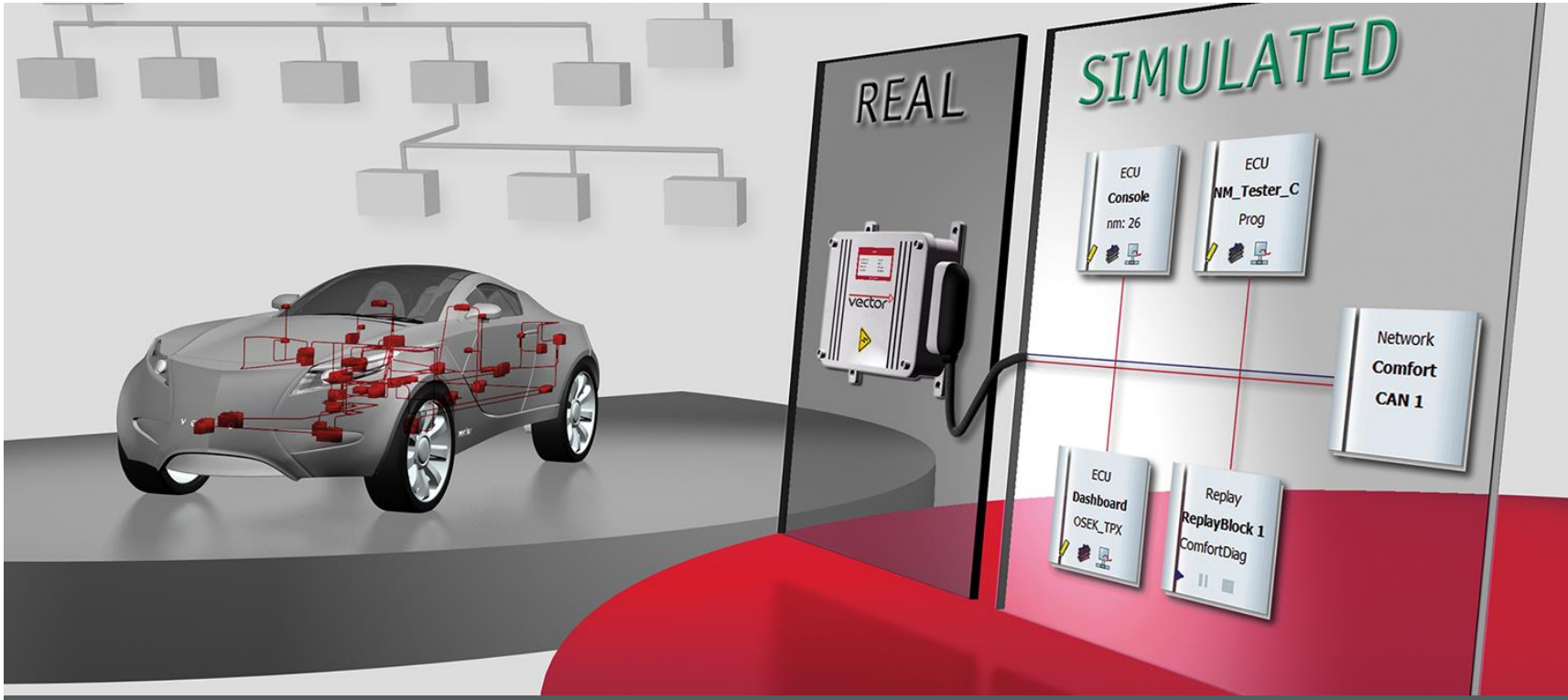
VECTOR



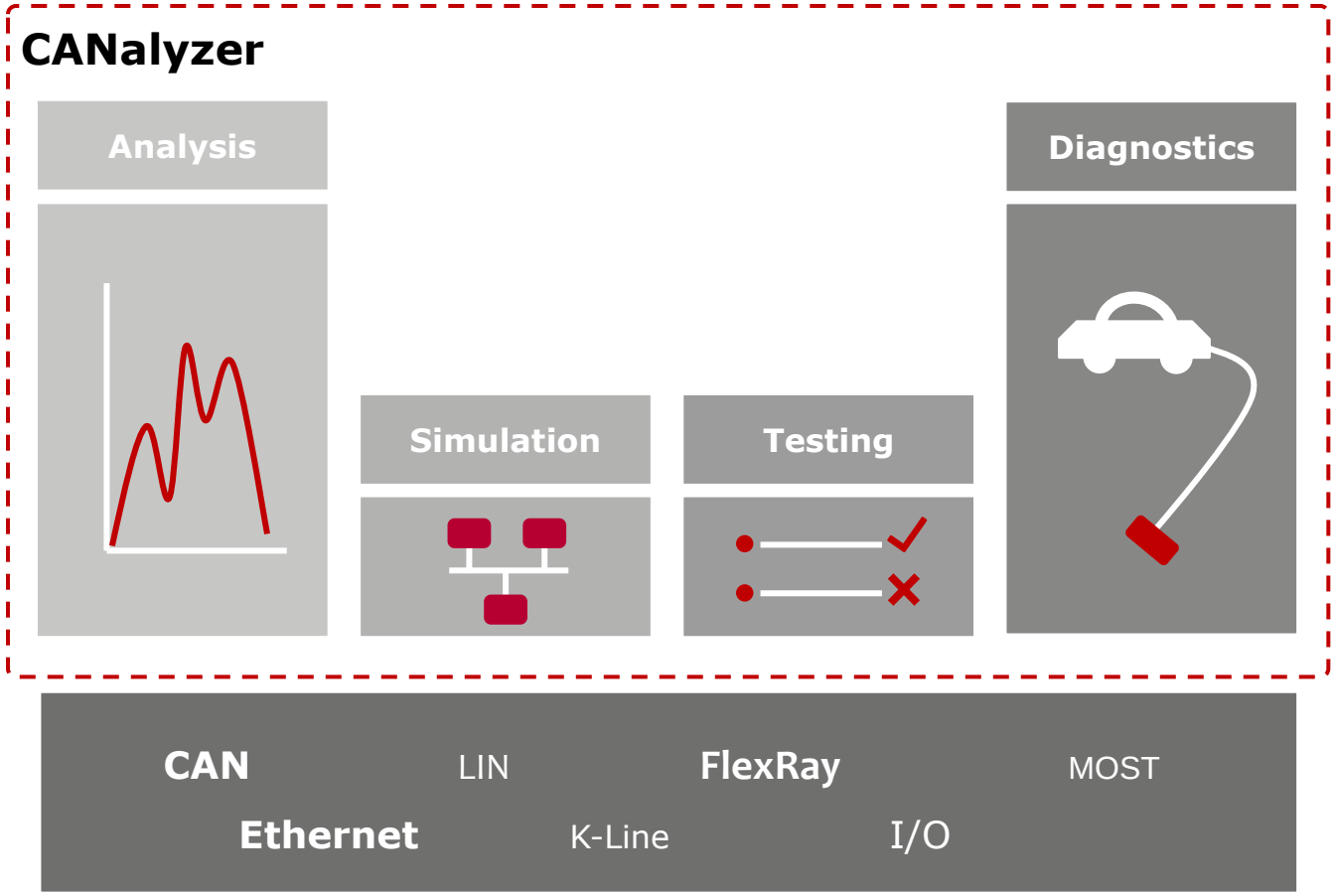
CANoe/CANalyzer

Tools for comprehensive CAN Network Analysis and Test - An Overview

Agenda

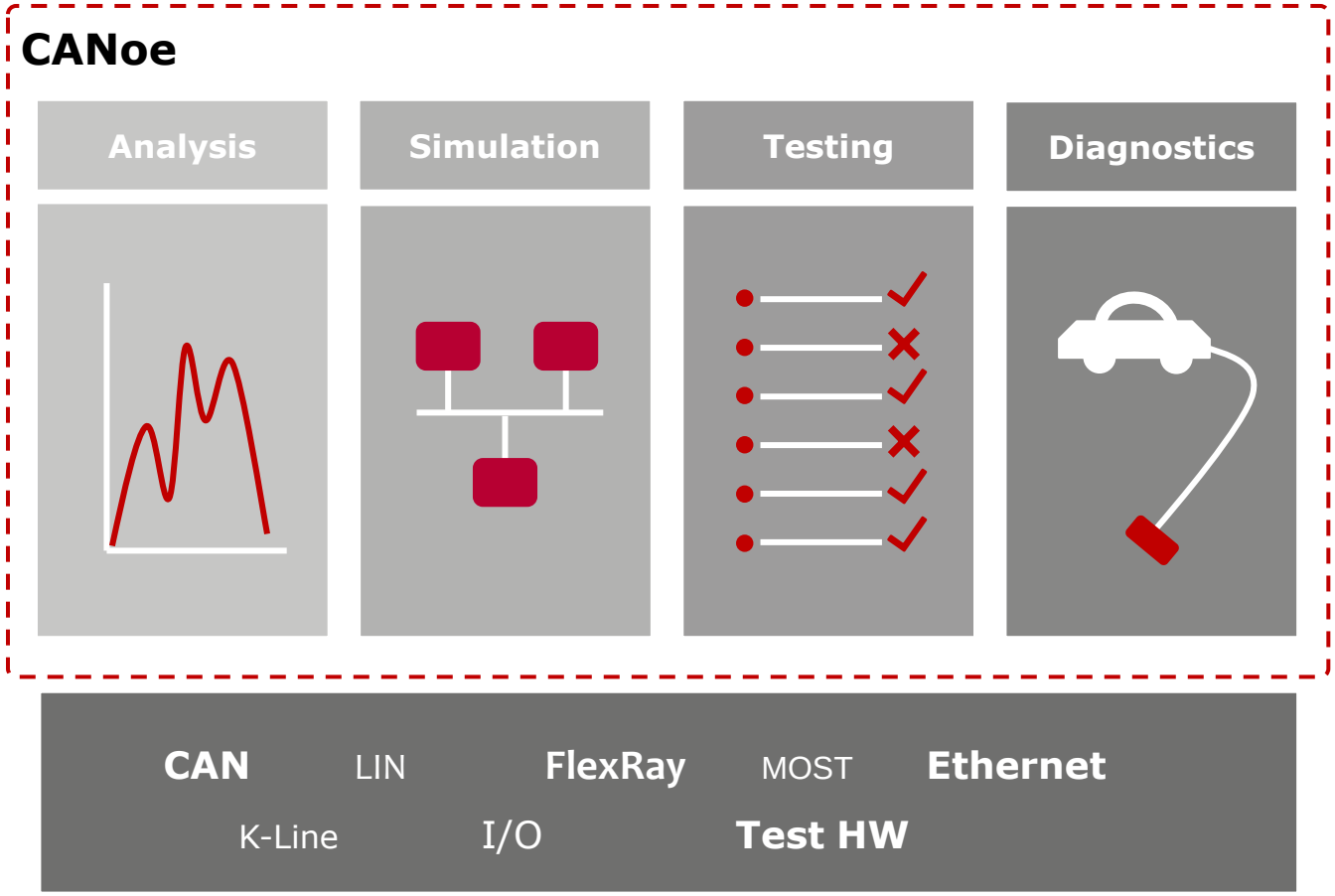
- **Overview**
- Measurement and Simulation Setup
- Working with Databases
- Analysis Windows
- Data Logging
- Offline Mode
- Simulation
- Testing
- Scalability
- Release Information
- General
- Scope
- Sensor
- CAN / CAN FD / CANopen

CANalyzer and CANoe: What is the difference?



CANoe and CANalyzer offer powerful functions for analysis, simulation, testing and diagnostics.

CANalyzer and CANoe: What is the difference?



CANoe and CANalyzer offer powerful functions for analysis, simulation, testing and diagnostics.

Basic Setup

Input

DBC, ARXML, FIBEX (CAN, CAN FD)

DBC, FIBEX, ARXML (Ethernet)

CDD, ODX, MDX (Diagnostics)

FIBEX, ARXML (FlexRay)

LDF (LIN)

EDS/DCF/XDD/XDC (CANopen)

CANoe / CANalyzer

Configuration Files

Templates

Vector Network Interface

CAN*, CAN FD, LIN

Ethernet

FlexRay

*3,3V TI SN65HVD233HD Transceiver available

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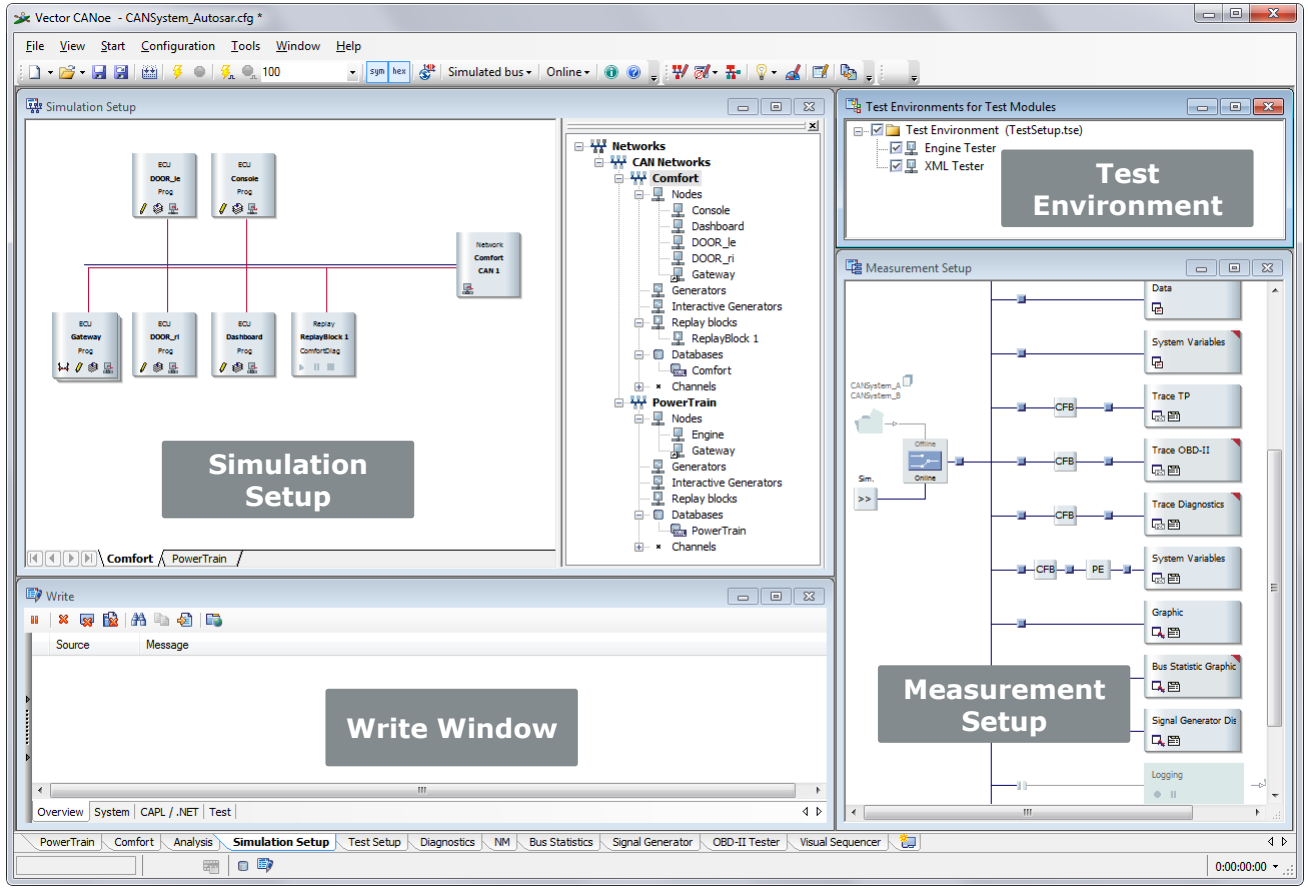
Main Windows in CANoe



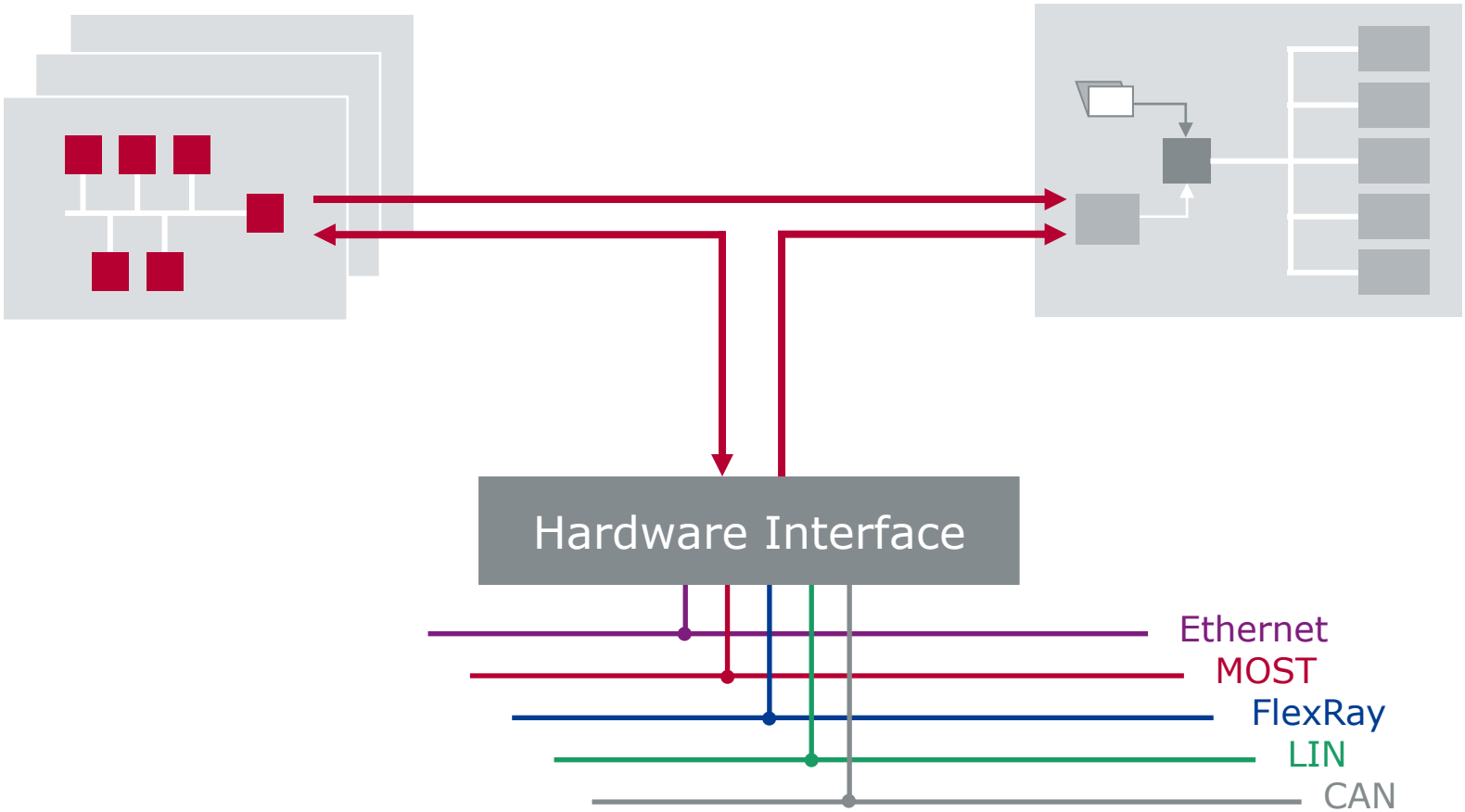
Symbol Databases:

dbc, fibex, arxml, ldf

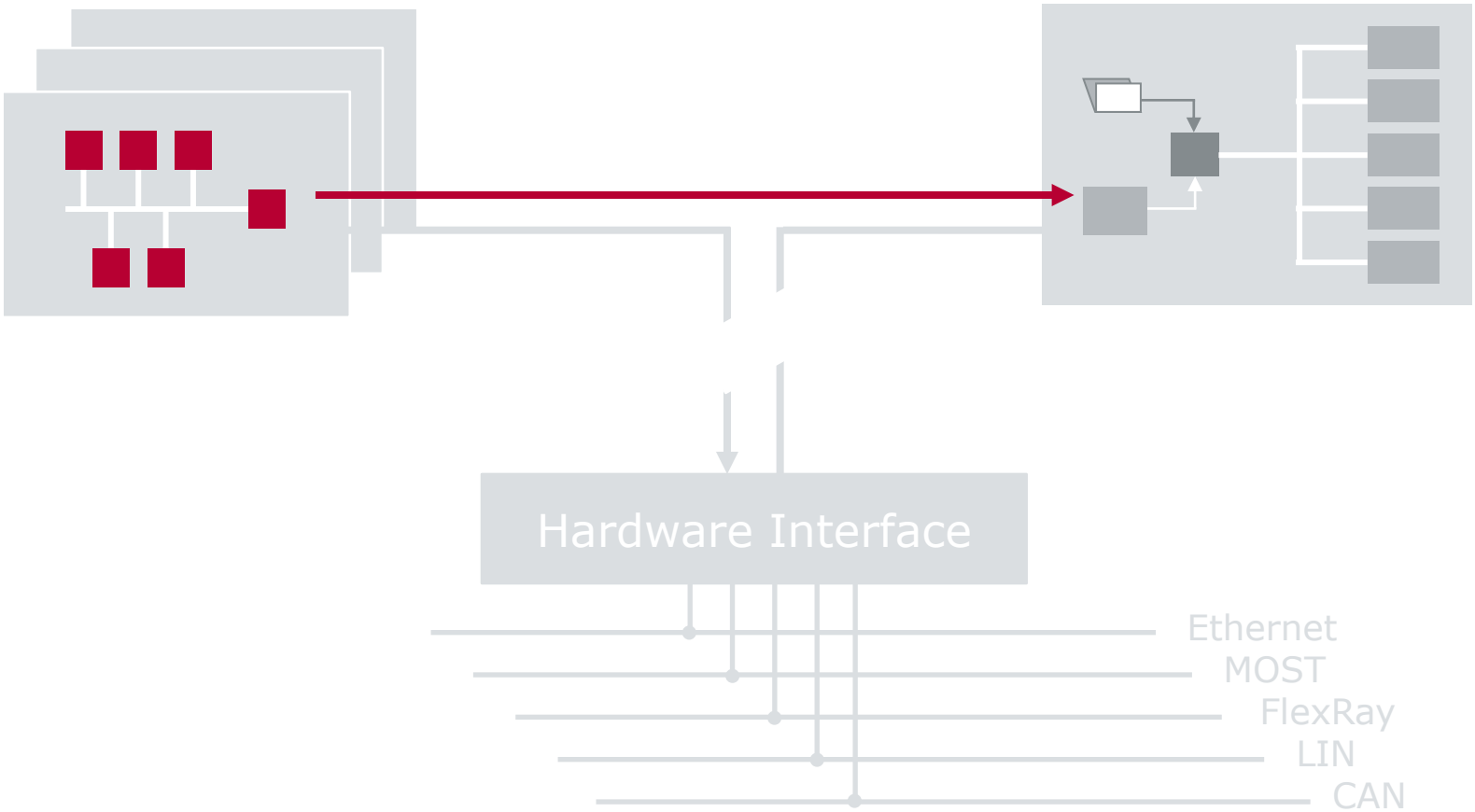
Test Modules

System/Error Messages, Warnings, CAPL output…

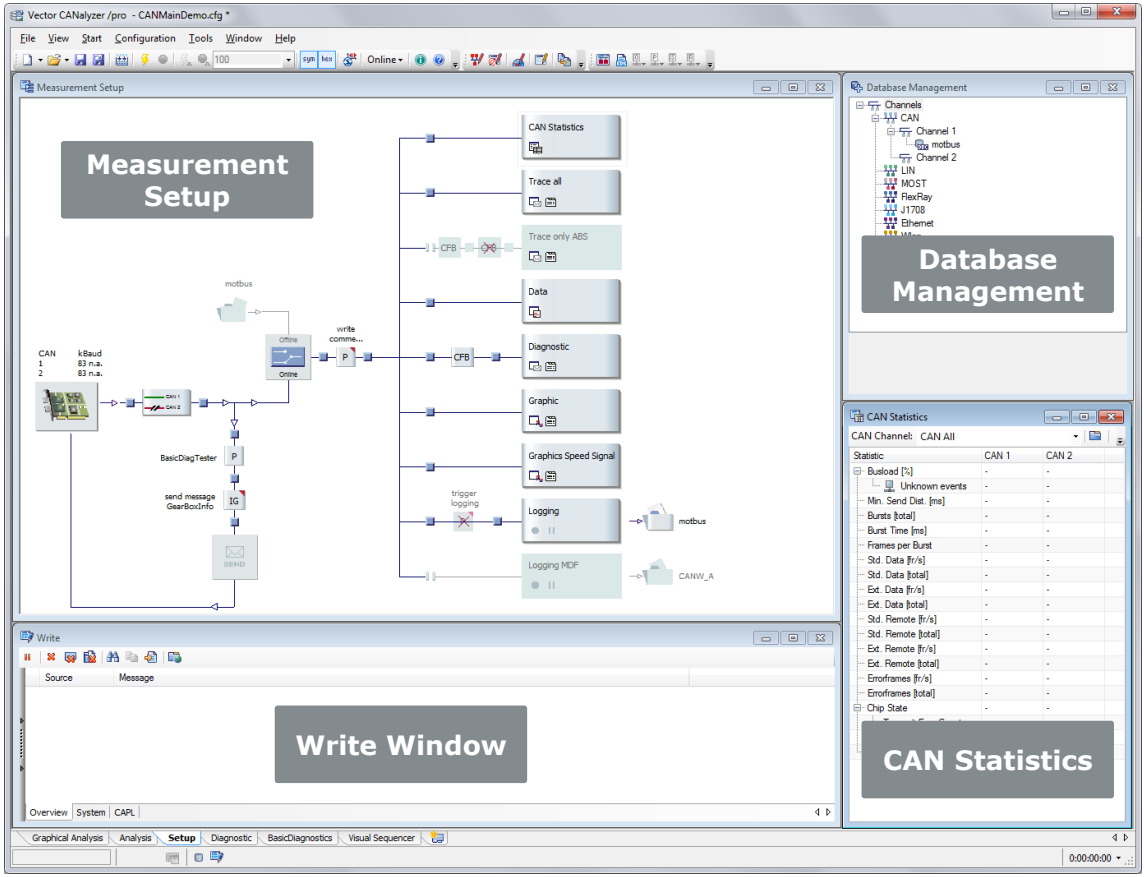
Data Flow in CANoe (Real Bus Mode)



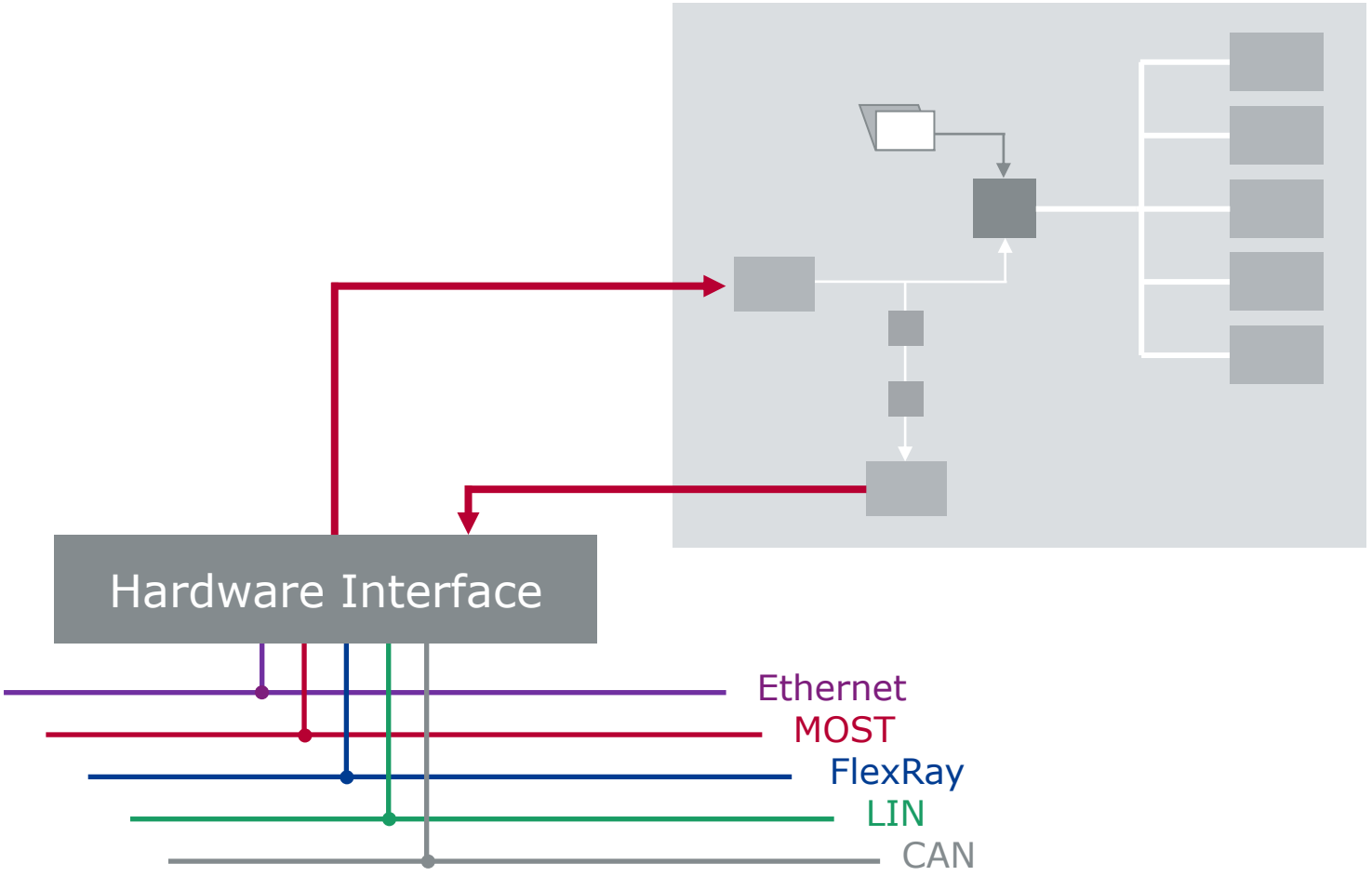
Data Flow in CANoe (Simulated Bus Mode)



Main Windows in CANalyzer



Data Flow in CANalyzer



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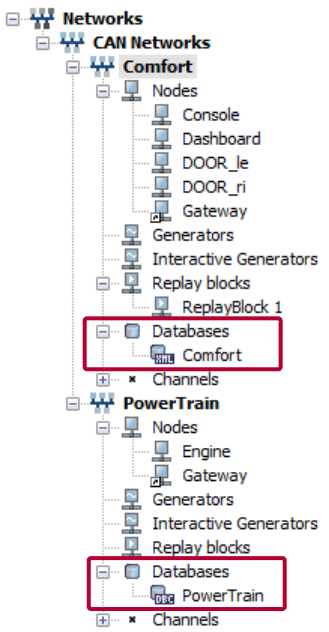
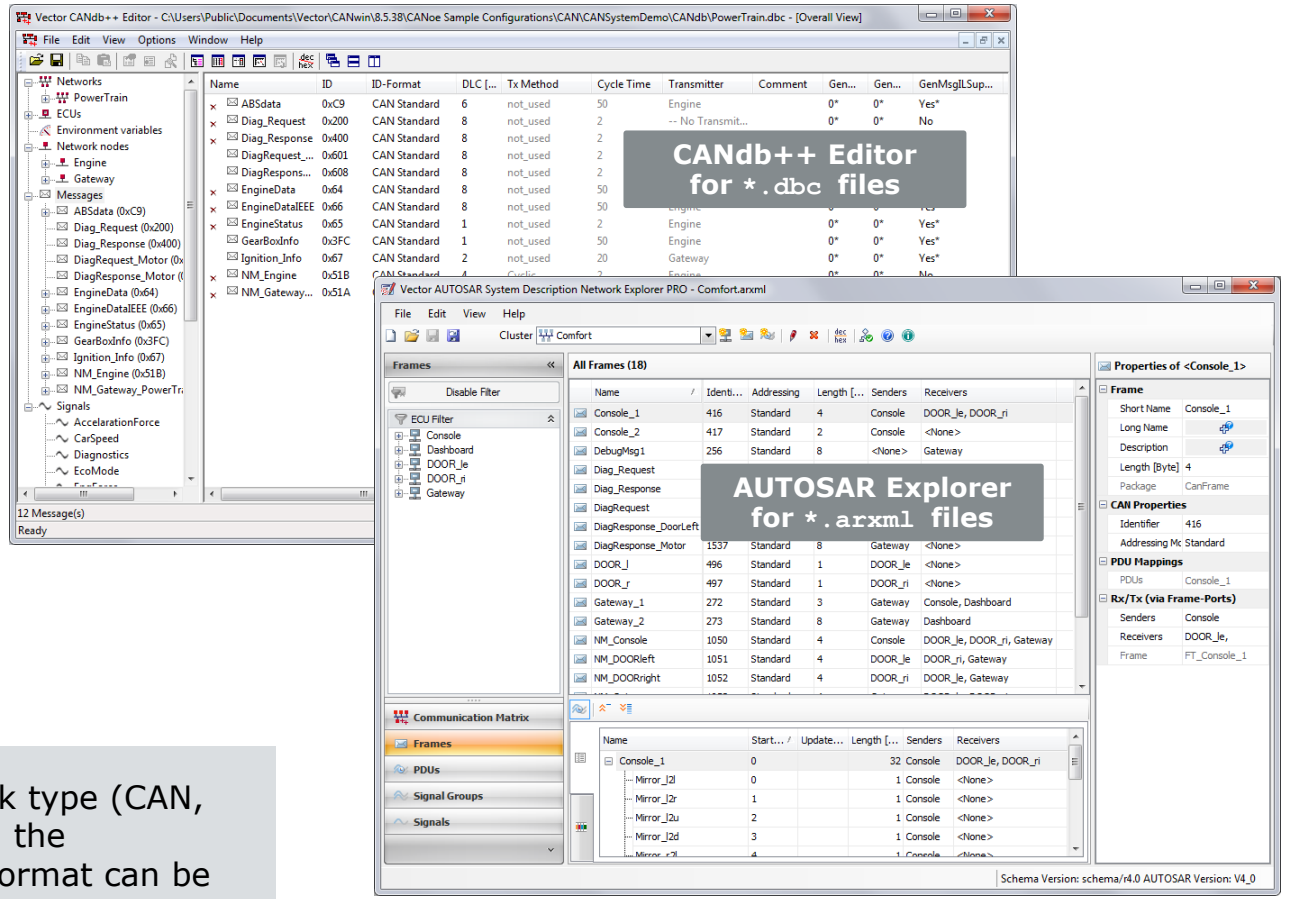
Assigning a Database

In CANoe's Simulation Setup, one or more databases can be added to the defined networks:



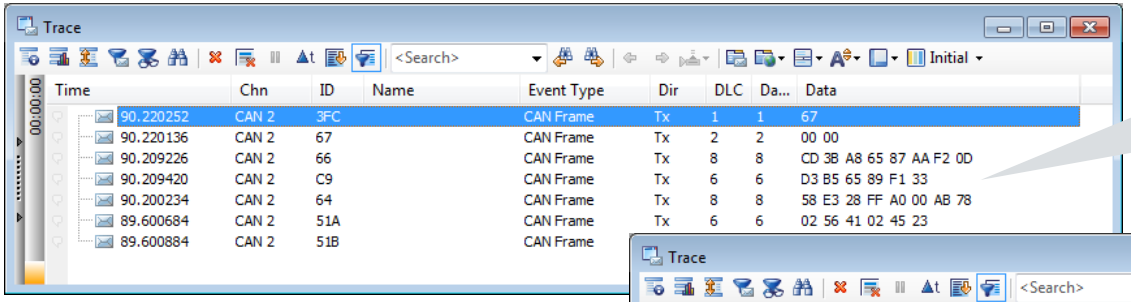


Depending on the network type (CAN, LIN, FlexRay, Ethernet…), the corresponding database format can be selected.

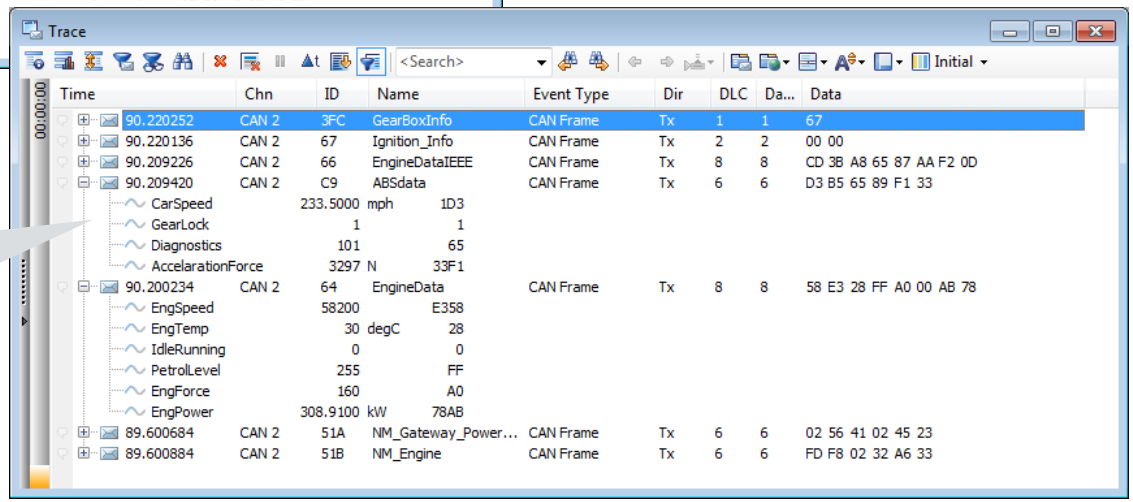
Effect in Analysis

Among other things, databases contain:

- Assignment between message identifier and symbolic message name
- Signal descriptions



Without database assignment, there is no symbolic interpretation of the data



With database assignment, messages are displayed with their symbolic names and described signals

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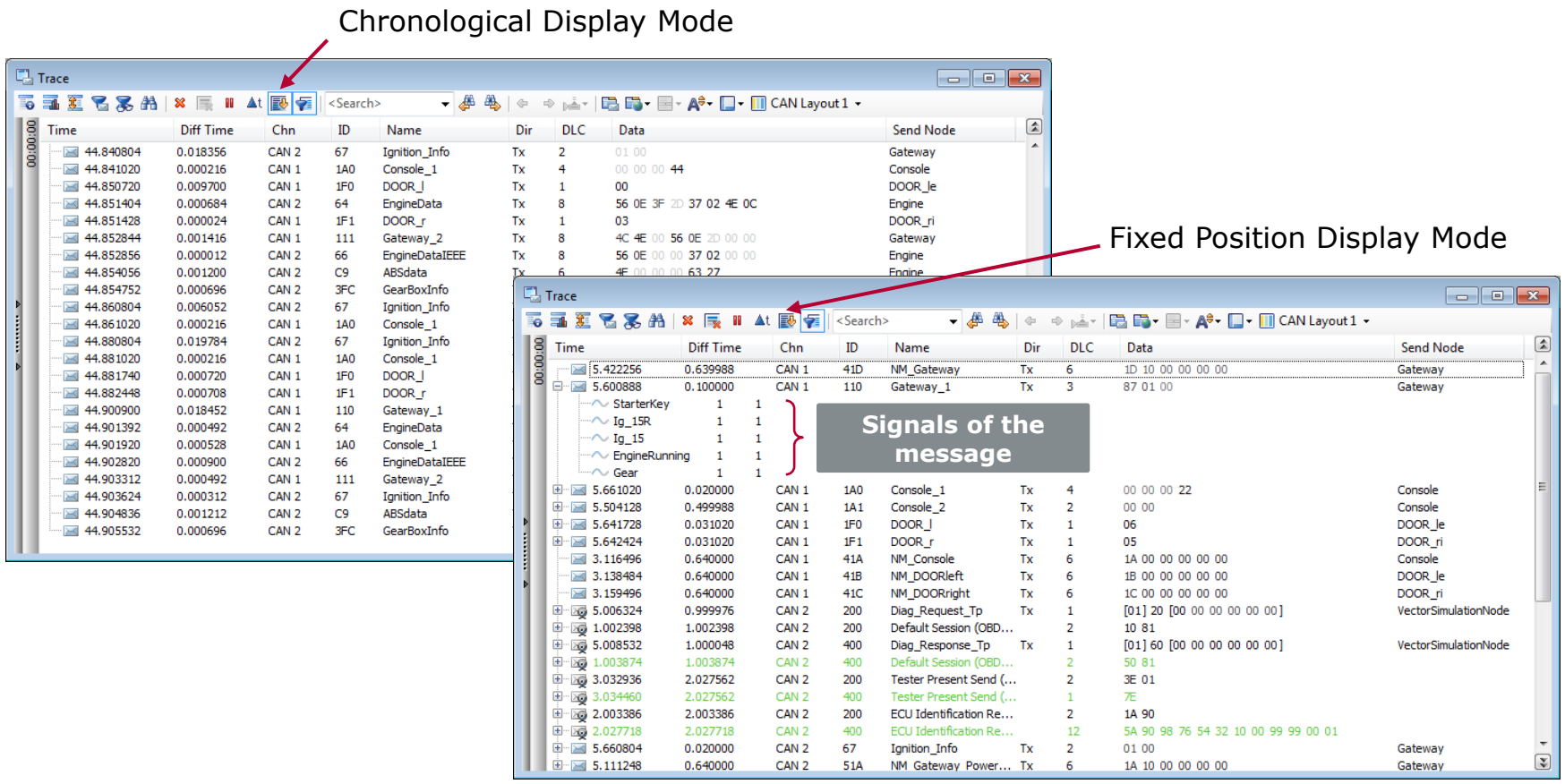
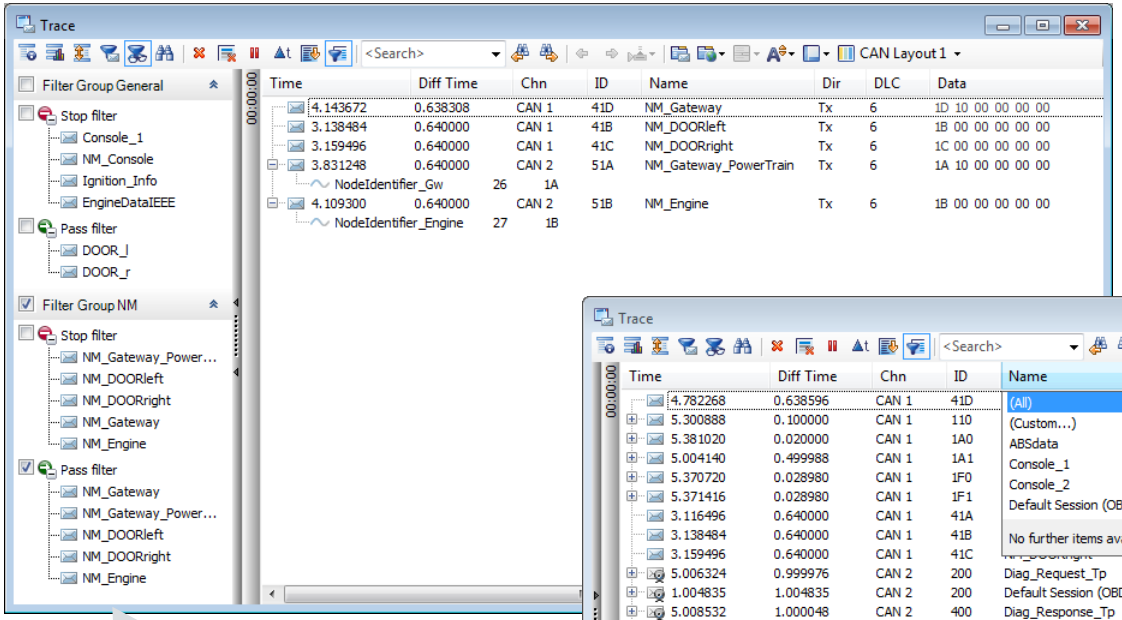
Trace Window

Messages are displayed as line of text in the Trace Window. When choosing the Fixed Position Display Mode, signals can also be displayed.

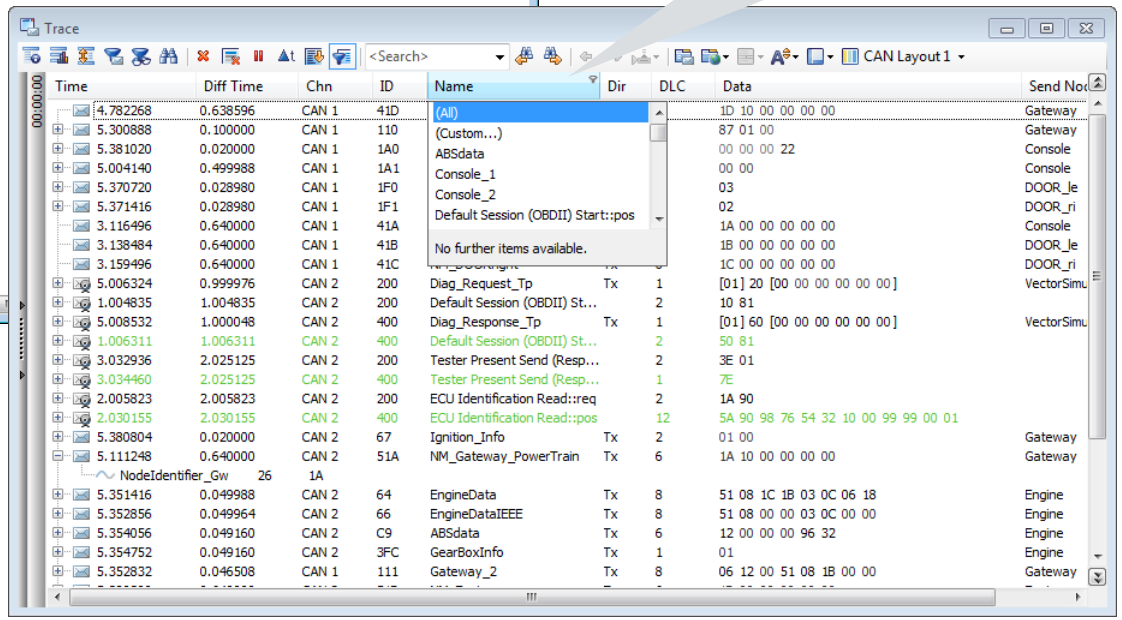


Trace Window – Filter Options

Different filter options are available in the Trace Window. They can be activated and deactivated during the measurement:



Column Filters can be configured for every column during running measurement

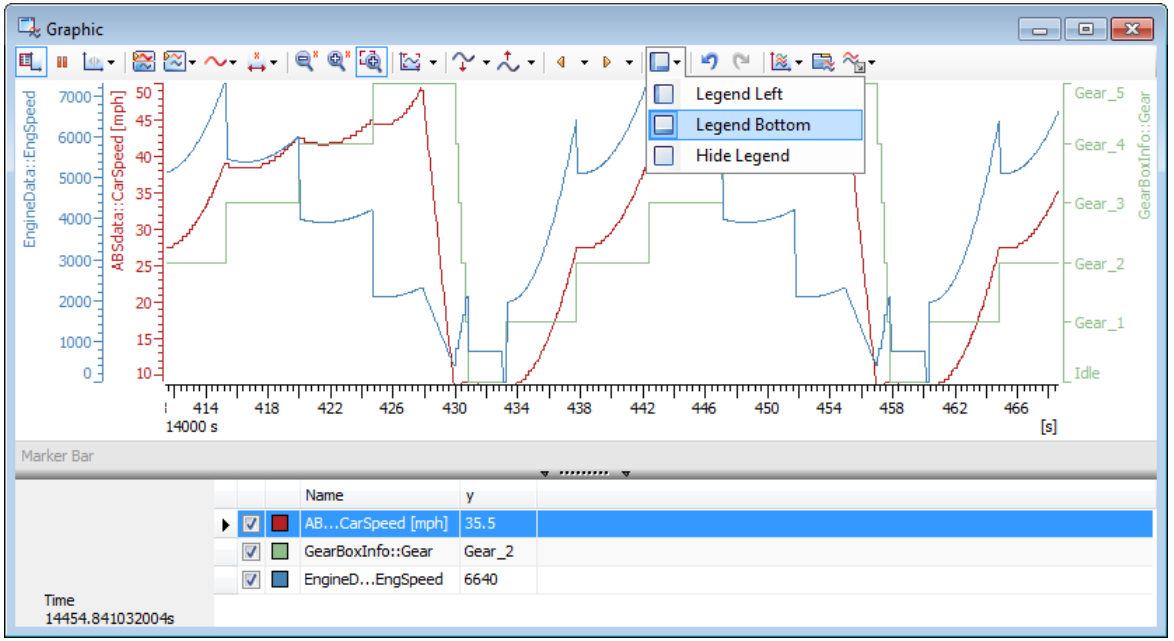


In the analysis filters area, *Stop and Pass Filters* can be configured

Graphics Window

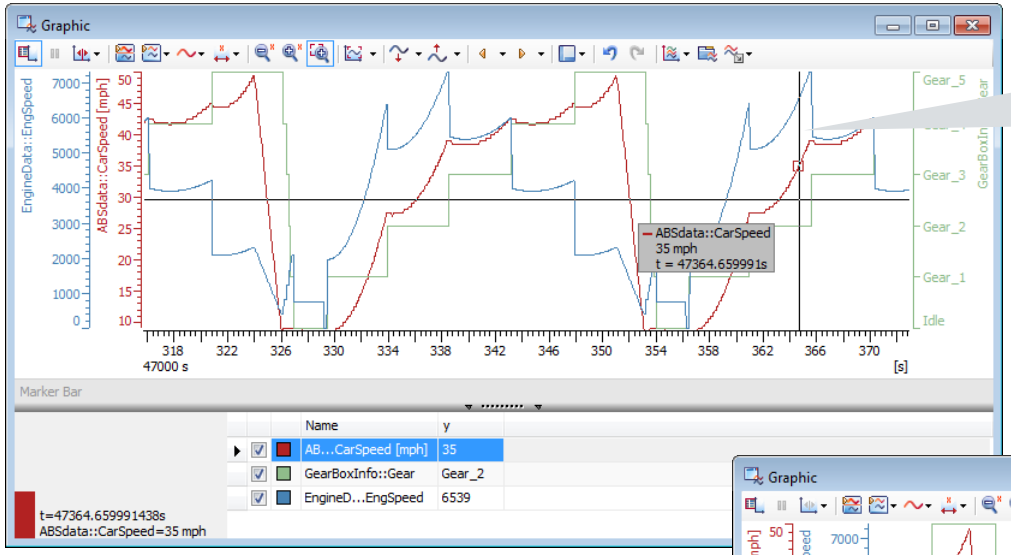
In the Graphics Window symbols are displayed graphically in an XY diagram:

- Symbols are Signals, Variables and Diagnostic Parameters
- Symbols can be added to the Graphics Window via context menu or drag &drop
- Various functions are available for highlighting/hiding curves and their measurement points
- A Legend can be displayed

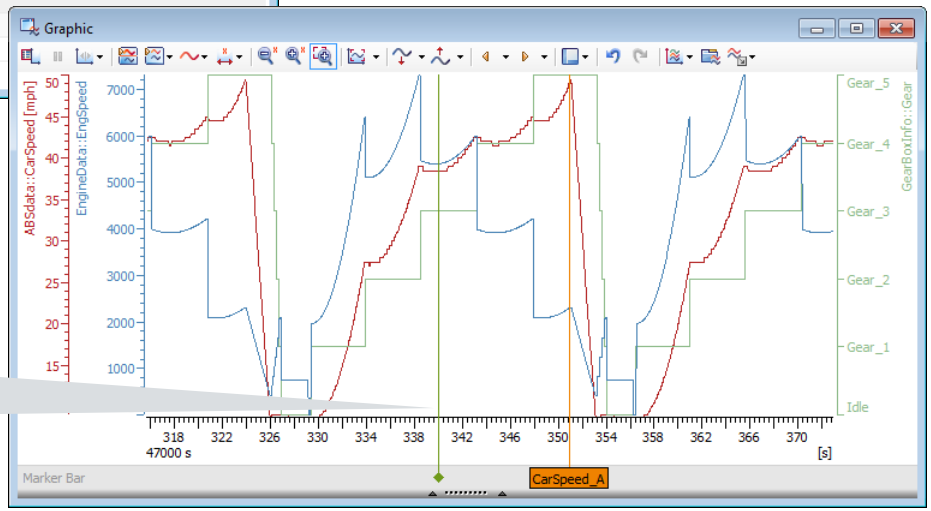


Graphics Window – Measurement and Evaluation

Various functions allow to measure and evaluate the curves:



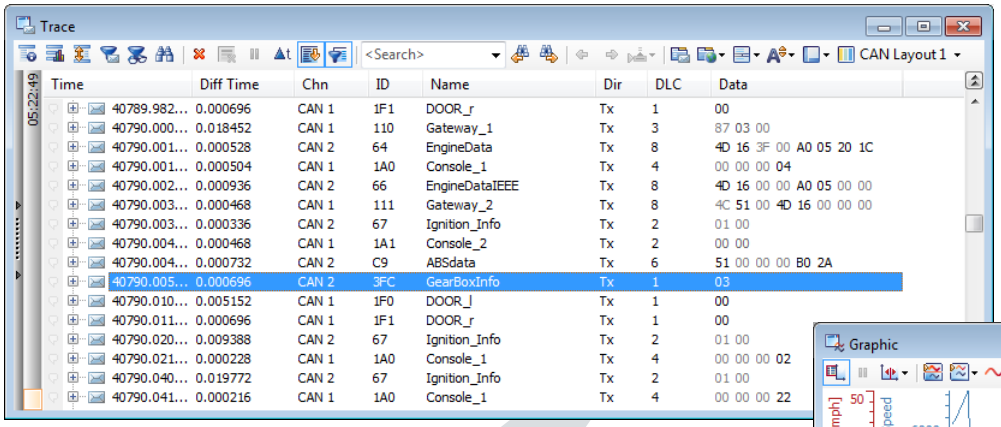
Measurement Cursor and Difference Cursors for absolute and relative value analysis



Markers can be set to easily tag and locate different points in time of a measurement

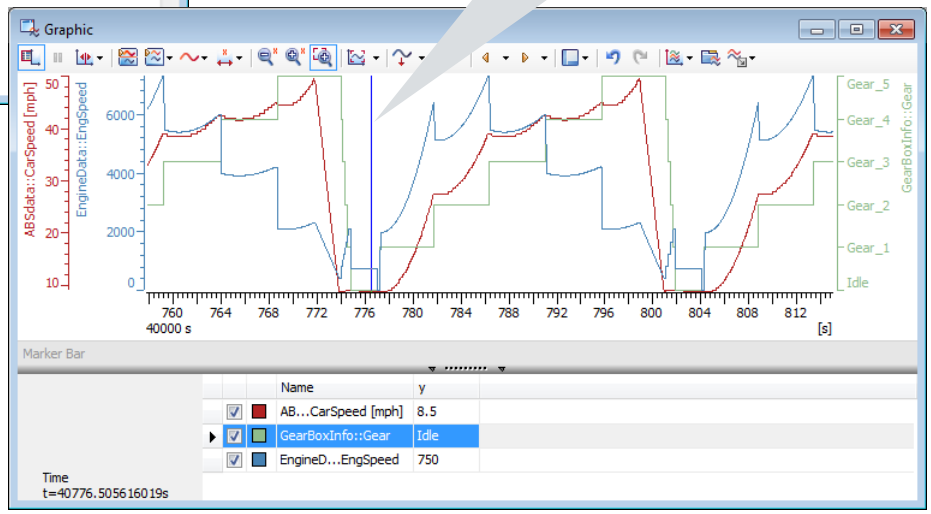
Synchronize Windows

Data can be analyzed synchronously after stop of measurement. Amongst others, synchronization of analysis windows is supported in Trace and Graphics Windows.



When moving the measurement curser in Graphics Window, the corresponding message in Trace Window is marked

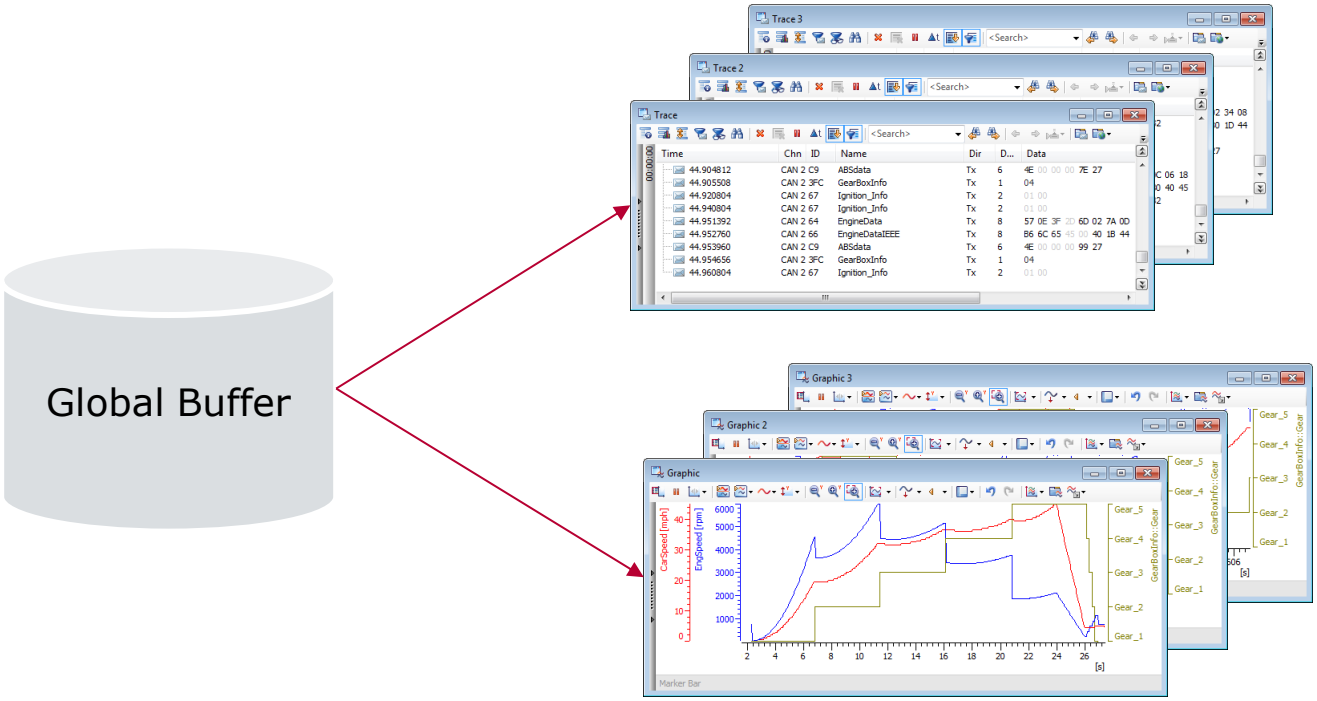
When marking a message in the Trace Window, the corresponding event in the synchronized Graphics Window is marked by a blue measurement curser



Data History

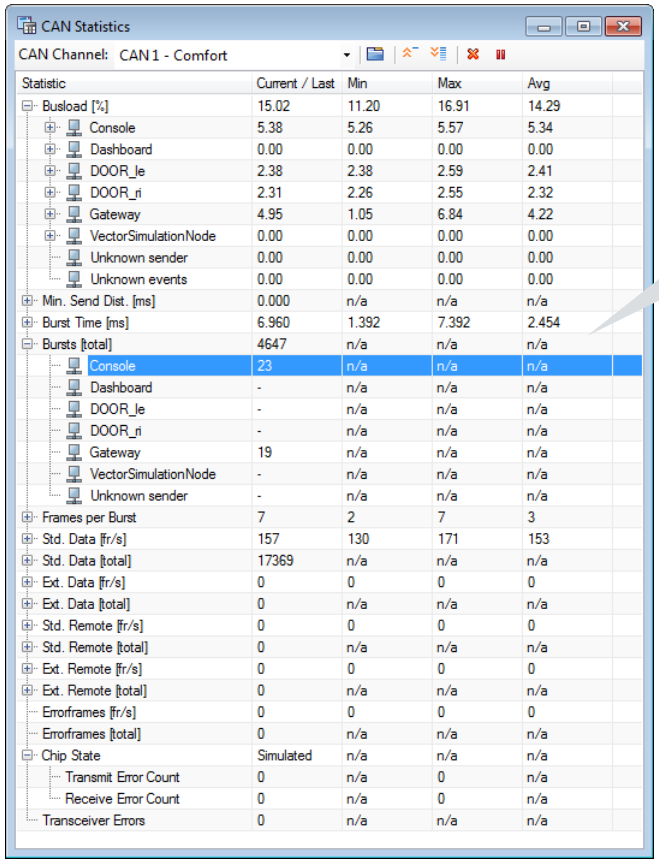
CANoe saves measured data from Trace and Graphics Window in a Global Buffer. The size of the buffer, hence the length of the data history, is influenced by the hard disk space used:

- Maximum data history: up to 200GB swap file
- Short data history: no swap file, smallest system stress



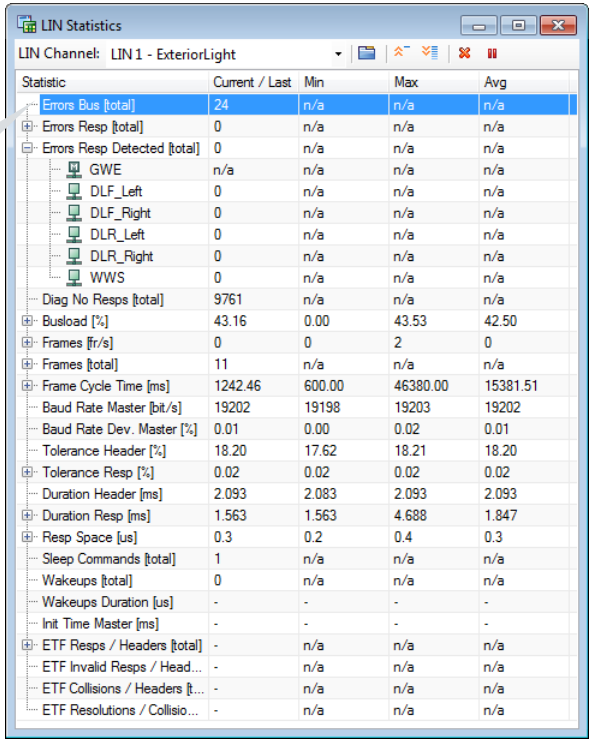
Statistics Window

The Statistics Window displays statistics of bus activities during measurement:



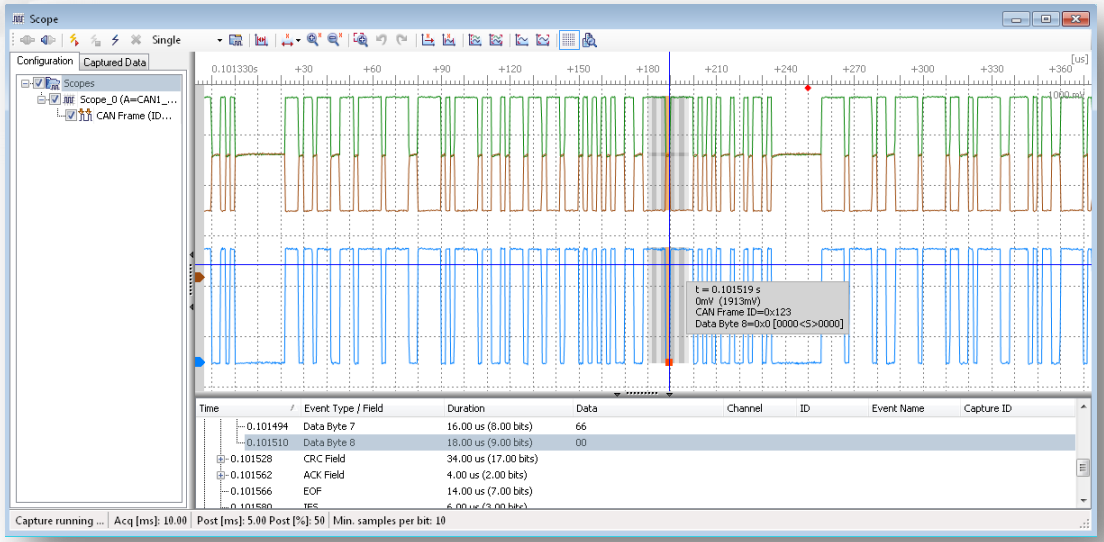
Total number of bursts during the measurement as well as the burst time

Error Statistics (Bus specific)



Option Scope

- Integrated oscilloscope solution for CANoe and CANalyzer
- Powerful combination of USB scope and development/analysis tool
- Scope triggered via sync line of Vector bus interfaces
  - e.g. VN1630/40, VN7600, VN8970, CANcardXLe, XL-Family

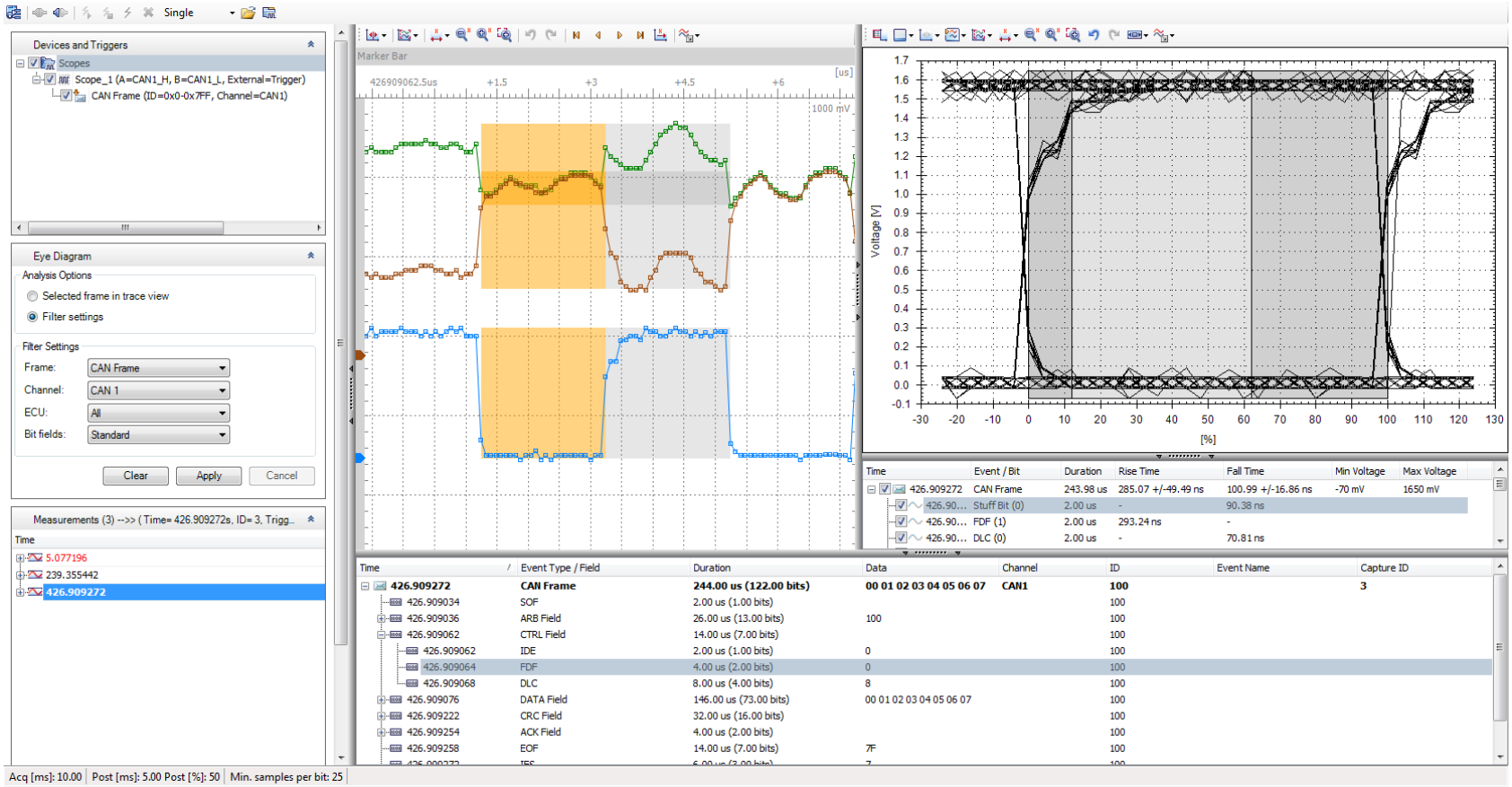


Scope Hardware

- USB precision oscilloscope with up to 4 channels and 200 MHz bandwidth
  - USB-powered for 2 channels (1 CAN/FR or 2 LIN/IO)
  - External power supply needed for 4 channels (2 CAN/FR or 4 LIN/IO)
- 500 MS/s sampling rate with up to 512 MS buffer
- Bus connection via Scope Bus Probe with DSUB bus connector
- External triggering via sync line of bus interface
  - Connection via Scope Trigger Y-Cable for Vector interfaces
- Only available from Vector

Scope Window

- Synchronized views for scope signal and bus events
- Analysis of CAN signals
- Eye diagram to determine wiring quality and optimal sampling point



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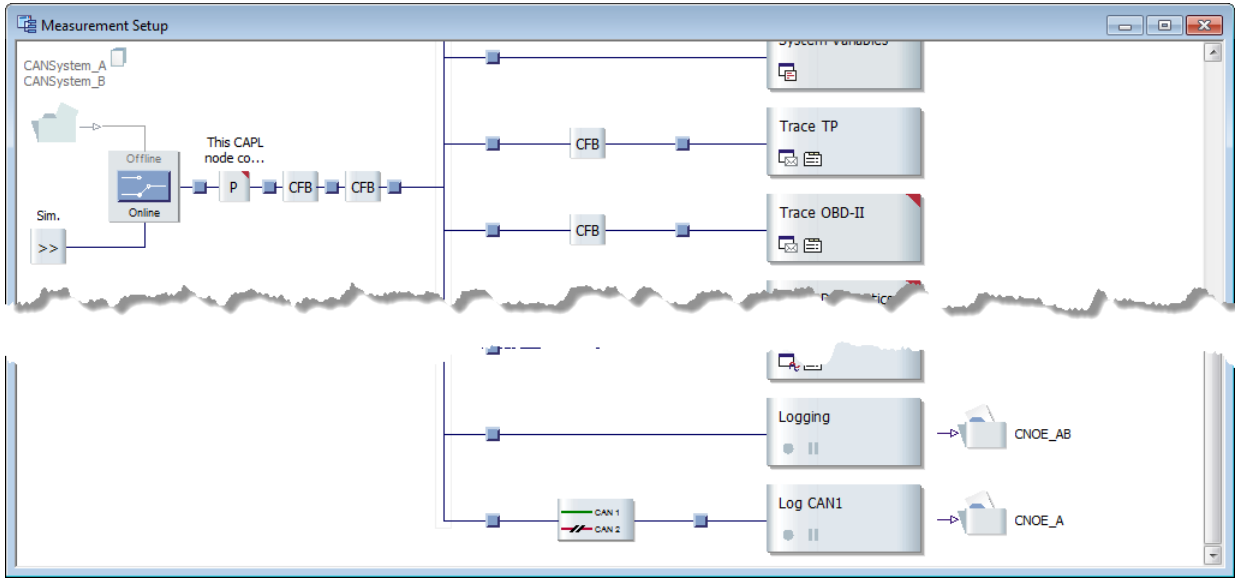
Logging Block

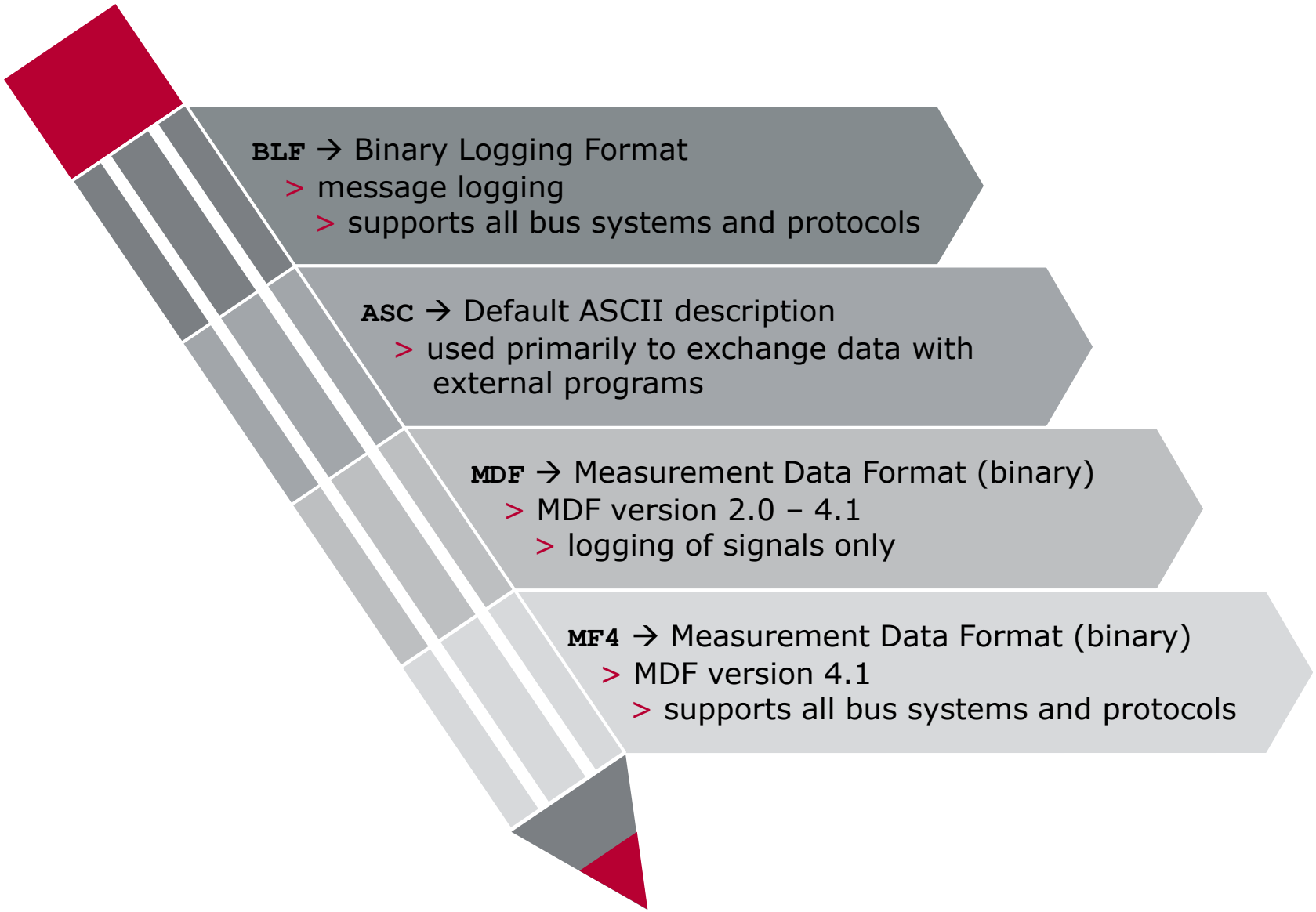
Data can be recorded during measurement for offline analysis or to be replayed on the bus:



- Logging is configured in the Measurement Setup
- Multiple logging branches are possible
- Triggers are used to start/stop the logging
- Filters can be used to reduce the amount of data in the log file

VECTOR

Log File Format



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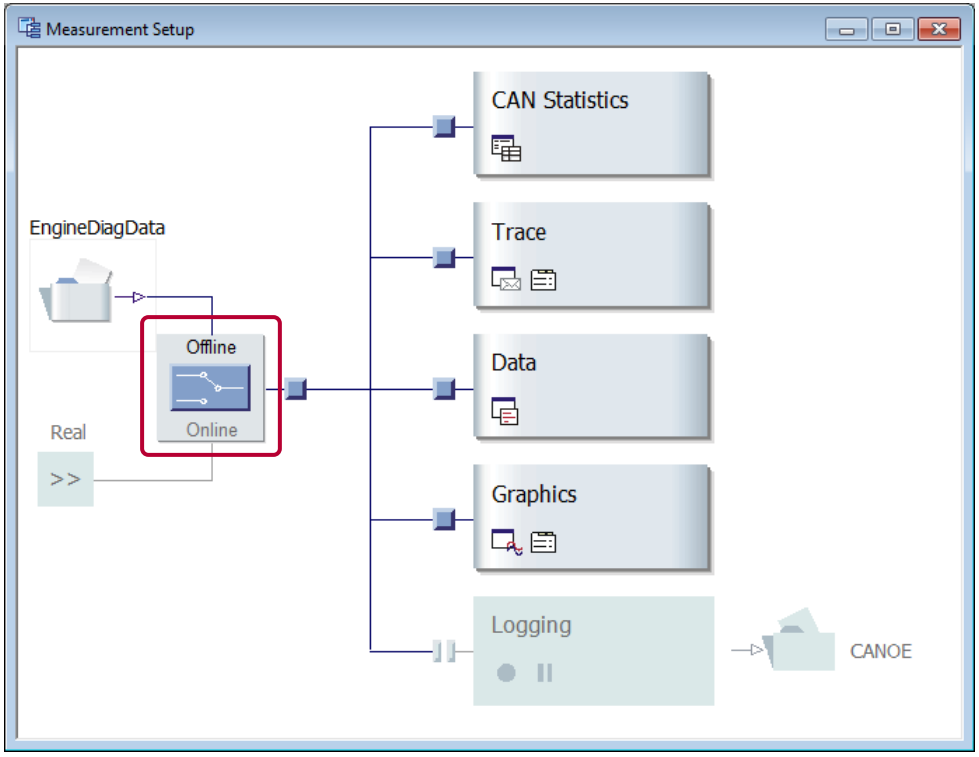
Overview

In Offline Mode, recorded measurement values from a log file are used as Data Source:

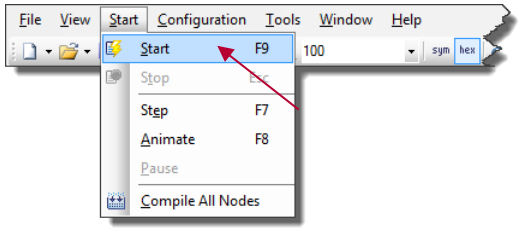
- All analysis windows can be used just like in Online Mode
- In CANoe, the Simulation Setup is not active in Offline Mode
- In CANalyzer, the send branch is not active in Offline Mode



Control Offline Mode

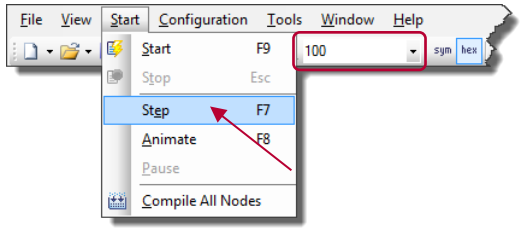
Start and Stop

> Entire file is played back



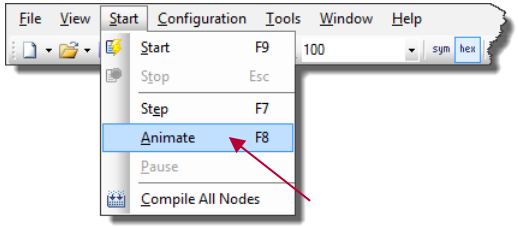
With configurable step width

> Automatic pause at the end of the step



Animated flow

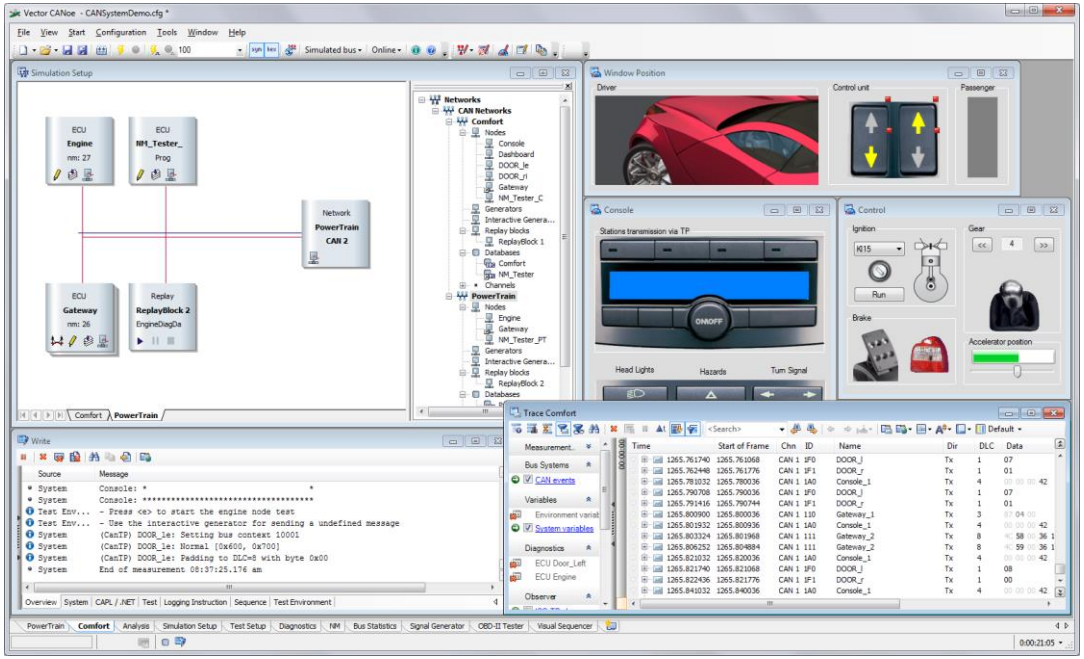
> Slow-motion display of events



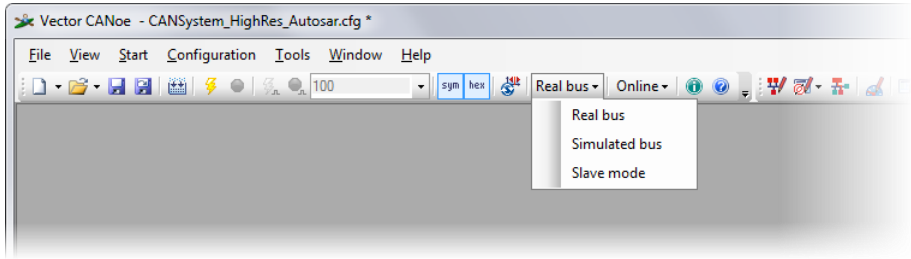
Simulation of Entire Networks or Remaining Bus

CANoe is the comprehensive software tool for development, test and analysis. Using CANoe, you can create simulations of Entire Networks or the Remaining Bus:

- Usage of a single CANoe model in all phases of development
- Function development and regression testing is supported
- Gateway simulation for different bus systems is possible



Execution Mode



Real bus

- With a remaining bus simulation, the real bus mode has to be selected
- Real time is derived from connected network interface HW

Simulated bus

- Communication network is simulated
- An **animation factor** can be specified: the simulated measurement then appears slowed-down resp. accelerated by this factor

Slave mode

- Time basis is controlled from external application, e.g. COM client

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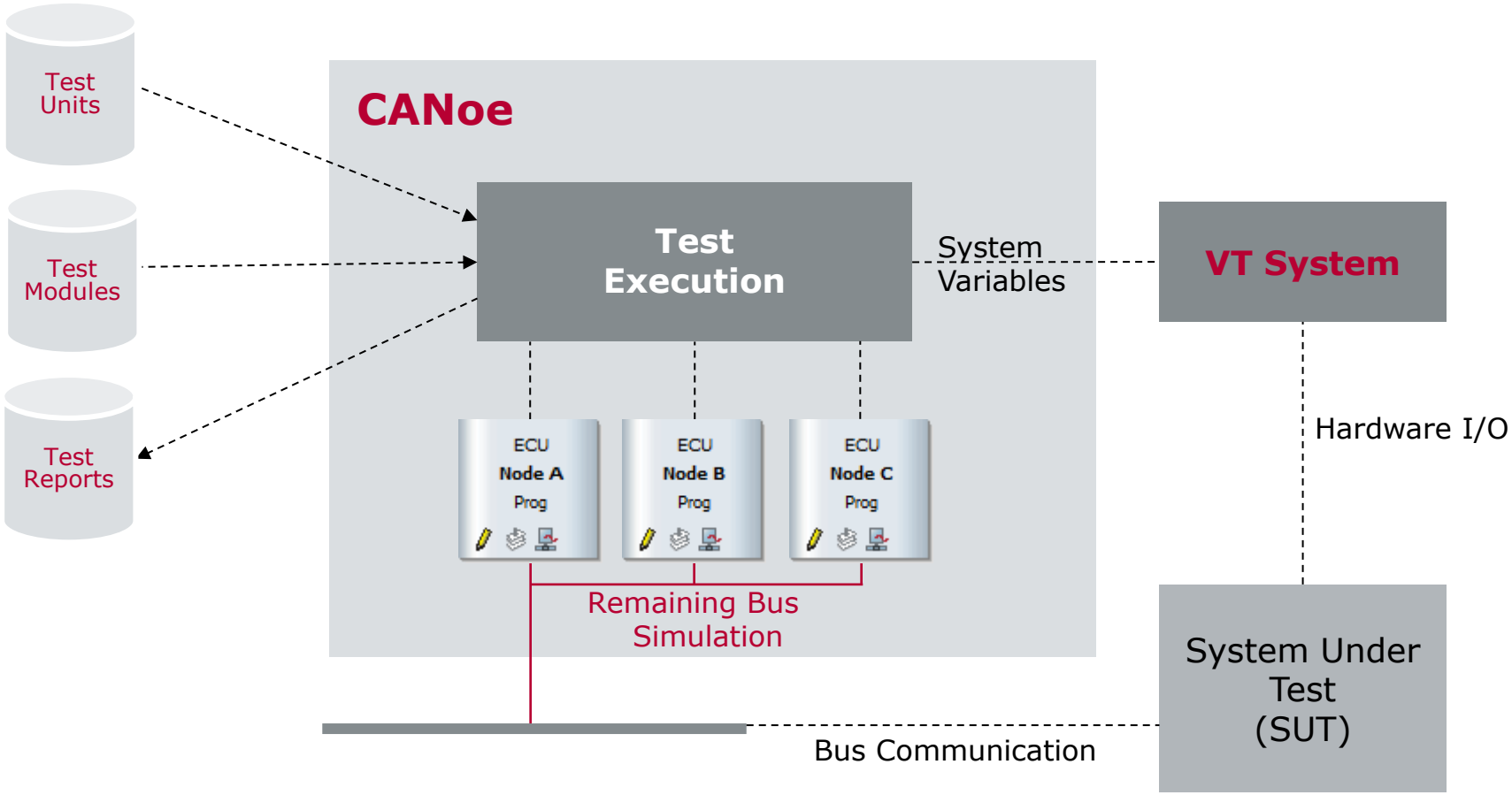
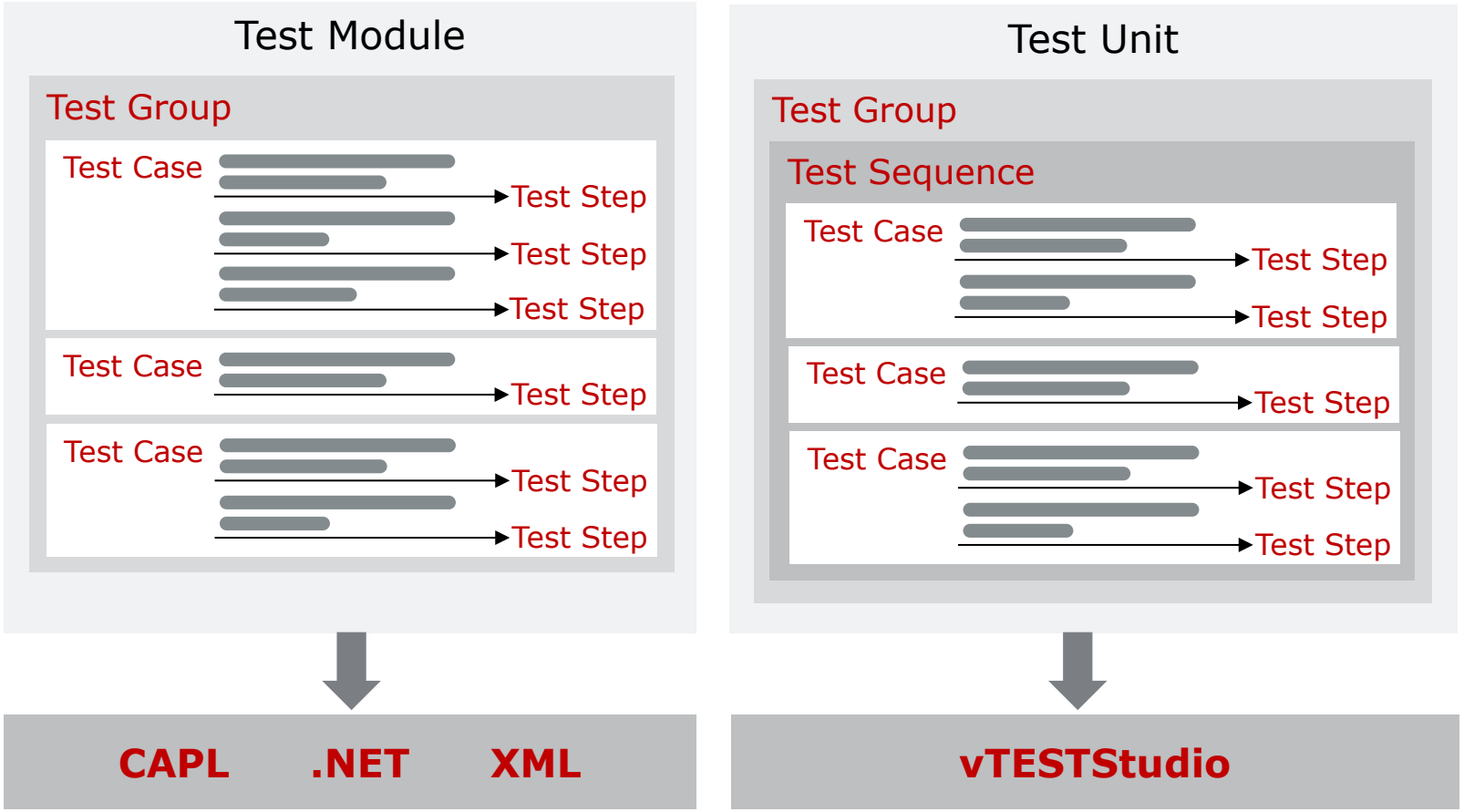
CANoe Test Environment

CANoe is the ideal tool for efficient automated ECU and system testing:



Test Specification

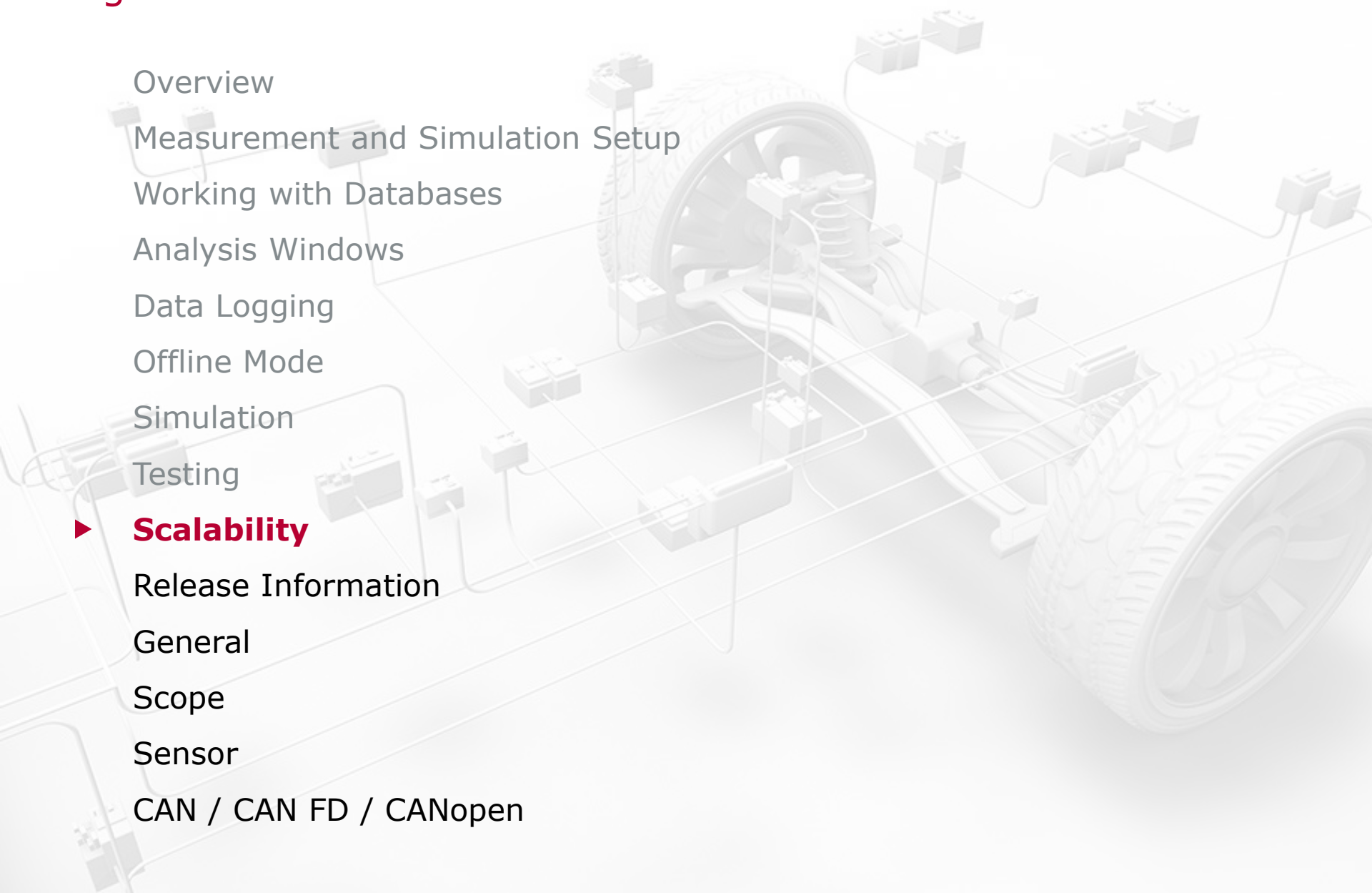
In CANoe, sequential tests are implemented in test modules or test units:



VECTOR

Screenshot mit laufendem Test

Agenda



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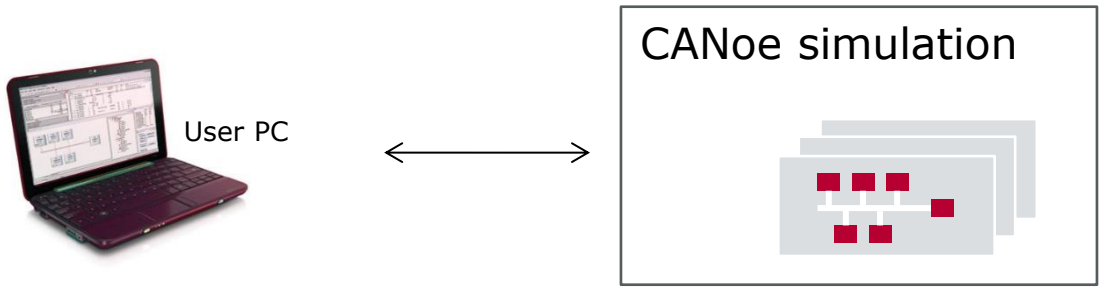
Overview

- CANoe allows decoupling of user interface and simulation part (CANoe RT)
  - The simulation can be run on a dedicated device or PC
  - Typical operating system: Windows Embedded 7
  - No negative effects of other PC tasks (e.g. compiling, virus scan, Outlook, etc.) to the simulation
  - Higher accuracy, lower jitter, lower simulation latency
  - The same CANoe configuration can be used for CANoe RT and normal CANoe operation



CANoe RT Applications

VN89xx: Network interface and simulation platform

USB

VN89xx

VT60xx: VT board as simulation platform

Ethernet

VT System

CANoe RT Rack: IPC as simulation platform

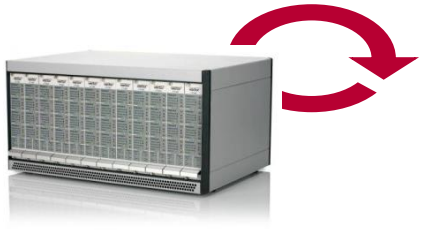
Ethernet

CANoe RT Rack

Special application: Simulation without user interaction:

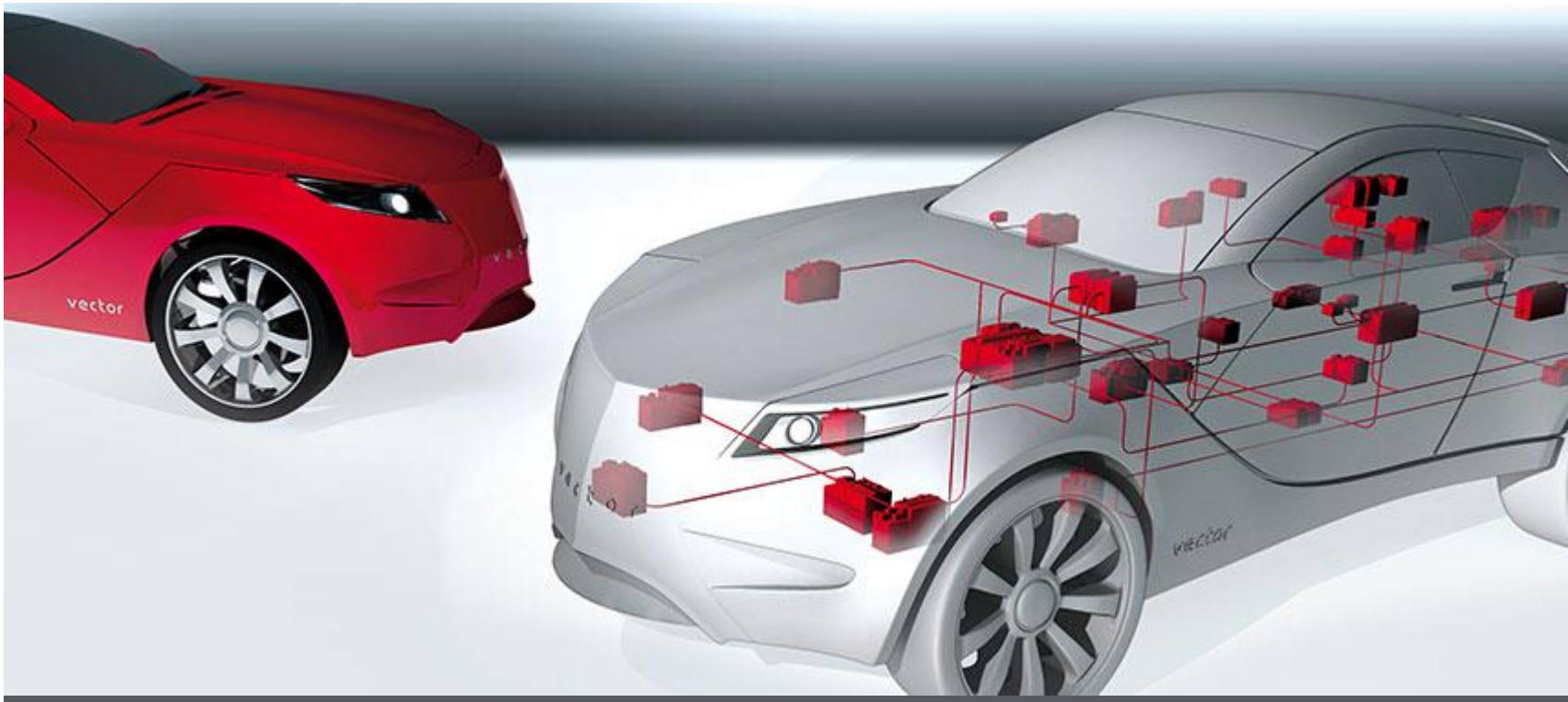
VN8900 standalone

VT System standalone



VT System

VECTOR



CANoe/CANalyzer New Features

Version 10.0

V1.53 | 2016-03-08

Agenda

Skip topic

Overview

- Release date 10.0
  - 2017-05-17
- Supported bus systems
  - CAN & CAN FD, LIN, FlexRay, MOST, J1708, Ethernet, WLAN

- Options
  - XCP, AMD (AUTOSAR monitoring and debugging) – CANoe
  - Car2x
  - Scope for CAN & CAN FD, LIN, FlexRay
  - J1939, ISO11783, CANopen, J1587
  - Aerospace options: AFDX®, A429, CANaero
  - Sensor: PSI5, SENT, SPI

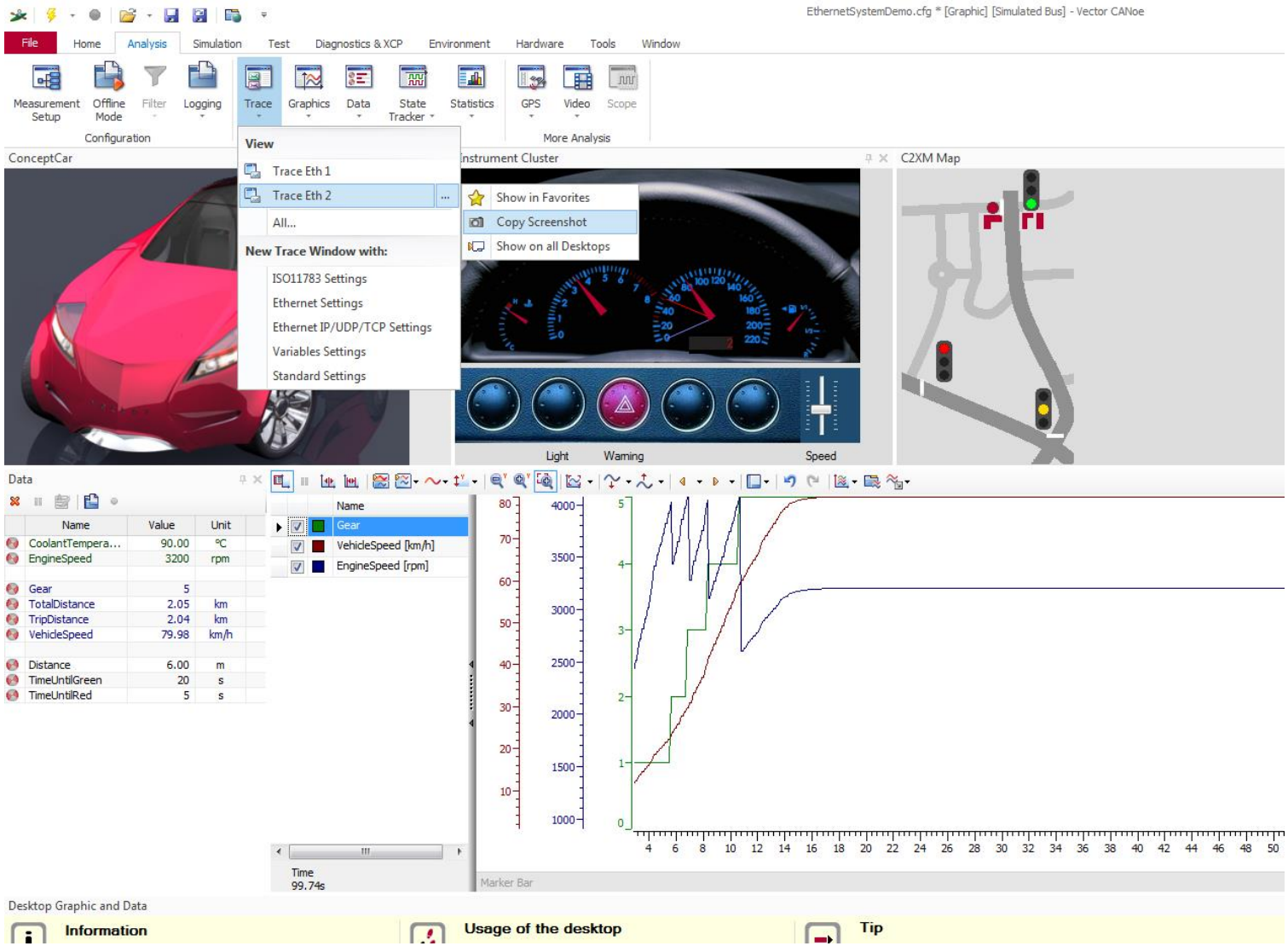
Agenda

Skip topic

Main Benefits

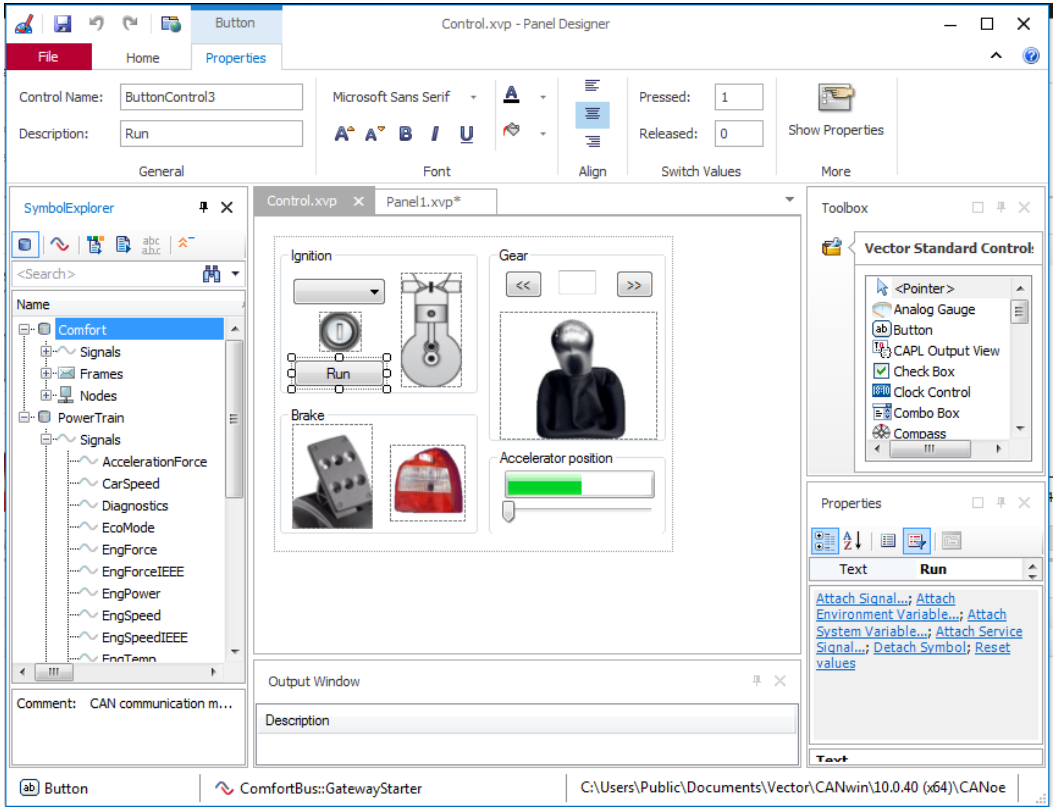
- Test Report Viewer
- Improved offline mode configuration and enhanced video/picture display
- New stress device VH6501 for CAN and CAN FD
- Simplified diagnostic simulation support
- Support of SPI with option .Sensor
- Improved usability with ribbon in Panel Designer

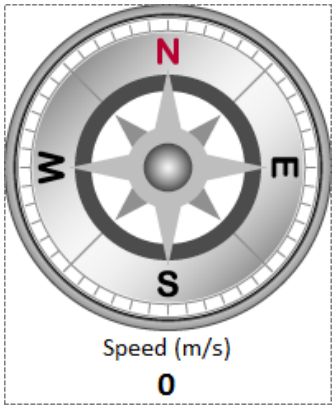
Modern GUI Layout with Windows 10 Style



Panel Designer

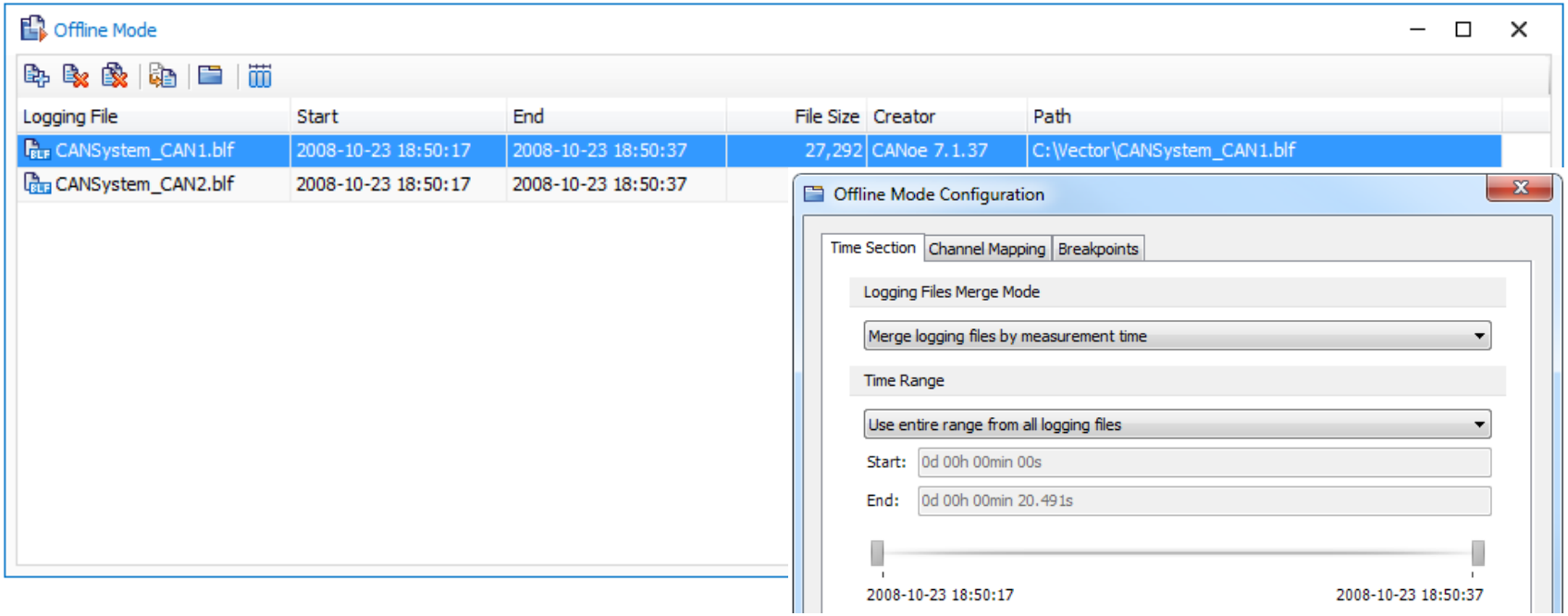
- New GUI layout with ribbon
- Simple to use overlay ribbon for all major control properties
- New Compass control for direction and speed
- Panel loading performance improved





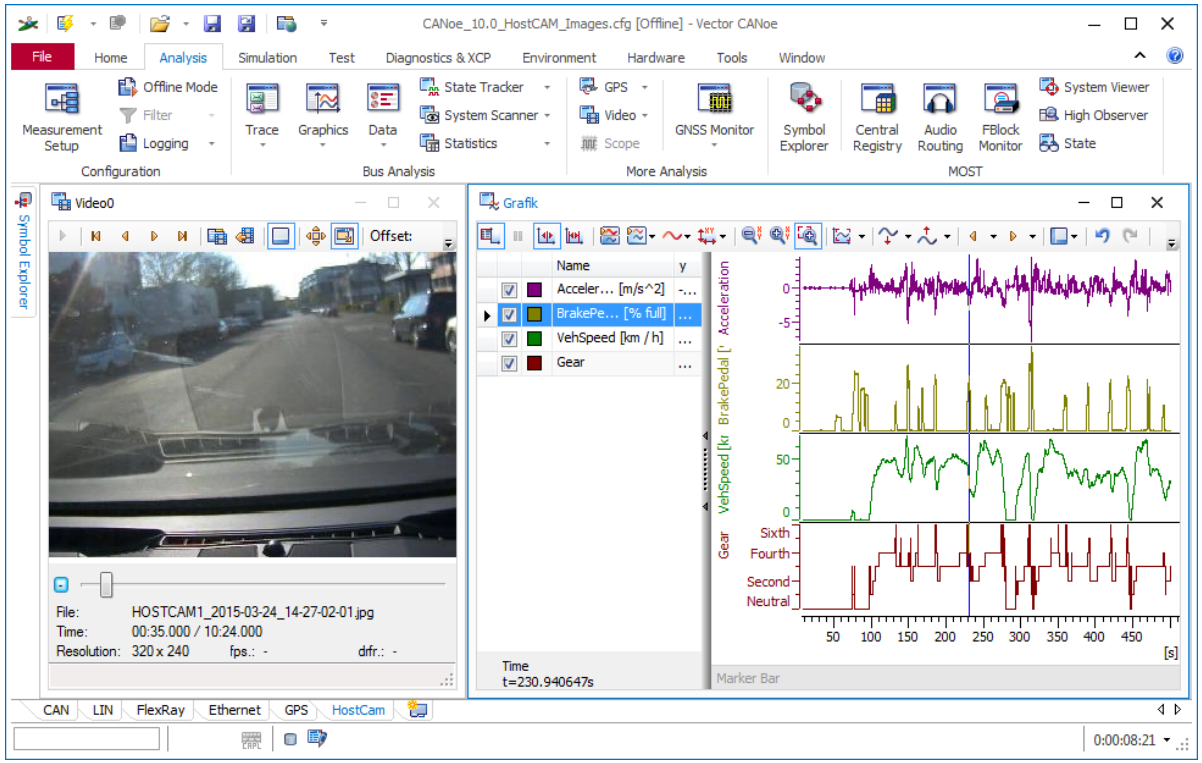
Offline Mode

- New window replaces several dialogs
- Display meta data of configured logging files
- Easily drag and drop logging files from Windows Explorer
- Two merge modes for offline analysis
  - By date/time and time stamp
  - By time stamp only



Video Window

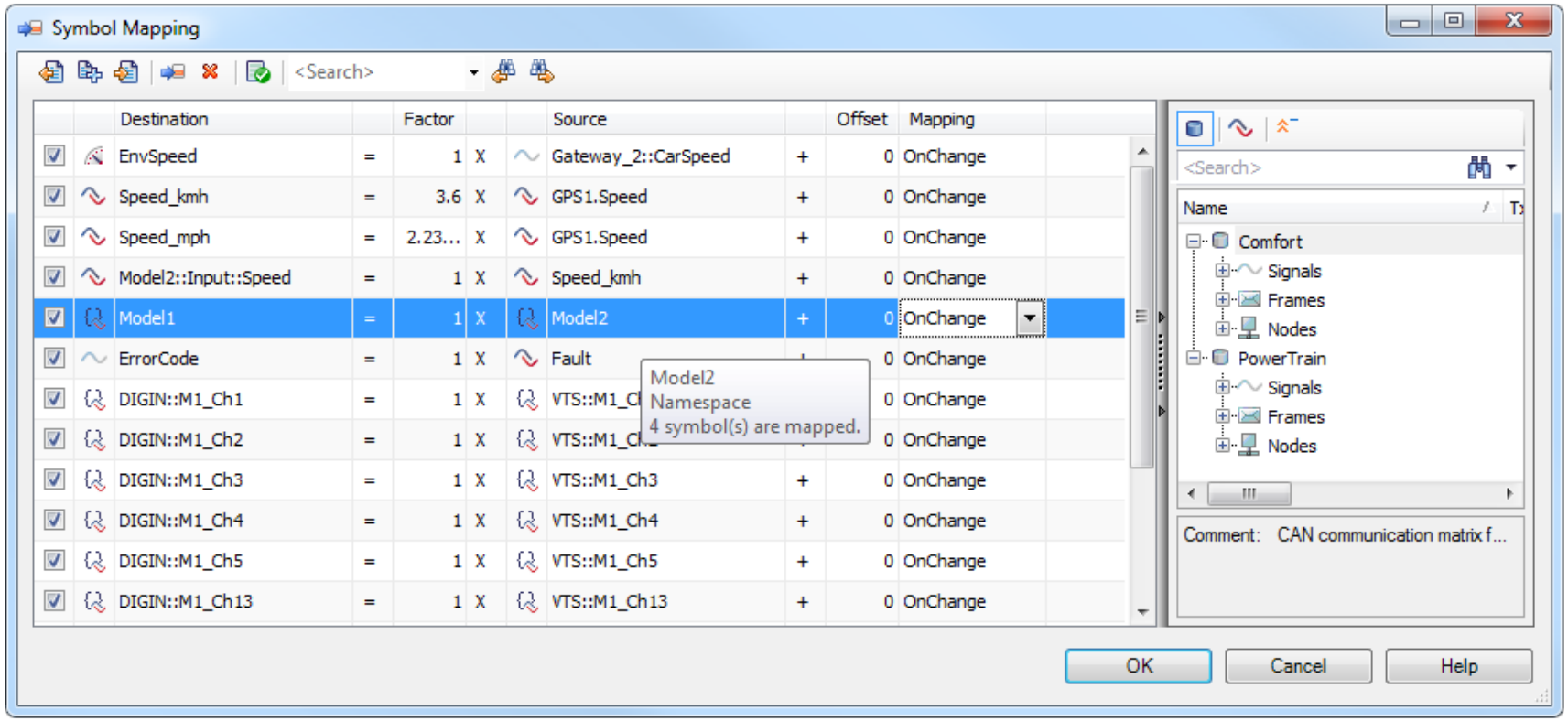
- Improved offline mode
  - Display of images delivered by GL Logger synchronized to the logged bus messages



  - Display of video frames during offline mode

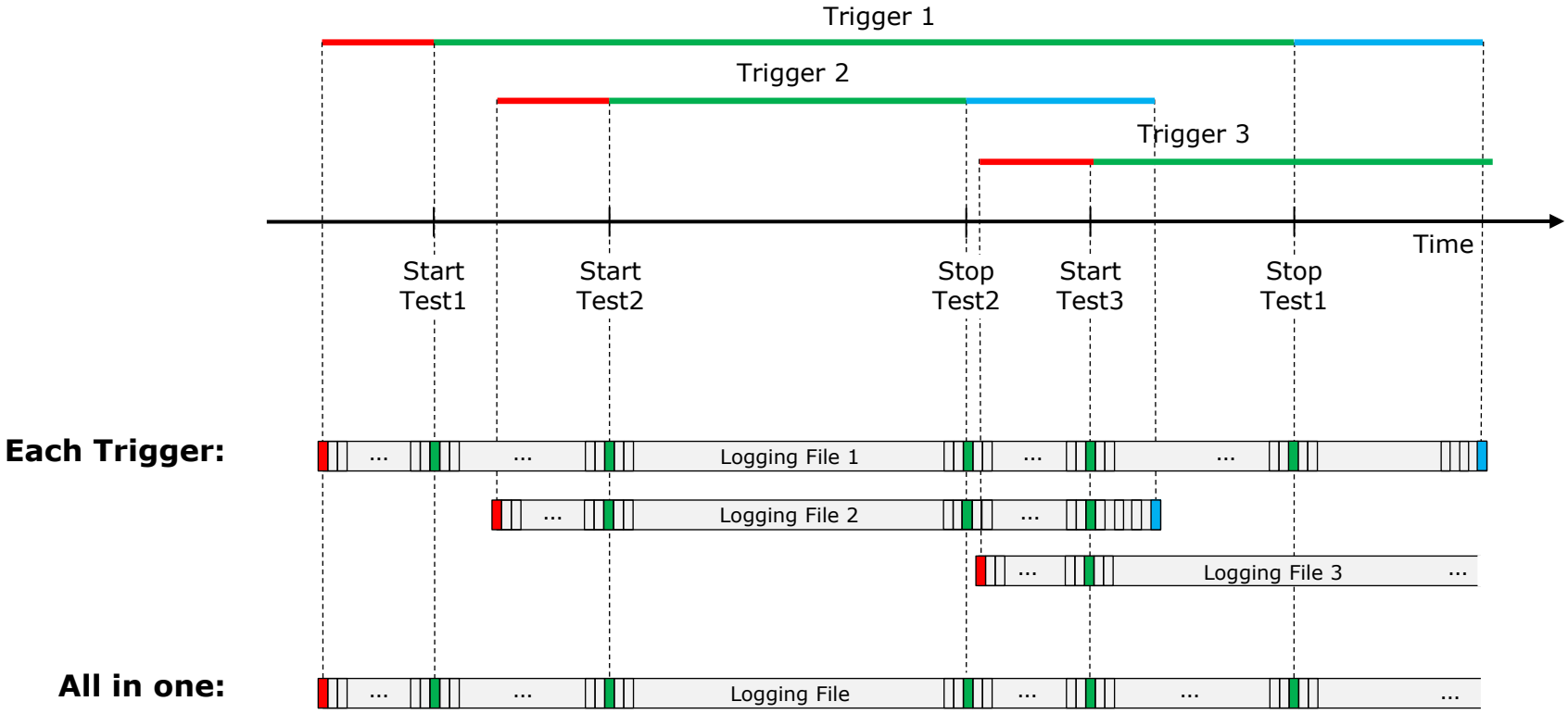
Symbol Mapping Dialog

- Rework of the Symbol Mapping Dialog
- Assign from right to left
- Mapping of complete namespaces



Logging

- Coupled start and stop condition with toggle trigger
- Retriggering is always allowed, overlapping can occur at any time
- Use fieldcode {IncTrigger} to split files by trigger
- Test Cases / Test Units / … can now be used as trigger conditions

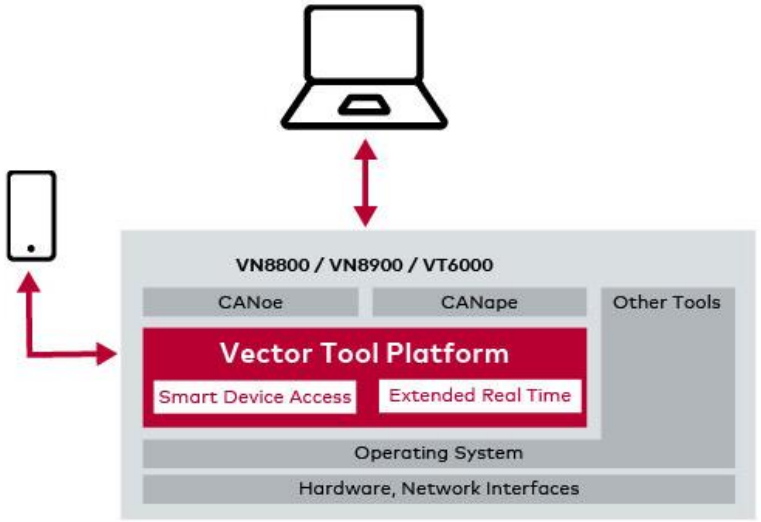


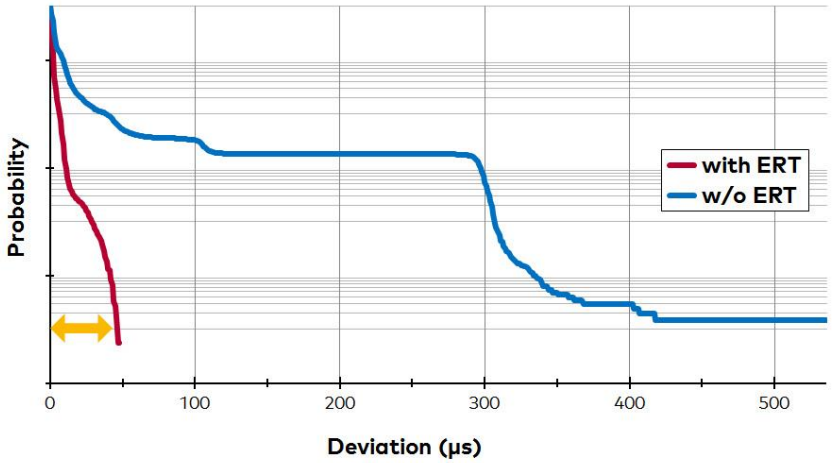
VN8914

- New Network Interface VN8914, successor of VN8912A
  - Intel Core-i7 6822EQ: 4 CPU cores, 6th Generation, 8GB RAM
  - External Power Up/Down control
  - SD card slot with direct access on the back side
  - USB Device connector secured by locking screws
    (conform to USB 3.0 Vision standard, cable is optional accessory)
  - Planned for Q3/2017

VTP - Extended Real Time

- Extended Real Time (ERT) is a part of the Vector Tool Platform
- ERT improves the latency and determinism of CANoe with the VT System
- Higher sampling rates of 200 µs and 500 µs can be achieved
  - > VT6051A, VT1004, VT7001 and VT2816

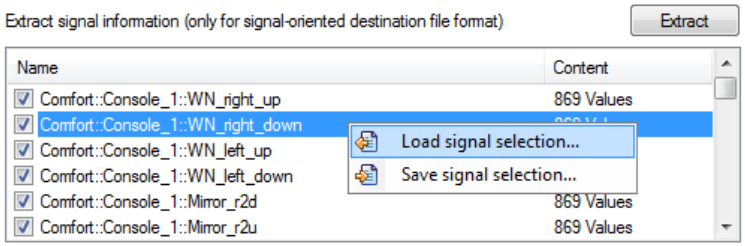




Further Improvements

- Start Value Window: Automation with CAPL & COM Interface
  - Use Case: Freshness Counter

- Logging Export Dialog: Signal list can be saved and reloaded



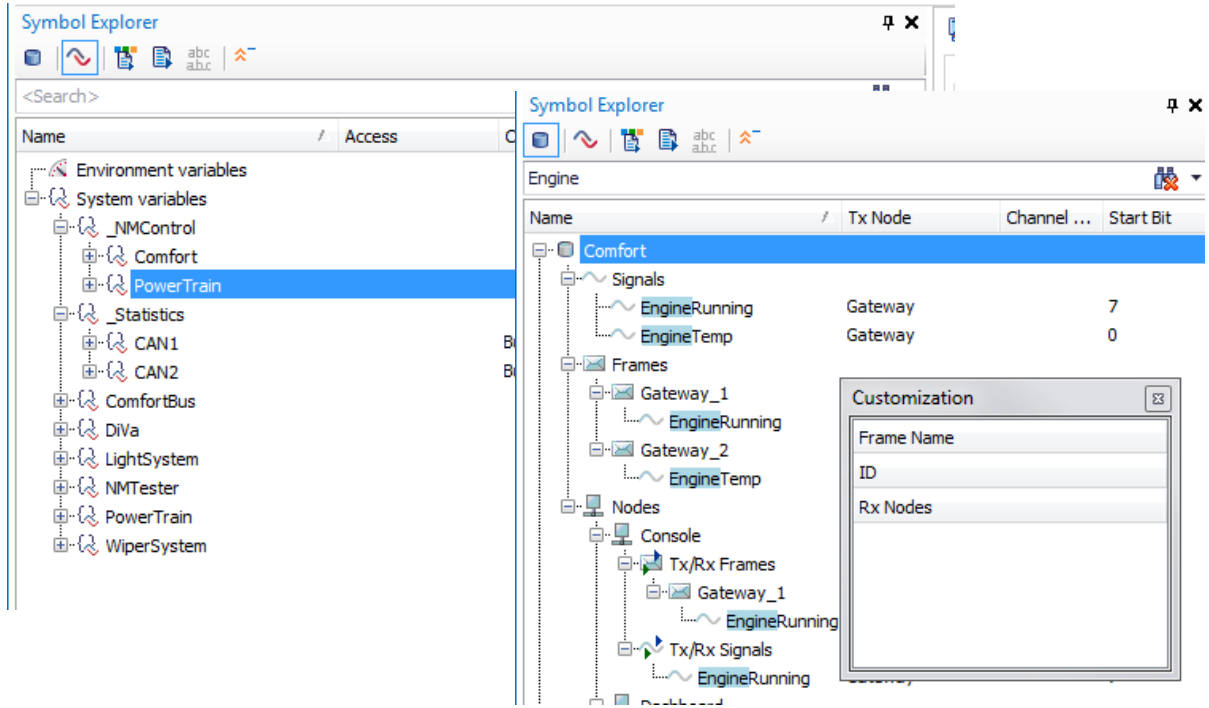
- Support the Windows Task Bar extension
  - Start and stop measurement
  - Show progress of long lasting actions (compile, convert, …)

Further improvements

- GPS Window
  - Support for GNSS receiver other than GPS. E.g. Galileo, Glonass, Baidou and QZSS
  - Improved selection of COM port
- Support Assistant
  - Installation as common component (only one instance per Computer)
  - Reports from all tools can be opened easily
  - Integration of online crash tutorial
- With 9.0 SP
  - Redesign of Vector I/O configuration Dialog
  - CAPL Browser can save source files encrypted
  - Support of VN8810

Further improvements II

- New Symbol Explorer and Symbol Selection Dialog (with 9.0 SP)
  - Columns with field chooser
  - Filtered Search through entire tree
  - Easy switch between item types



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- **Scope**
- Sensor
- CAN / CAN FD / CANopen

Skip topic

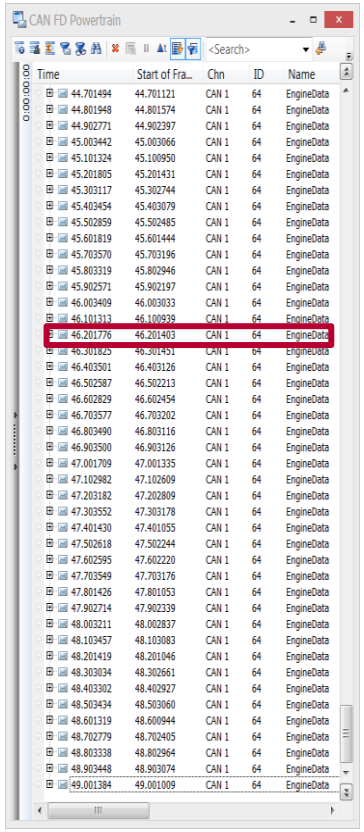
Features

- **CANoe/CANalyzer version 9.0 SP2**
  - Eye diagram and serial bit mask analysis for CAN, CAN FD
- **CANoe/CANalyzer version 9.0 SP3**
  - Eye diagram and serial bit mask analysis for FlexRay (CAPL)
  - Support of Option Sensor for SENT and PSI5
- **CANoe/CANalyzer version 9.0 SP4**
  - Eye diagram and automated transition time measurement for LIN
  - Import/export of eye diagram masks
- **CANoe/CANalyzer version 10.0**
  - Fast automated scaling according to trigger condition e.g. BRS bit by CAN FD
  - Continuous online eye diagram analysis with persistency mode
  - Improved comparison of signals via Compare Mode
  - New native binary export format CSFX (approx. 5 times smaller than CSF)
  - New measurement cursor concept
  - Support of signal symmetric testing via CAPL (planned for 10.0 SP3)

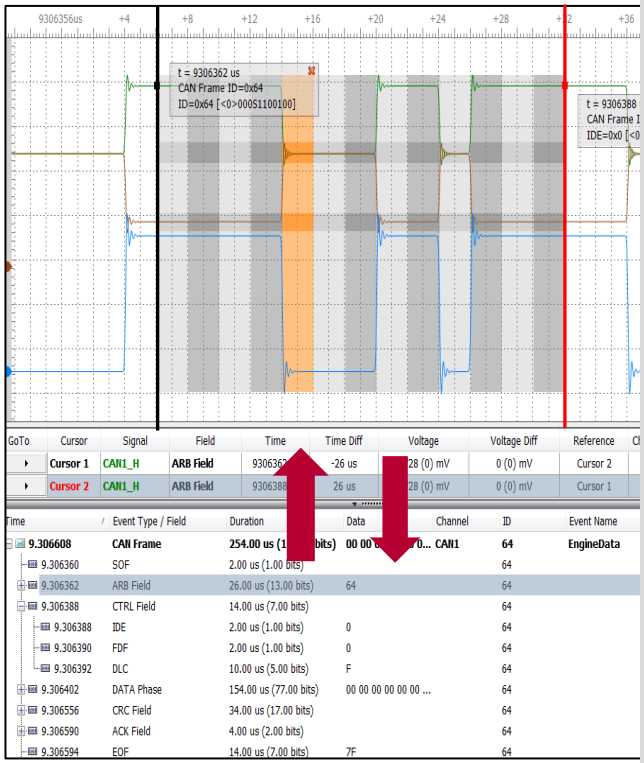
Time Synchronized Roundtrip Analysis

All views have the time base of network interface !

CANoe Trace



Scope graph view

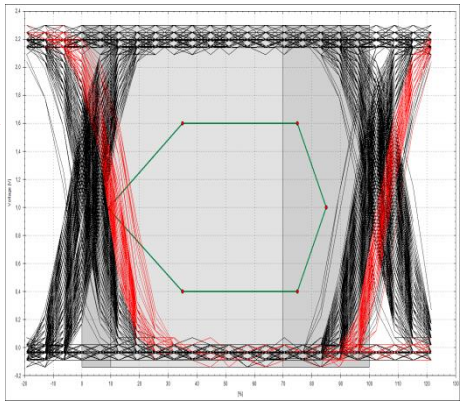


Scope protocol trace view

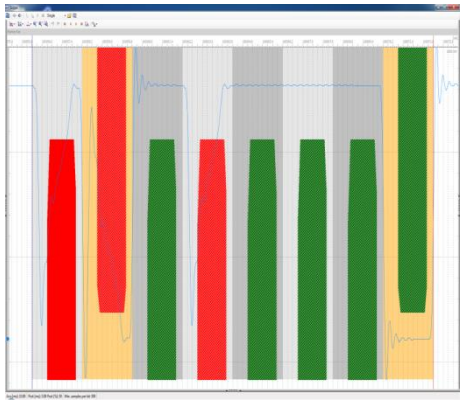
TEST AUTOMATION

Program Interface (CAPL)

Eye Diagram



Bit Mask Analysis



Data Link-Layer | **Frame-Layer** | **Bit-Layer**

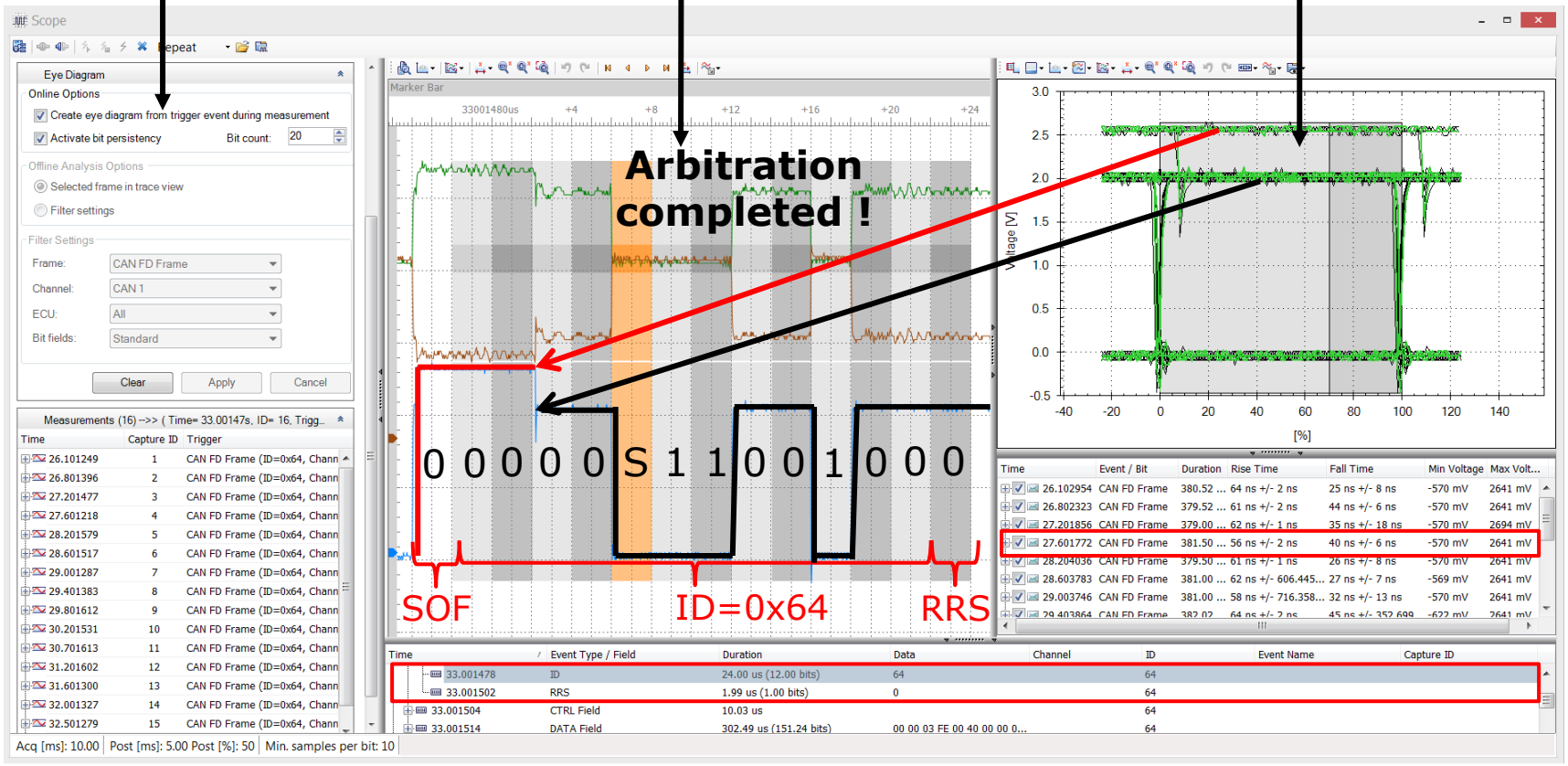
Eye Diagram – From Frame to Bit Analysis

Configuration

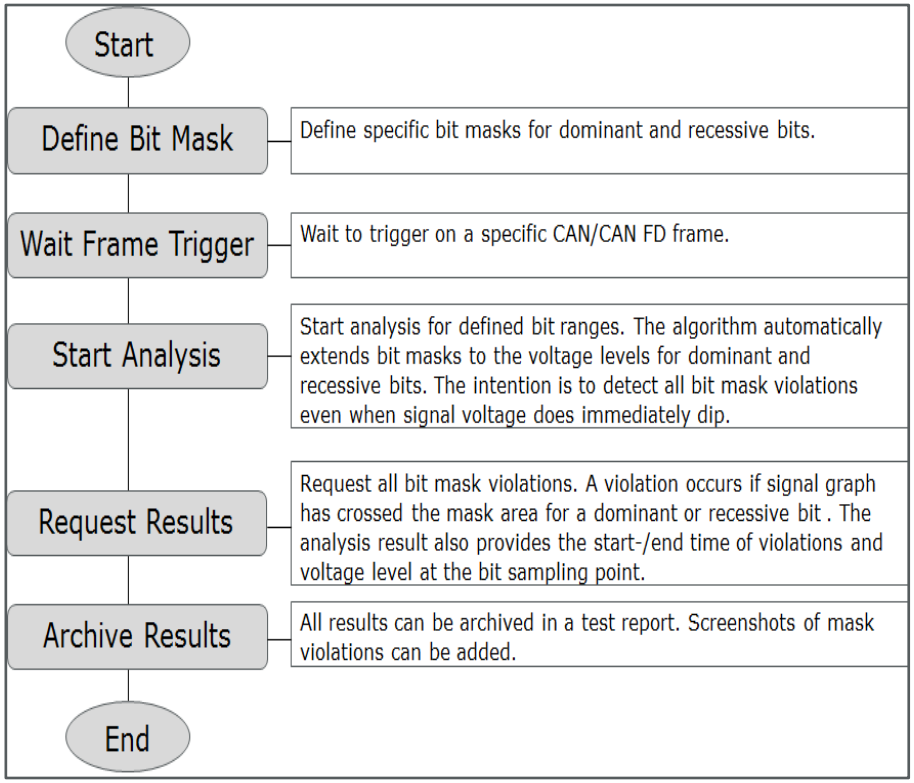
Data History

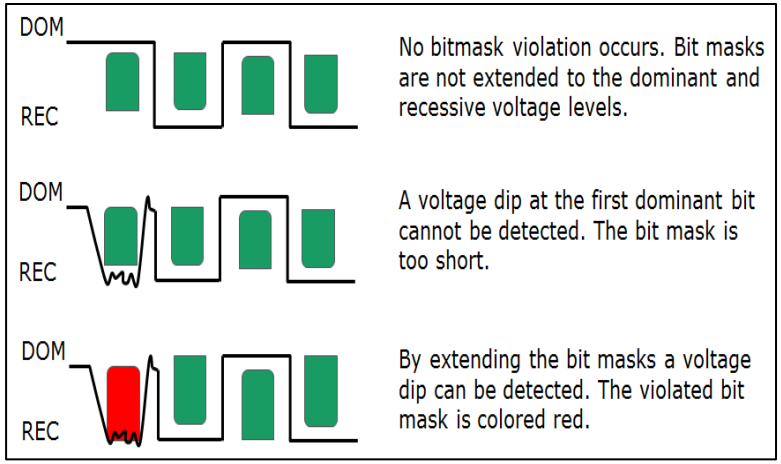
Graph View: Highlighted bits in measurement graphs reflect the eye diagram analysis

Eye Diagram: Analyzed bit range from ID field to RRS-Bit



Bit Mask Analysis – Program Flow





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- **Sensor**
- CAN / CAN FD / CANopen

General

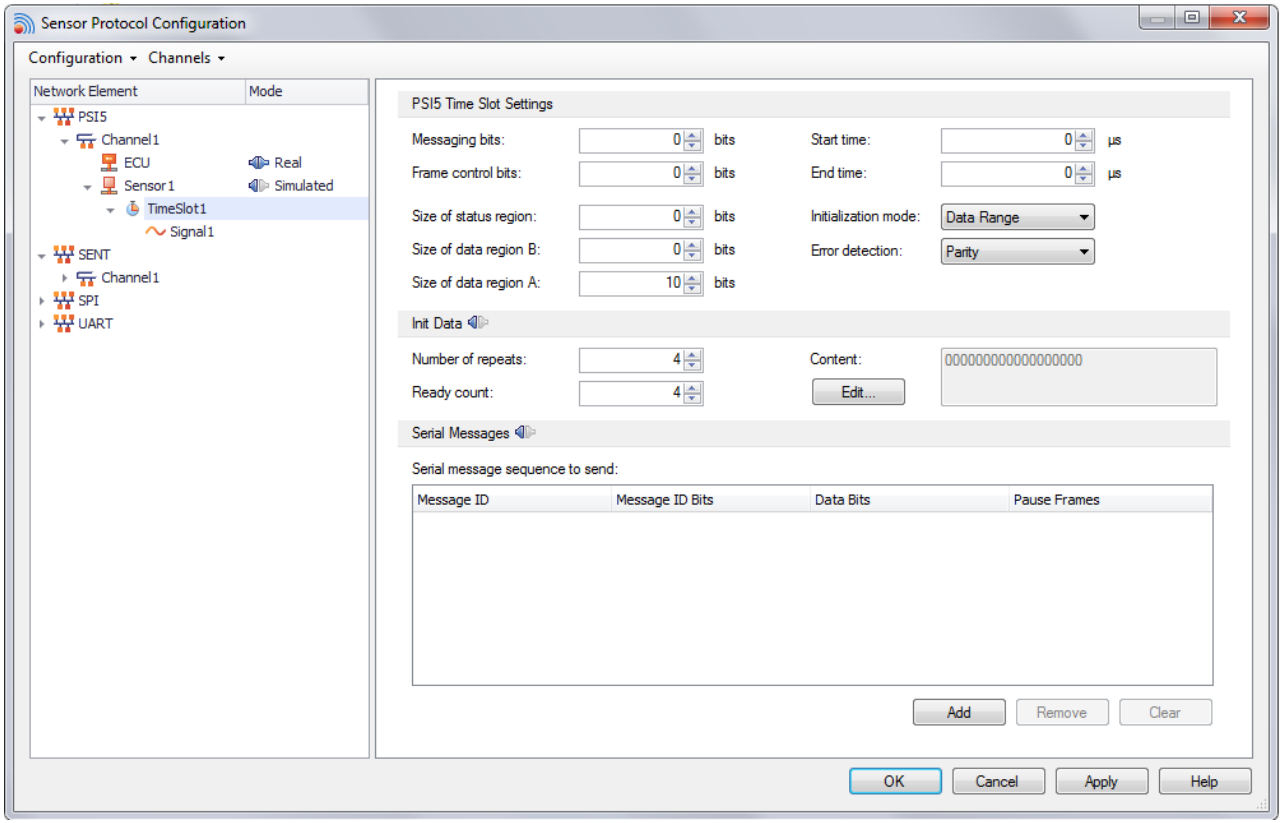
- Option Sensor available since **CANoe 9.0 SP3**
- The Option Sensor is CANoe only
- The Option Sensor requires VT2710 as network interface

- Coverage of the Option Sensor with CANoe 9.0 SP3
  - Protocols requiring a license
    - PSI5
    - SENT

- Protocols supported with the CANoe core feature set (following in subsequent CANoe versions)
  - SPI (CANoe 10.0)
  - UART
  - I2C
  - LVDS

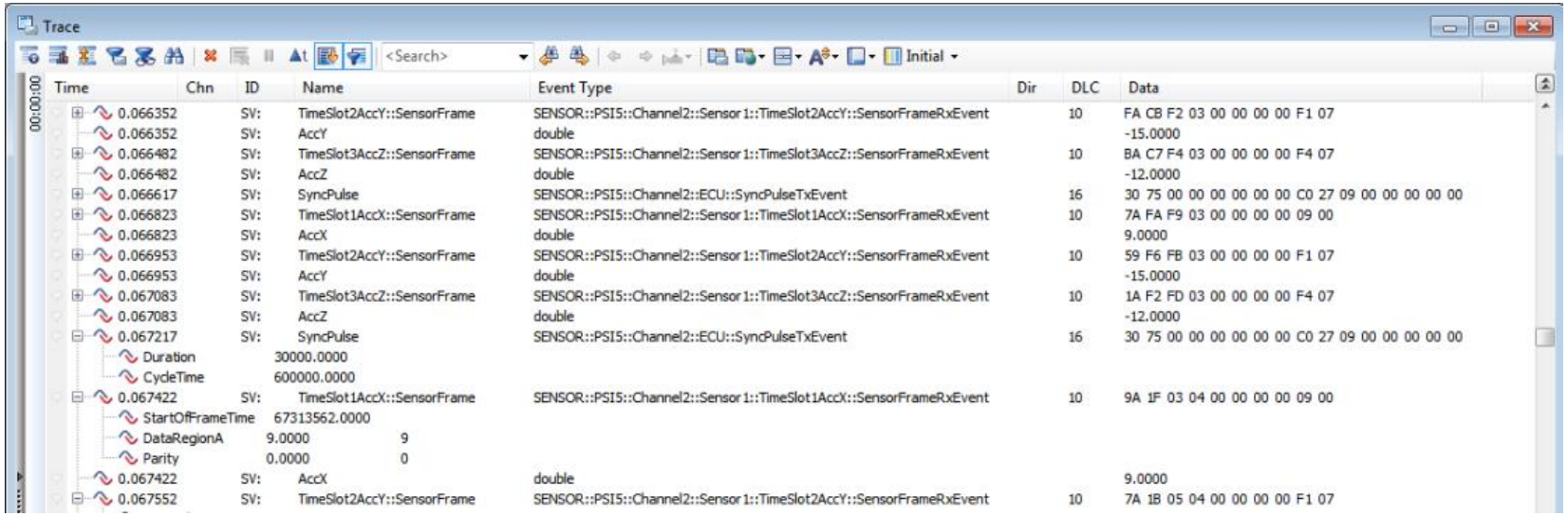
Configuration

- Intuitive GUI to configure Sensor channels
- Sensor configurations can be exported and used in other CANoe configurations



Simulation and Analysis

- Sensor protocol events modeled generically based on System Variables
- Support of CANoe's Analysis Features
  - Analysis Windows
  - Panels
  - Logging

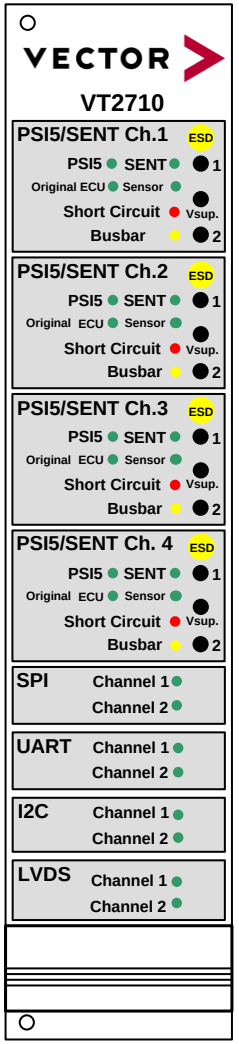


- Support of CANoe's test and simulation capabilities:
  - Powerful CAPL API
  - Usage of test modules and test units for automated testing

VT 2710 Main Features

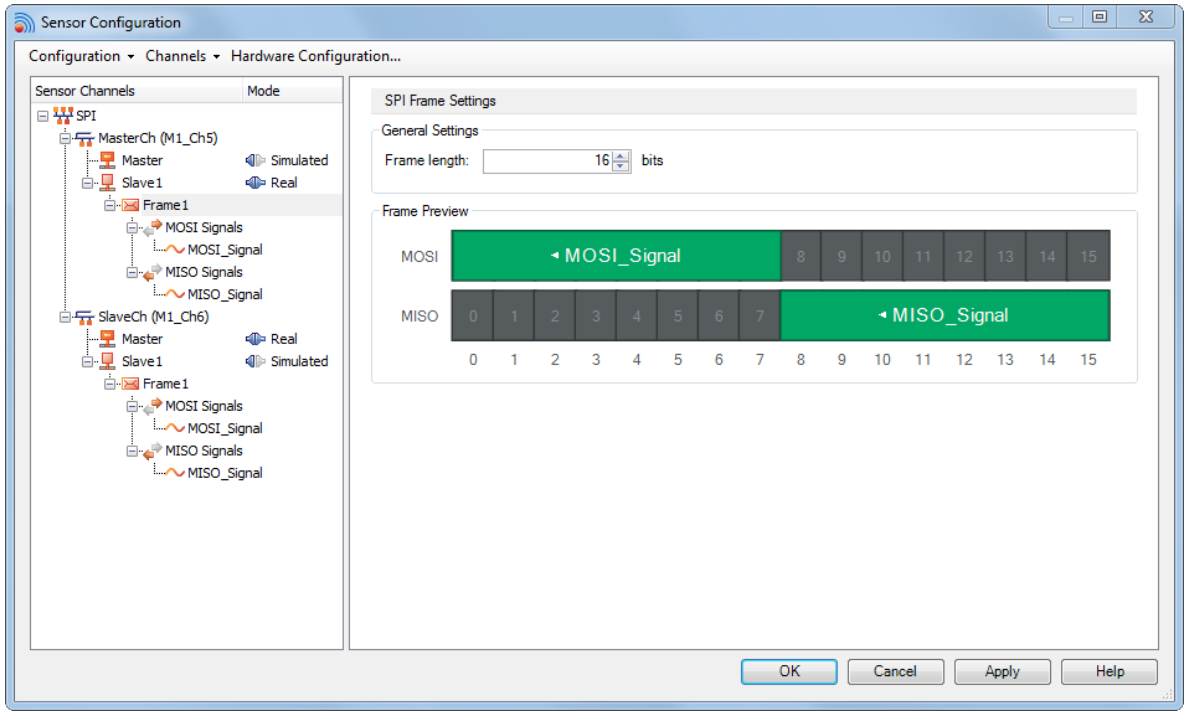
- Modular concept
  - Basic Module: 2 SPI/UART + 2 I2C + 2 LVDS channels
    - channels available with CANoe > 10.0
  - Up to 4 PSI5/SENT channels can be equipped
    - 1 piggy board per channel
  - PSI5/SENT channels are galvanically isolated

- Operation modes
  - Sensor simulation
  - ECU simulation
  - Monitoring
  - „Active probes“ via LVDS
    - Proprietary interface incl. power supply
    - channels available with CANoe > 10.0
- Self Test capability for PSI5 / SENT
- On-Board reference voltage for automatic self calibration



SPI Support (new with CANoe 10.0)

- Analyzing SPI communication
- Simulating an SPI master / SPI slave
- 5 CS lines available
- Bit rate up to 10MBit/s for master simulation and monitoring
- Bit rate up to 6MBit/s for slave simulation

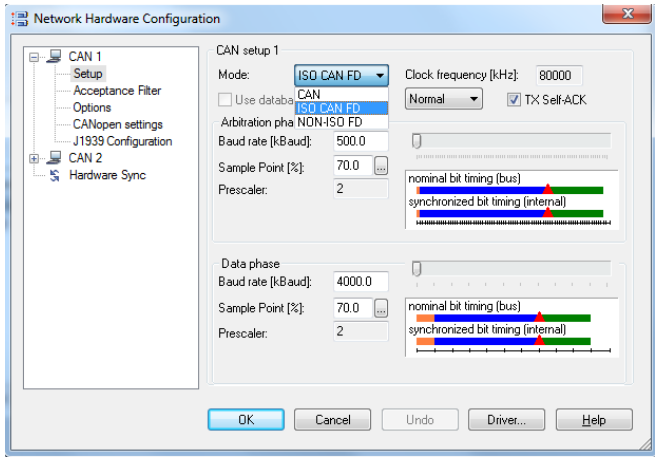


CAN FD: Selection of ISO / non-ISO

- Current Approach:
  - Two Driver Setups
    - Setup 9.2.1: non-ISO drivers
    - Setup 9.9.7: ISO drivers

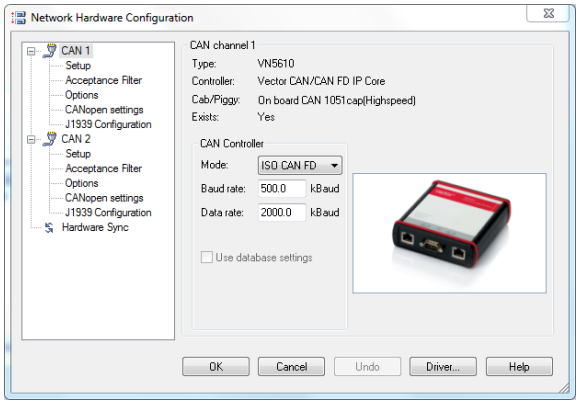
- Future Approach:
  - Drivers that allow to switch between non-ISO and ISO CAN FD
  - First switchable drivers available in Q3 2017

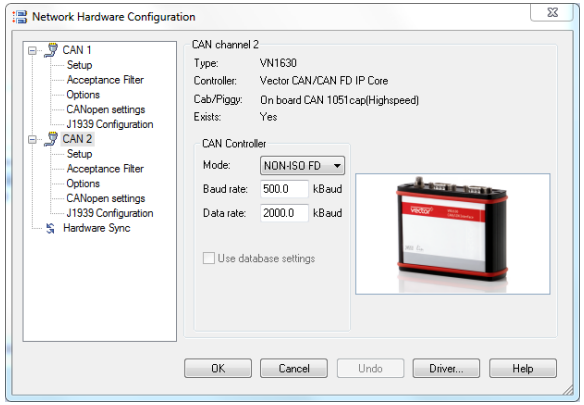
- CANoe and CANalyzer now allow to configure the FD mode in the Network Hardware Configuration



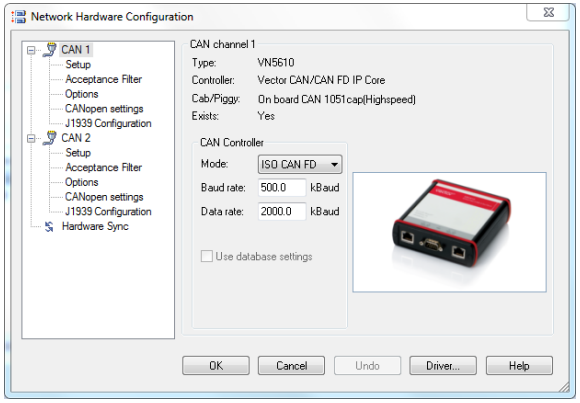
CAN FD: Selection of ISO / non-ISO

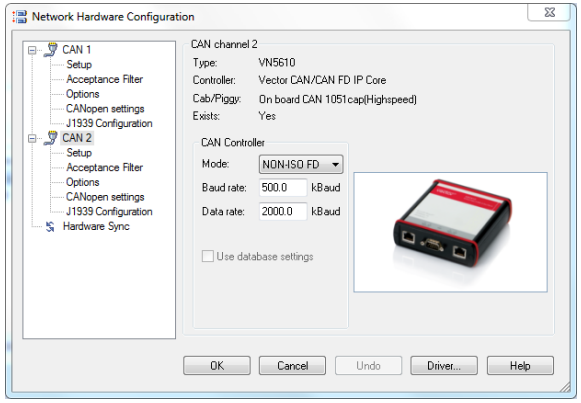
- Using non-ISO and ISO FD in one configuration:
  - Currently use two different types of network interfaces
    - E.g. VN5610 with ISO driver and VN1600 with non-ISO driver





- In future network interfaces will allow to select the FD mode channel wise





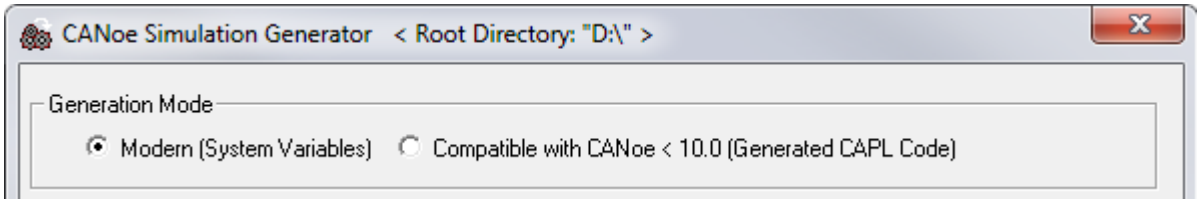
CAN FD: Extended Configuration via DBC

- For CAN FD, the following attributes can be used for configuration via a DBC file*:
  - Baudrate, BaudrateCANFD
  - TimeQuantaMin, TimeQuantaMax, TimeQuantaCANFDMin, TimeQuantaCANFDMax
  - SamplePointMin, SamplePointMax, SamplePointCANFDMin, SamplePointCANFDMax
  - SyncJumpWidthMin, SyncJumpWidthMax, SyncJumpWidthCANFDMin, SyncJumpWidthCANFDMax
  - SSPOffsetCANFDMin, SSPOffsetCANFDMax

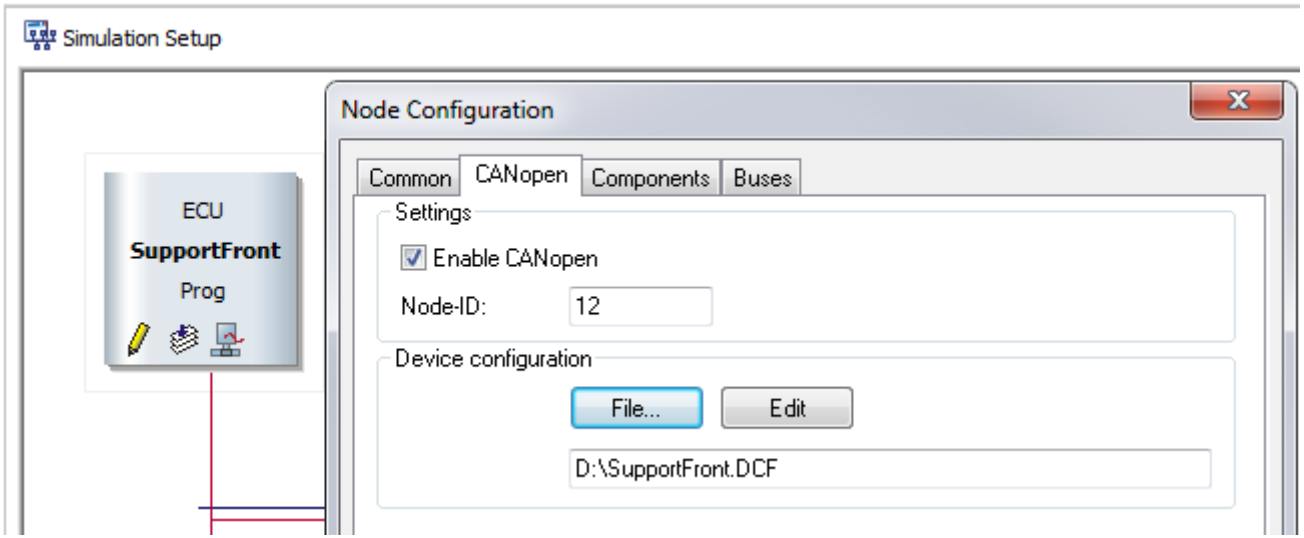
*Note: To use the attributes it is required to set **Use database settings** in the **Network Hardware Configuration** dialog.

New CANopen Simulation Concept (CANoe only)

- New option in the ProCANopen CANoe Simulation Generator



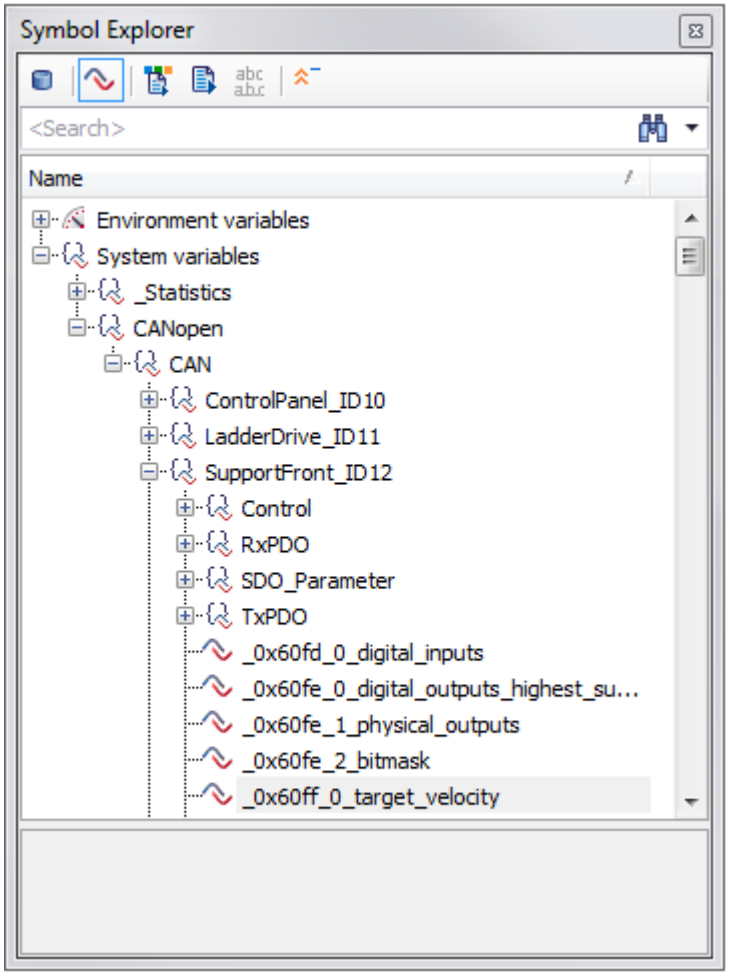
- CANopen support is now integrated in the node configuration directly:
  - Node ID
  - Device Configuration file (*.dcf *.xdc)



CANopen System Variables (CANoe only)

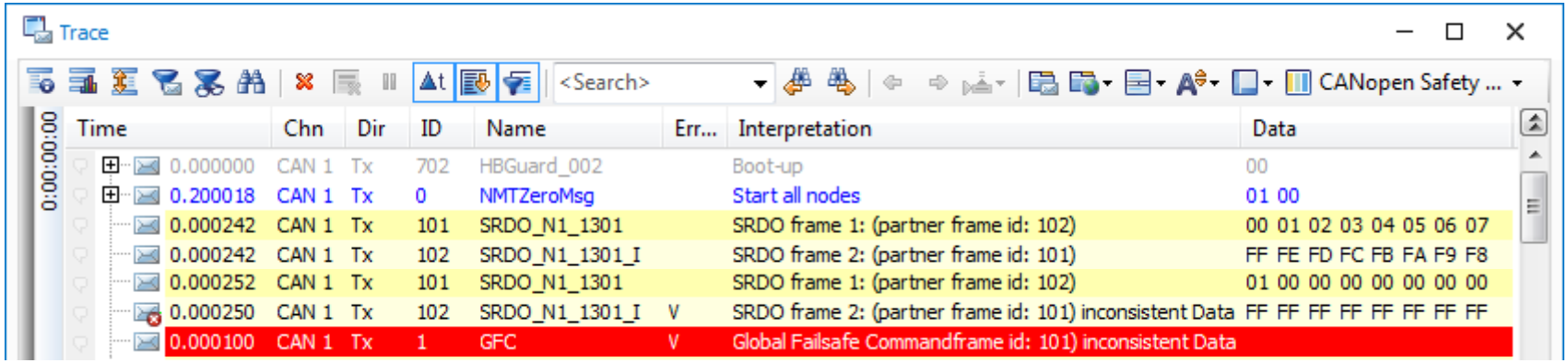
- System variables represent the Object Dictionary of each simulated CANopen device
  - Namespace: NodeName_ID
  - Variables: _Index_SubIndex_Name

- Benefits
  - Less and easier to read code
    “What was 0x60FF Sub 0 again?”
  - PDO mapping completely transparent to the (CAPL) application
  - System variables can be controlled from test units and test modules, panels, Signal Generators, etc.



CANopen Safety (CANoe only)

- New simulation concept supports CANopen Safety (CiA 304, EN 50325-5)
- Features
  - Safety PDOs (SRDO) are sent redundant (one is bit-inverted)
  - SRDO configuration validated with CRC checksum
  - Global fail-safe command (GFC) is sent on data consistency errors or timing violations



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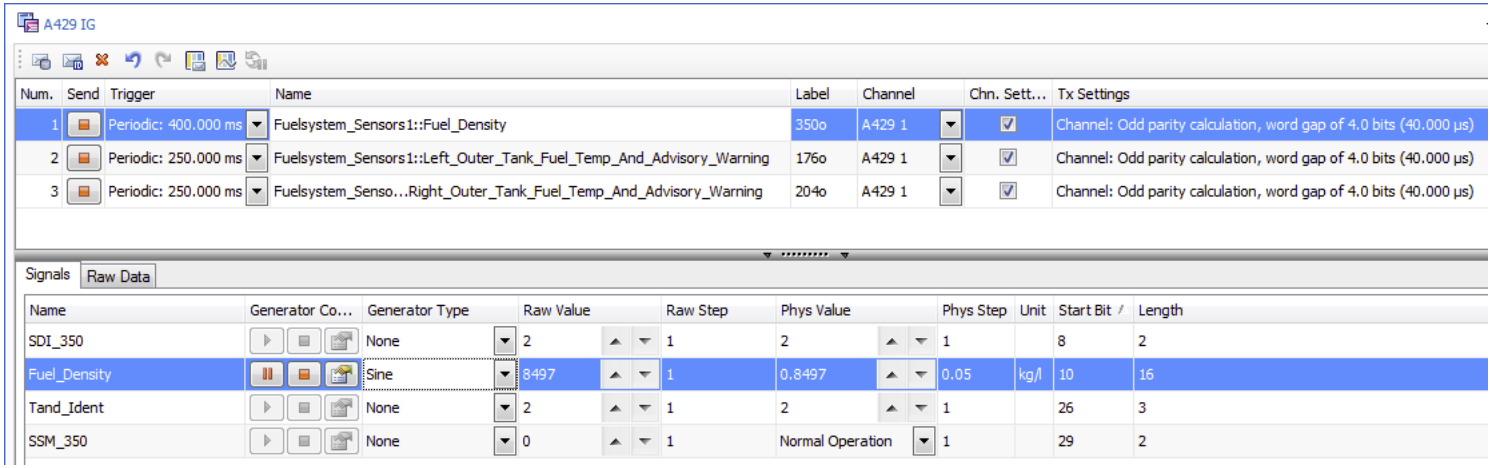
Options AFDX, A429, CANaero

- Option AFDX
  - Extended support for ICMP (internet control message protocol)
    - Configuration via DBC, Decoding and highlighting in Trace Window, Additional support functions in CAPL

- Option A429
  - New ARINC-429 Interactive Generator



- Option CANaero
  - Enhanced message decoding in Trace Window
    - Decode node services, high integrity messages and software data loading

Vector Aerospace Message Editor (AME)

- Manage message descriptions for the options(*) AFDX, A429 and CANaero
  - Import, create, modify

- Supported input formats
  - Airbus ICD files (AFDX, ARINC-429, CAN)
  - XML profile descriptions according to ARINC 825-3
  - Vector XML format (label descriptions for ARINC-429)

- Supported output format
  - DBC files (options AFDX, A429 and CANaero)

*The tool is shipped with every option AFDX, A429 and CANaero.

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