:42:33.005 : Test Notice : CANchkEDS 2.4.15.0
11.07.19 : 09:42:33.005 : Test Notice : (c)2000-2008 Vector Informatik GmbH
11.07.19 : 09:42:33.005 : Test Notice : Open file C:\Users\Public\Documents\Vector\CANoe\Sample Configurations 12.0.77\CANopen\CANopenSystem\eds\Master.eds ...
11.07.19 : 09:42:33.005 : Test Notice : Checking ...
11.07.19 : 09:42:33.005 : Test Notice : Check is finished
11.07.19 : 09:42:33.005 : Test Notice : No errors or warnings detected
11.07.19 : 09:42:33.005 : Test Notice : CANchkEDS 2.4.15.0
11.07.19 : 09:42:33.005 : Test CAN    : CAN1  7FF Tx SD  6  02 01 00 00 01 00
11.07.19 : 09:42:33.006 : Test Info   : EDS checker: Passed
11.07.19 : 09:42:33.007 : Test Info   : ### Test case : 2.1  -  Test name : SDO 01 ###################################
11.07.19 : 09:42:33.007 : Test Info   : Read 1000h:00h with expedited transfer.
11.07.19 : 09:42:33.009 : Test CAN    : CAN1  7FF Tx SD  6  01 02 01 00 00 00
11.07.19 : 09:42:33.009 : Test Notice : SDO 01: Read object 1000h:00h
11.07.19 : 09:42:33.009 : Test CAN    : CAN1  601 Tx SD  8  40 00 10 00 00 00 00 00
11.07.19 : 09:42:33.012 : Test CAN    : CAN1  581 Rx SD  8  43 00 10 00 95 01 00 00
```

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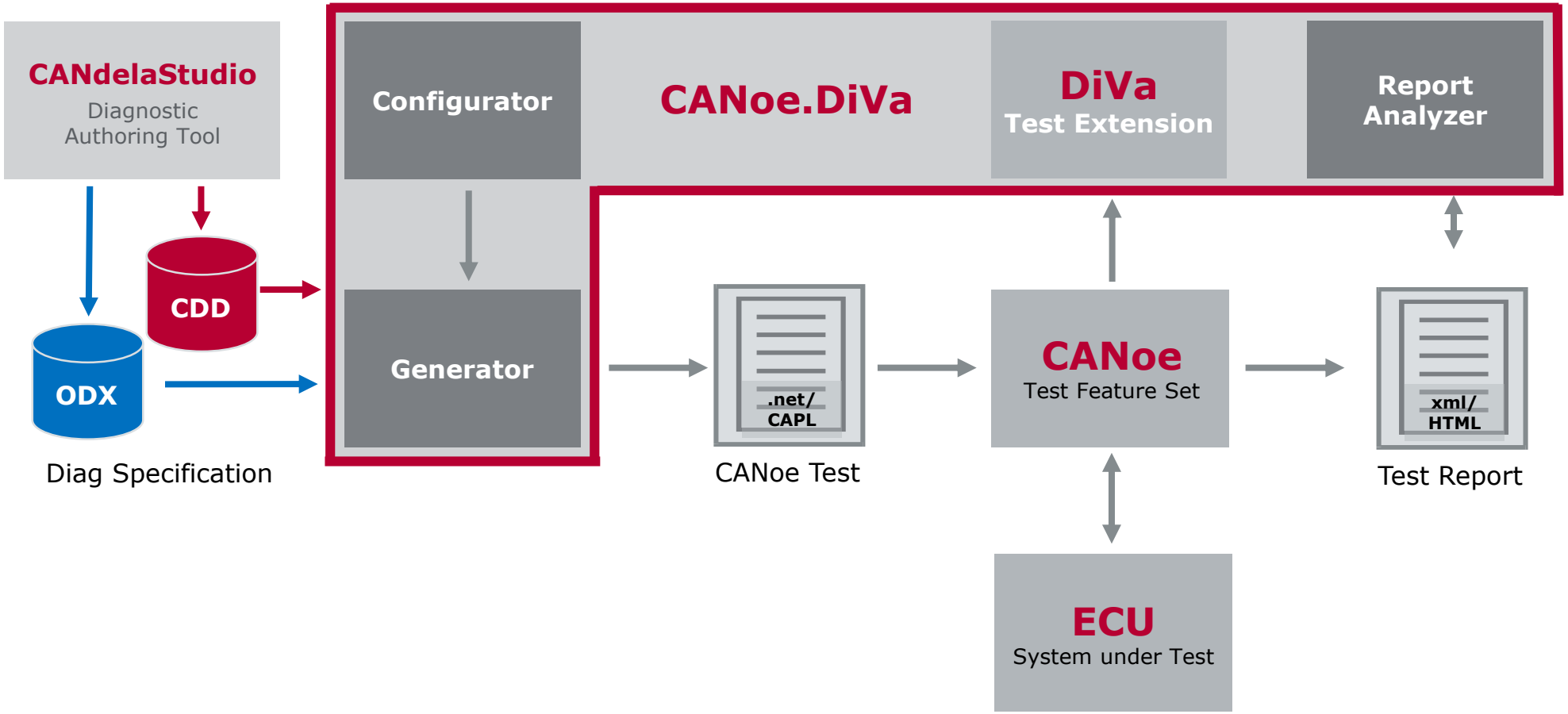
The Diagnostics Tool chain



Much more information at 2:15 this afternoon with PDG BDM, Vivek Jolly

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Application and hardware requirements

	Ethernet (TC8)	J1939	LIN	SCC	Car2x	CANopen	DiVa (Diagnostics)
CANoe	✓	✓	✓	✓	✓	✓	✓
.Ethernet	✓			✓			
.J1939		✓		✓ GB/T			
.LIN			✓				
.SCC				✓			
.Car2x					✓		
.CANopen						✓	
.DiVa							✓
vTESTstudio	✓	✓	✓	✓	✓	✓	✓
VT System			Optional or VH1150	✓			
VT7870 (+2)				✓			
R & S Test Equipment					✓		
Network Interface(s)	✓	✓	✓	✓	✓	✓	✓
SCC Test Package(s)				✓			
CiA Test Tool						✓	

✓ = required

✓ = recommended for additional test development

For more information about Vector
and our products please visit

www.vector.com

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Koncsol, Jeff
Vector North America