

CANoe/CANalyzer

Comprehensive CAN Network Analysis and Test - An Overview

Agenda

► Overview

Measurement and Simulation Setup

Working with Databases

Analysis Windows

Data Logging

Offline Mode

Stimulation & Simulation

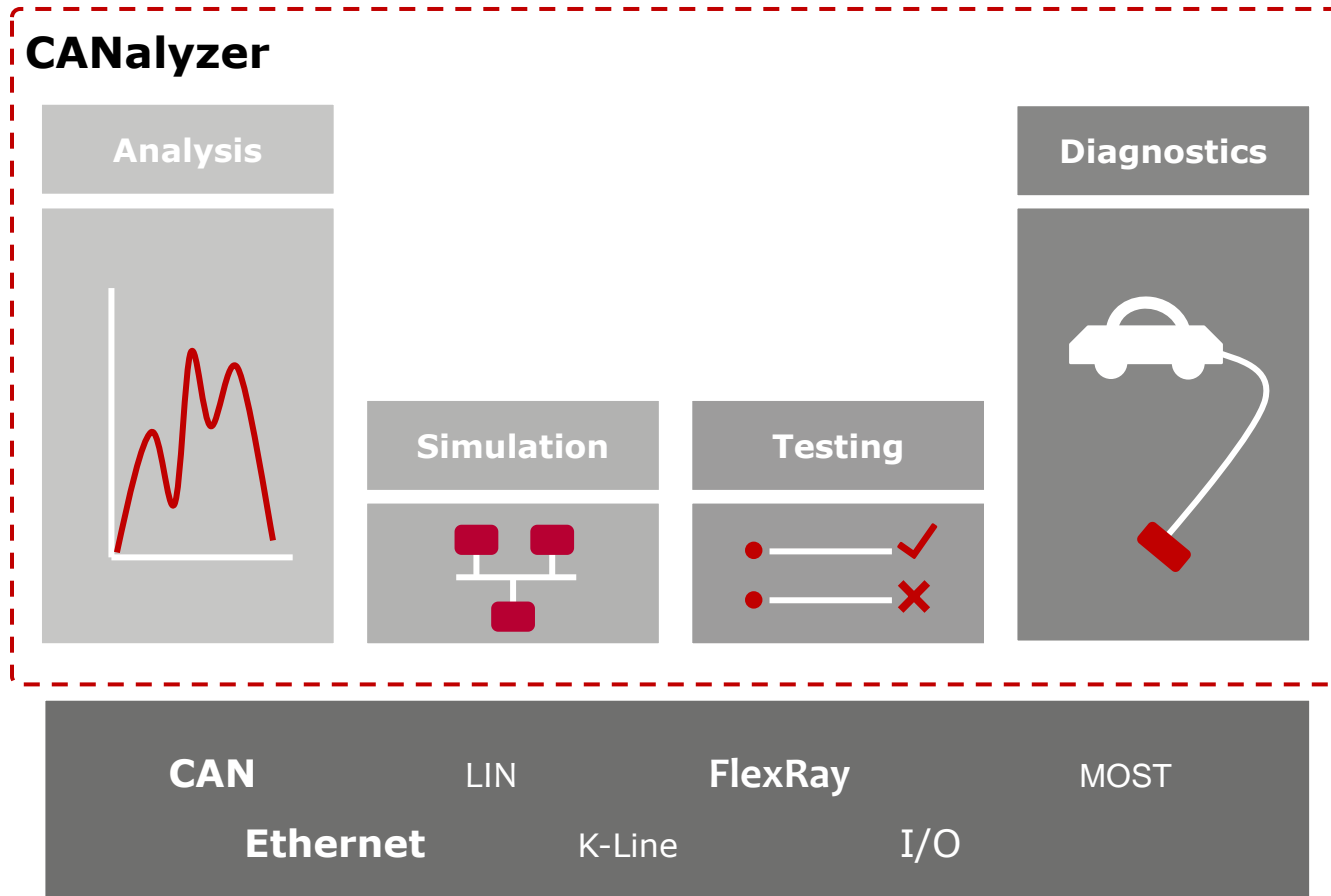
Testing

Scalability

Summary

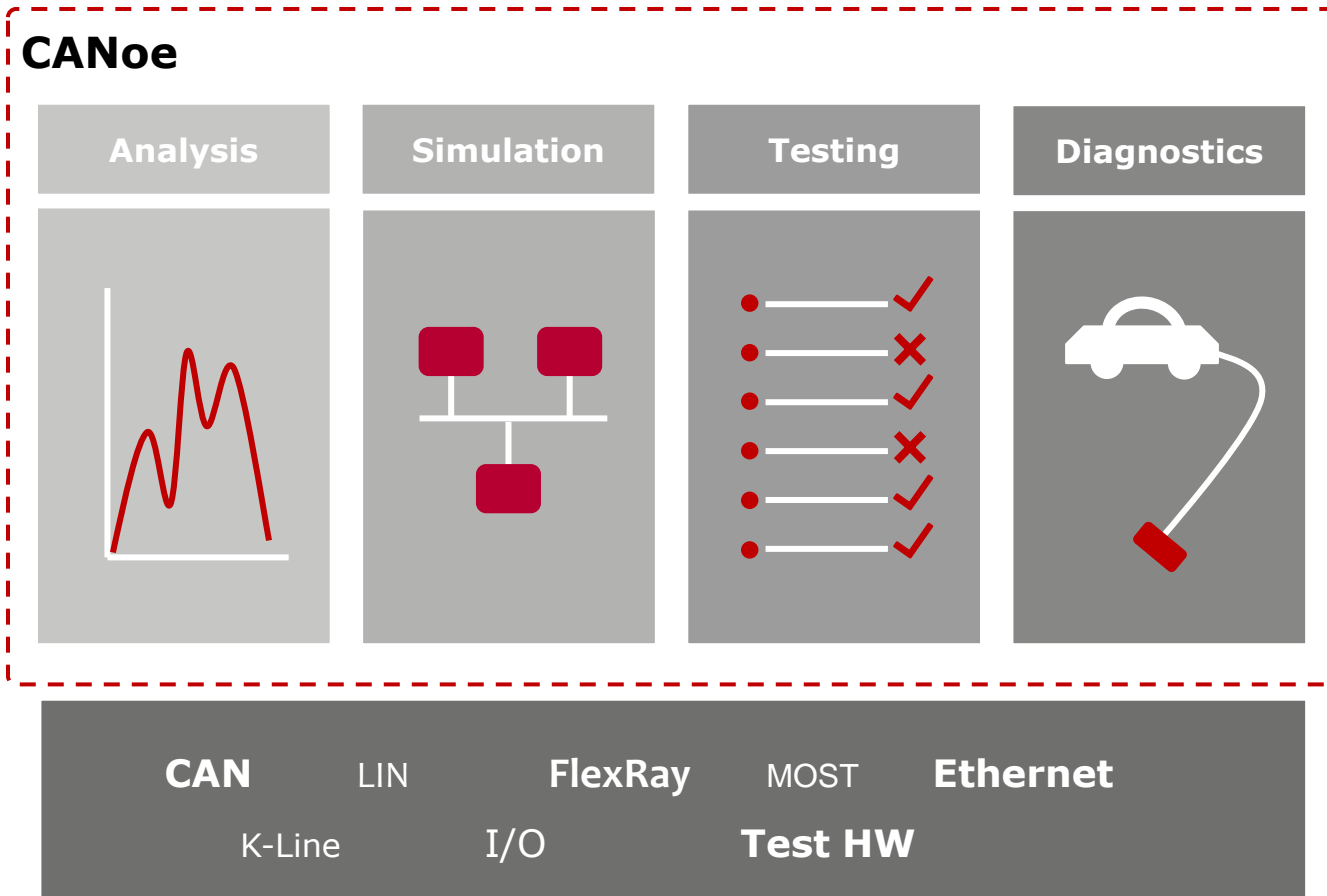


CANalyzer and CANoe: What is the difference?



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


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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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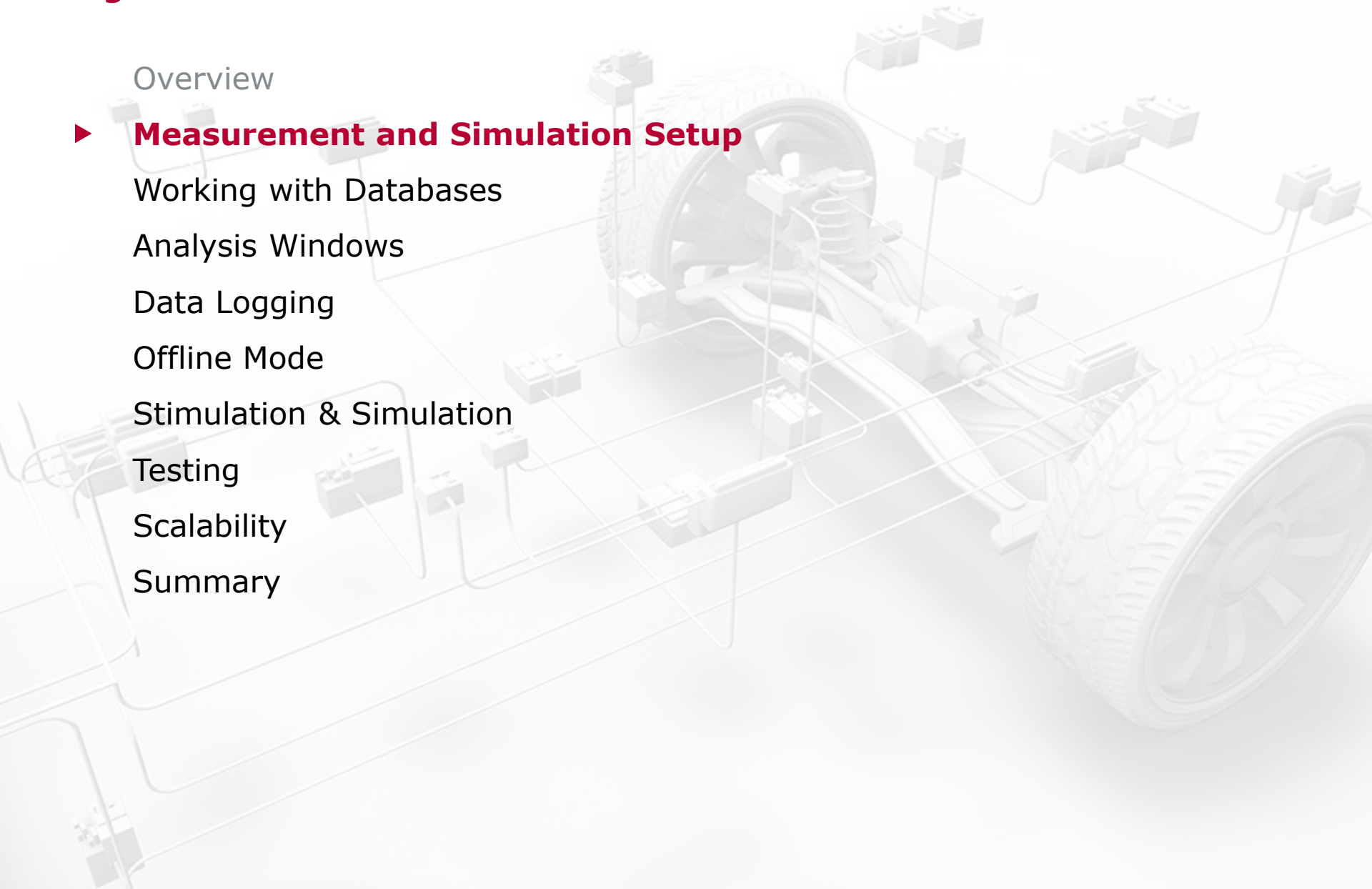
Offline Mode

Stimulation & Simulation

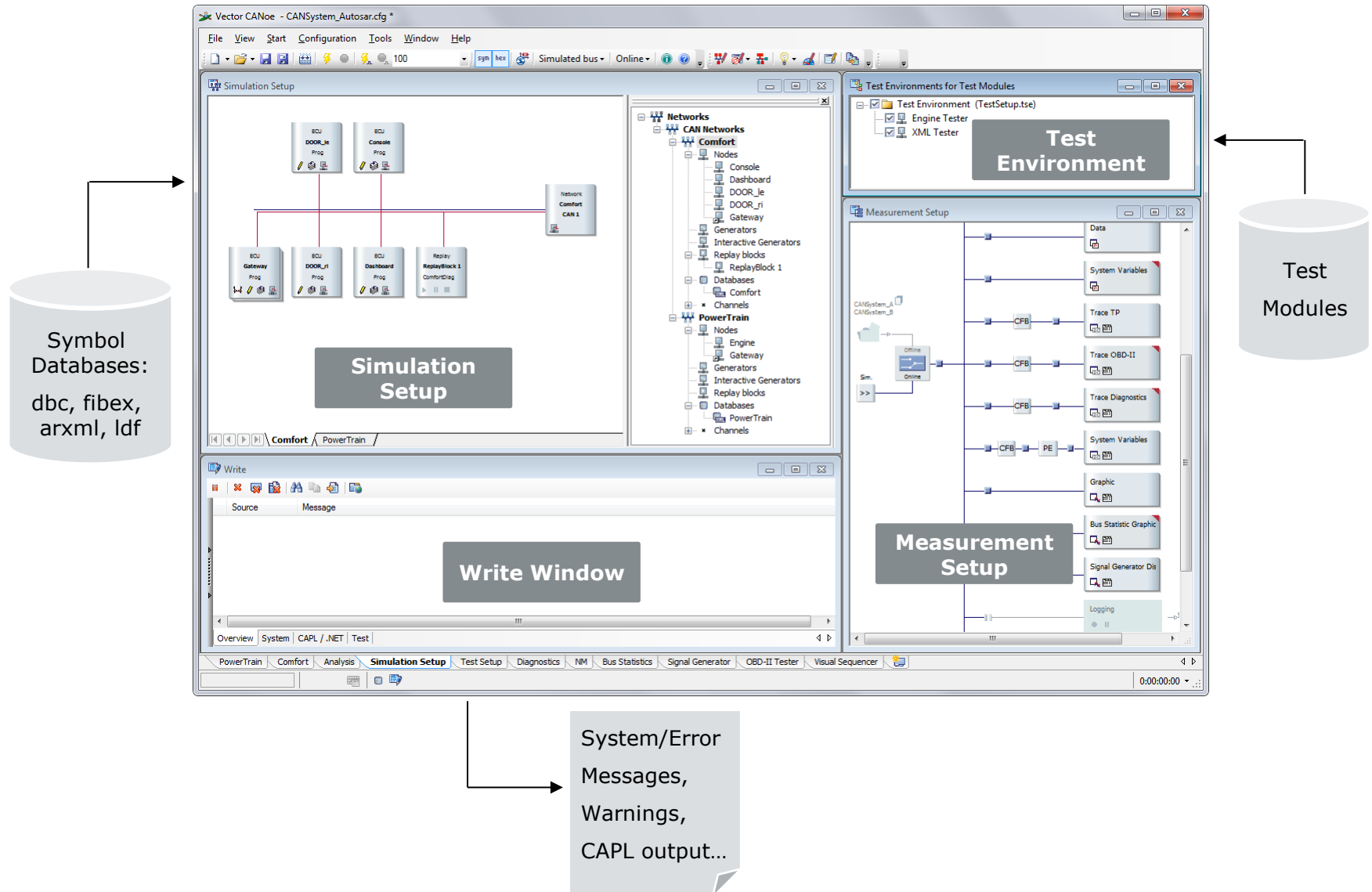
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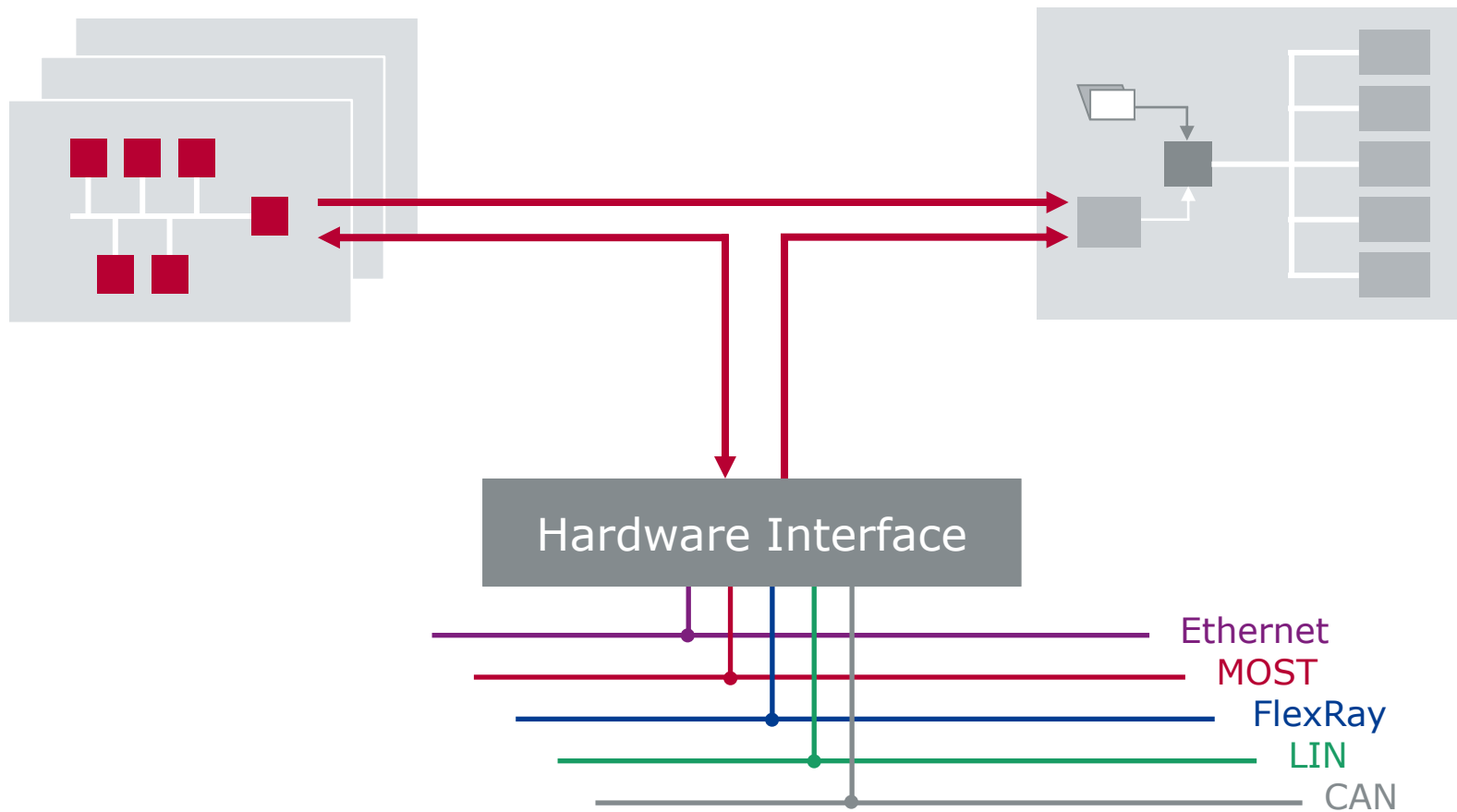
Summary



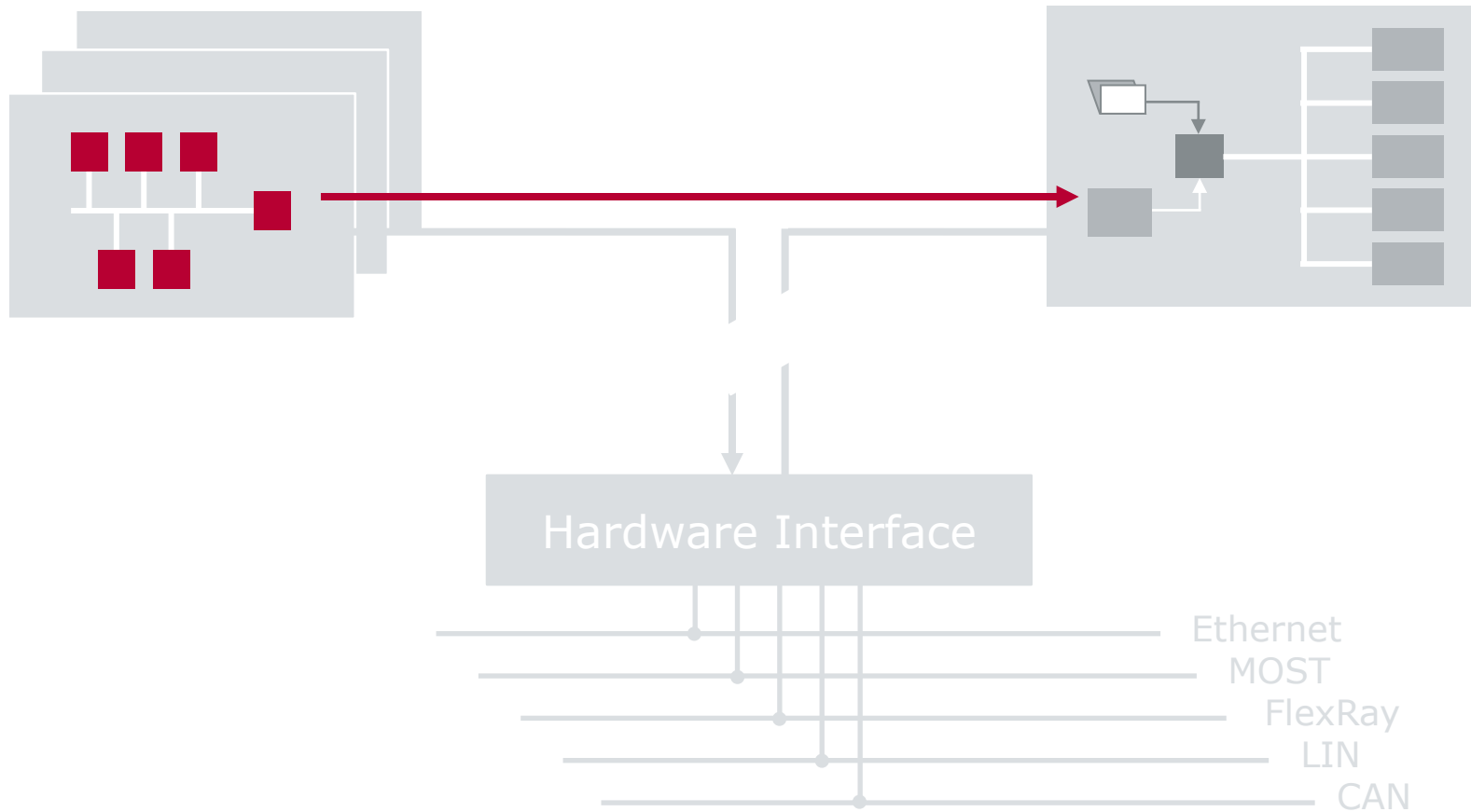
Main Windows in CANoe



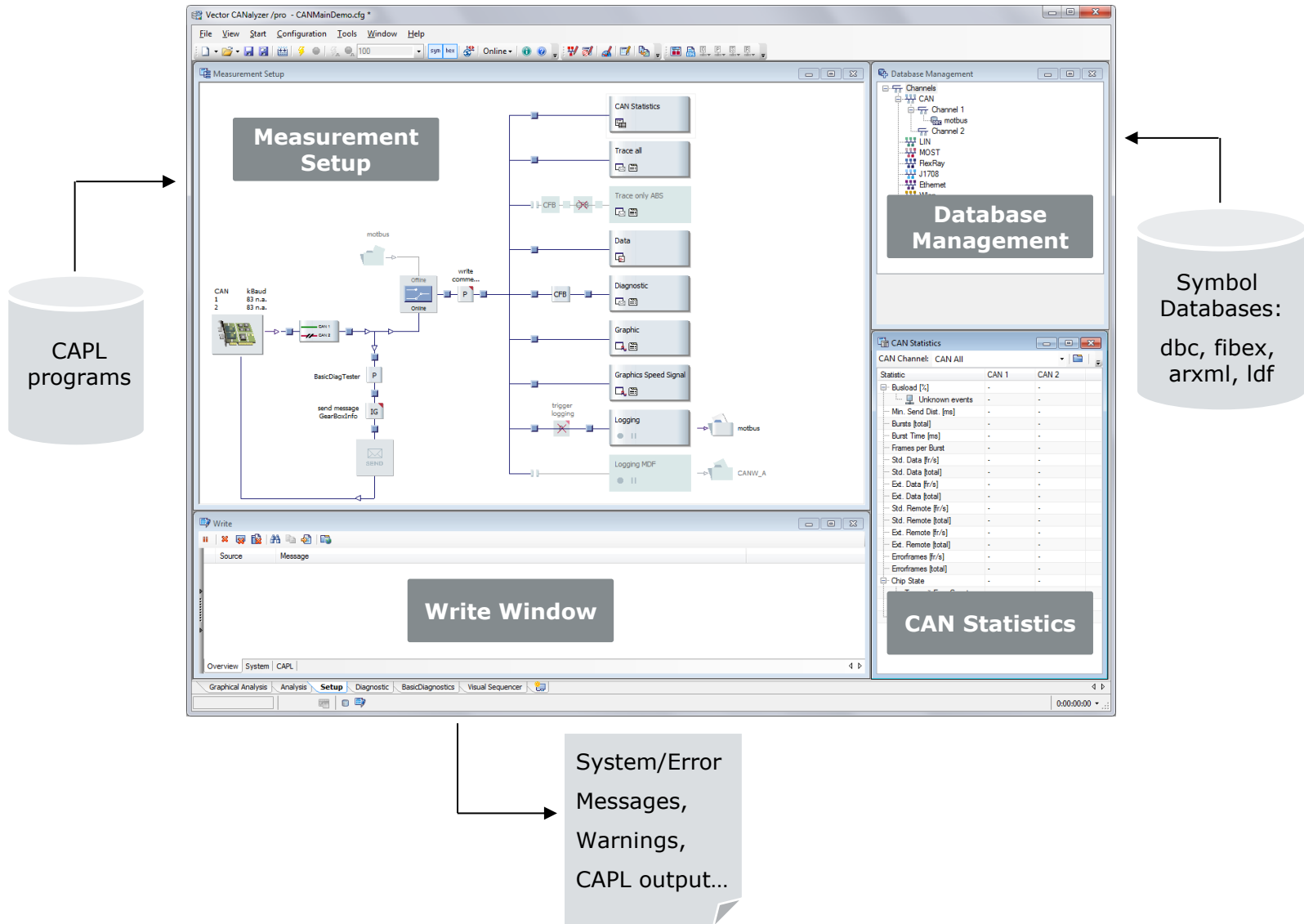
Data Flow in CANoe (Real Bus Mode)



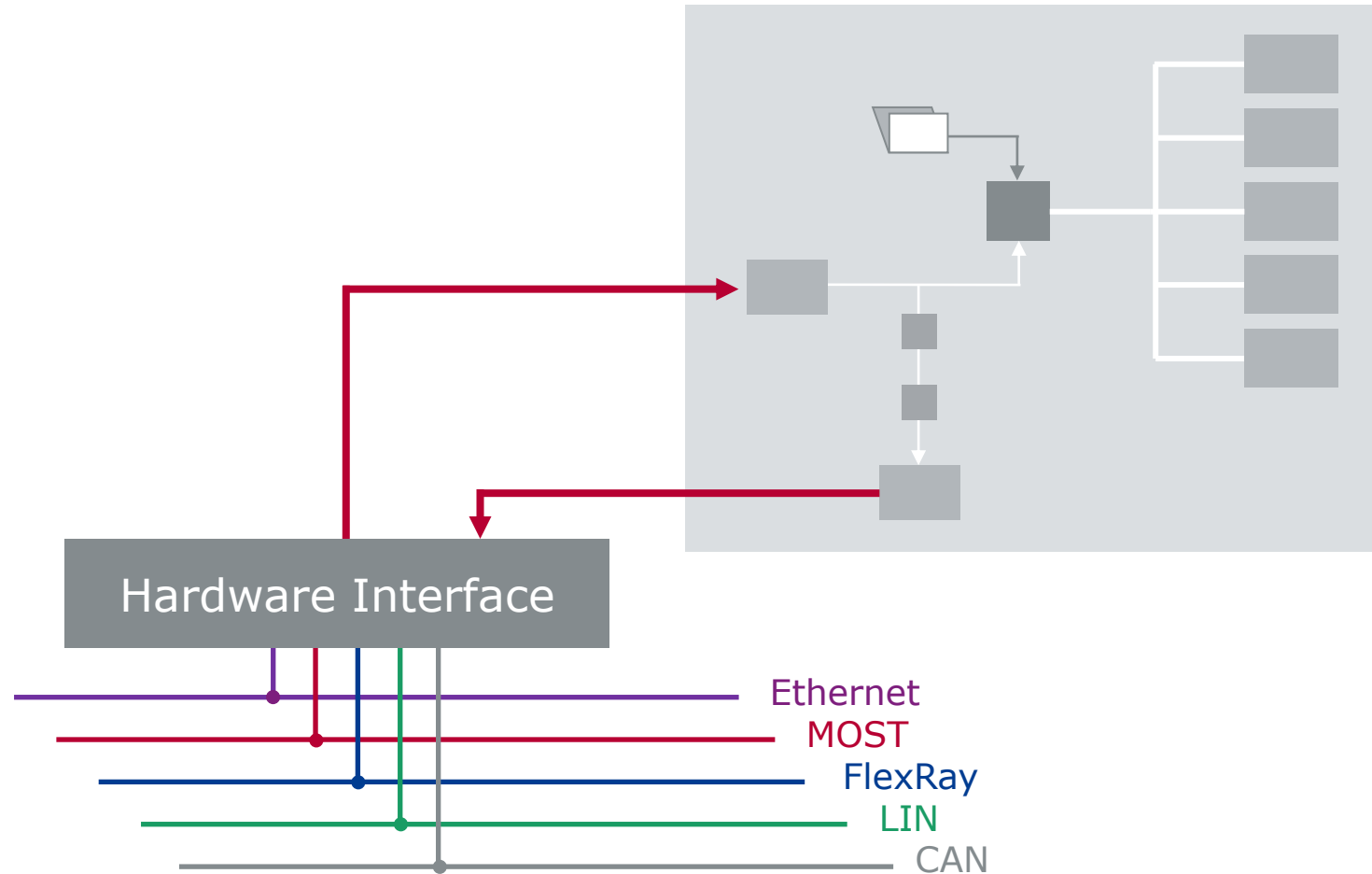
Data Flow in CANoe (Simulated Bus Mode)



Main Windows in CANalyzer



Data Flow in CANalyzer



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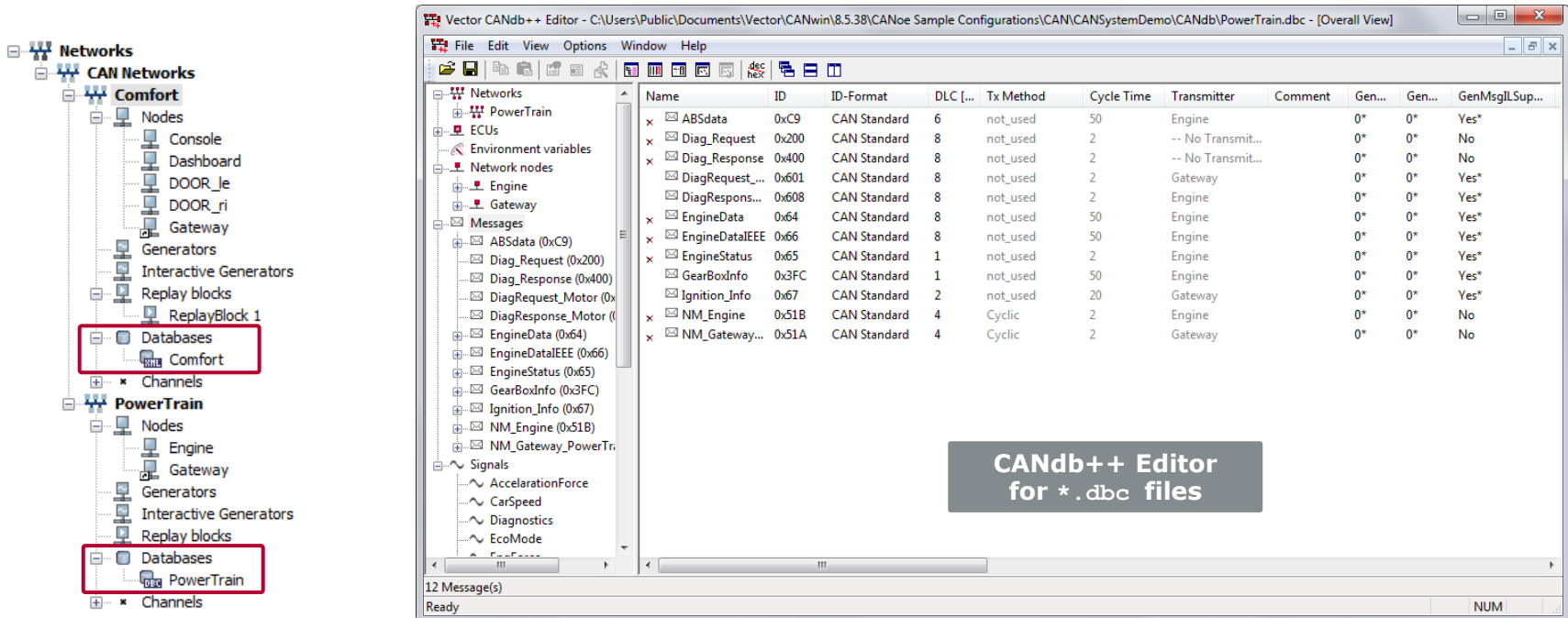
Scalability

Summary



Assigning a Database

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



The screenshot displays the Vector CANdb++ Editor interface. On the left, a tree view shows the project structure with two networks: 'CAN Networks' and 'PowerTrain'. Under 'CAN Networks', the 'Databases' folder is expanded, showing 'Comfort' and 'PowerTrain' databases. On the right, a table lists the CAN messages for the 'PowerTrain' database. A text box in the bottom right corner of the editor window reads: 'CANdb++ Editor for *.dbc files'.

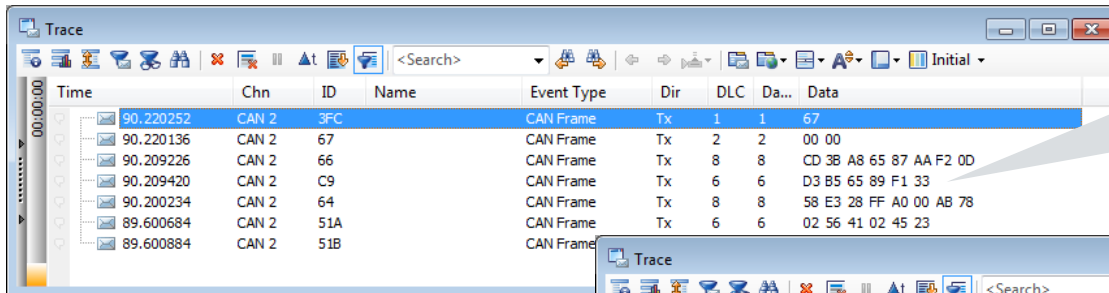
Name	ID	ID-Format	DLC	Tx Method	Cycle Time	Transmitter	Comment	Gen...	Gen...	GenMsgJLSup...
ABSDData	0xC9	CAN Standard	6	not_used	50	Engine		0*	0*	Yes*
Diag_Request	0x200	CAN Standard	8	not_used	2	-- No Transmit...		0*	0*	No
Diag_Response	0x400	CAN Standard	8	not_used	2	-- No Transmit...		0*	0*	No
DiagRequest...	0x601	CAN Standard	8	not_used	2	Gateway		0*	0*	Yes*
DiagRespons...	0x608	CAN Standard	8	not_used	2	Engine		0*	0*	Yes*
EngineData	0x64	CAN Standard	8	not_used	50	Engine		0*	0*	Yes*
EngineDataIEEE	0x66	CAN Standard	8	not_used	50	Engine		0*	0*	Yes*
EngineStatus	0x65	CAN Standard	1	not_used	2	Engine		0*	0*	Yes*
GearBoxInfo	0x3FC	CAN Standard	1	not_used	50	Engine		0*	0*	Yes*
Ignition_Info	0x67	CAN Standard	2	not_used	20	Gateway		0*	0*	Yes*
NM_Engine	0x51B	CAN Standard	4	Cyclic	2	Engine		0*	0*	No
NM_Gateway...	0x51A	CAN Standard	4	Cyclic	2	Gateway		0*	0*	No

- CANopen: dbc is generated by the network configuration tool ProCANopen

Effect in Analysis

Among other things, databases contain:

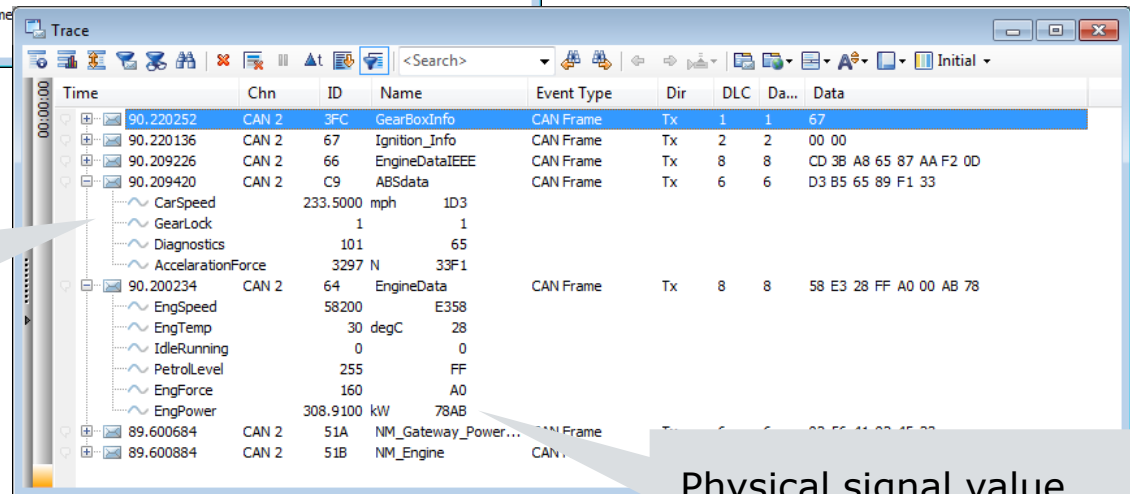
- Assignment between message identifier and symbolic message name
- Signal descriptions



Time	Chn	ID	Name	Event Type	Dir	DLC	Da...	Data
90.220252	CAN 2	3FC		CAN Frame	Tx	1	1	67
90.220136	CAN 2	67		CAN Frame	Tx	2	2	00 00
90.209226	CAN 2	66		CAN Frame	Tx	8	8	CD 3B A8 65 87 AA F2 0D
90.209420	CAN 2	C9		CAN Frame	Tx	6	6	D3 B5 65 89 F1 33
90.200234	CAN 2	64		CAN Frame	Tx	8	8	58 E3 28 FF A0 00 AB 78
89.600684	CAN 2	51A		CAN Frame	Tx	6	6	02 56 41 02 45 23
89.600884	CAN 2	51B		CAN Frame				

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

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



Time	Chn	ID	Name	Event Type	Dir	DLC	Da...	Data
90.220252	CAN 2	3FC	GearBoxInfo	CAN Frame	Tx	1	1	67
90.220136	CAN 2	67	Ignition_Info	CAN Frame	Tx	2	2	00 00
90.209226	CAN 2	66	EngineDataIEEE	CAN Frame	Tx	8	8	CD 3B A8 65 87 AA F2 0D
90.209420	CAN 2	C9	ABSdata	CAN Frame	Tx	6	6	D3 B5 65 89 F1 33
90.200234	CAN 2	64	EngineData	CAN Frame	Tx	8	8	58 E3 28 FF A0 00 AB 78
89.600684	CAN 2	51A	NM_Gateway_Power...	CAN Frame				
89.600884	CAN 2	51B	NM_Engine	CAN Frame				

Signal	Value	Unit
CarSpeed	233.5000	mph
GearLock	1	
Diagnostics	101	65
AccelerationForce	3297	N
EngSpeed	58200	E358
EngTemp	30	degC
IdleRunning	0	
PetrolLevel	255	FF
EngForce	160	A0
EngPower	308.9100	kW

Physical signal value display with units

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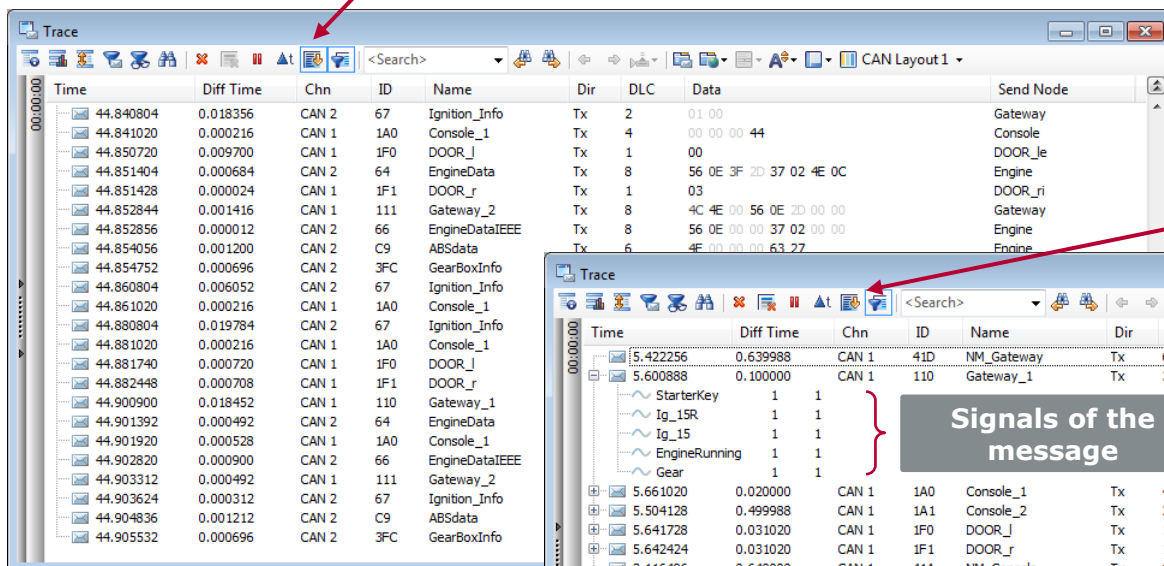
Summary



Trace Window

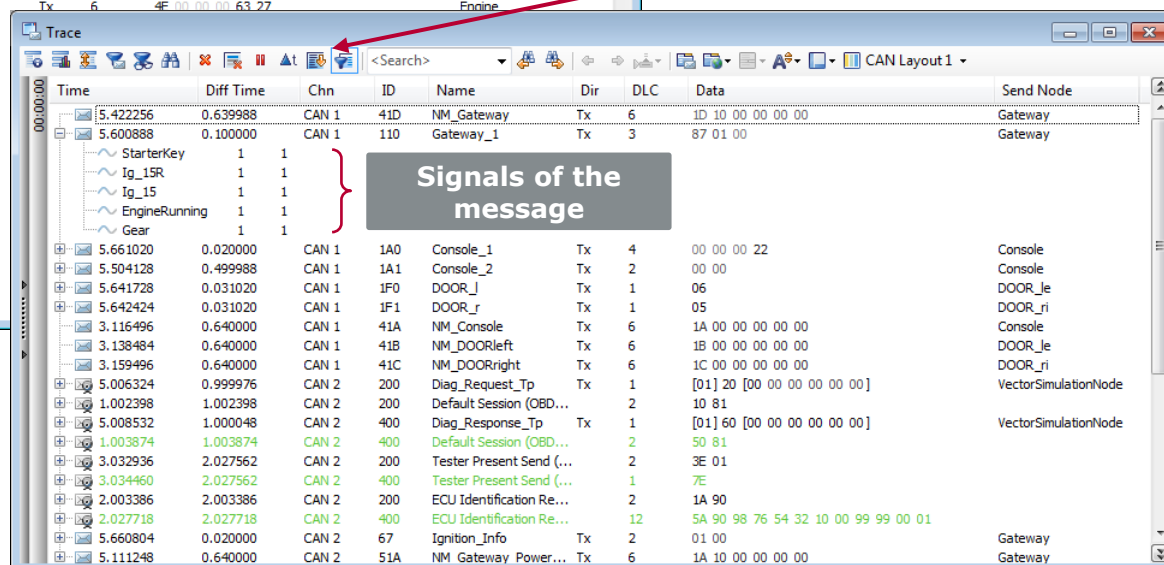
Messages are displayed as line of text in the Trace Window. When choosing the Fixed Position Display Mode, signals can also be displayed.

Chronological Display Mode



Time	Diff Time	Chn	ID	Name	Dir	DLC	Data	Send Node
44.840804	0.018356	CAN 2	67	Ignition_Info	Tx	2	01 00	Gateway
44.841020	0.000216	CAN 1	1A0	Console_1	Tx	4	00 00 00 44	Console
44.850720	0.009700	CAN 1	1F0	DOOR_l	Tx	1	00	DOOR_le
44.851404	0.000684	CAN 2	64	EngineData	Tx	8	56 0E 3F 2D 37 02 4E 0C	Engine
44.851428	0.000024	CAN 1	1F1	DOOR_r	Tx	1	03	DOOR_ri
44.852844	0.001416	CAN 1	111	Gateway_2	Tx	8	4C 4E 00 56 0E 2D 00 00	Gateway
44.852856	0.000012	CAN 2	66	EngineDataIEEE	Tx	8	56 0E 00 00 37 02 00 00	Engine
44.854056	0.001200	CAN 2	C9	ABSdata	Tx	6	4F 00 00 00 63 27	Engine
44.854752	0.000696	CAN 2	3FC	GearBoxInfo				
44.860804	0.006052	CAN 2	67	Ignition_Info				
44.861020	0.000216	CAN 1	1A0	Console_1				
44.880804	0.019784	CAN 2	67	Ignition_Info				
44.881020	0.000216	CAN 1	1A0	Console_1				
44.881740	0.000720	CAN 1	1F0	DOOR_l				
44.882448	0.000708	CAN 1	1F1	DOOR_r				
44.900900	0.018452	CAN 1	110	Gateway_1				
44.901392	0.000492	CAN 2	64	EngineData				
44.901920	0.000528	CAN 1	1A0	Console_1				
44.902820	0.000900	CAN 2	66	EngineDataIEEE				
44.903312	0.000492	CAN 1	111	Gateway_2				
44.903624	0.000312	CAN 2	67	Ignition_Info				
44.904836	0.001212	CAN 2	C9	ABSdata				
44.905532	0.000696	CAN 2	3FC	GearBoxInfo				

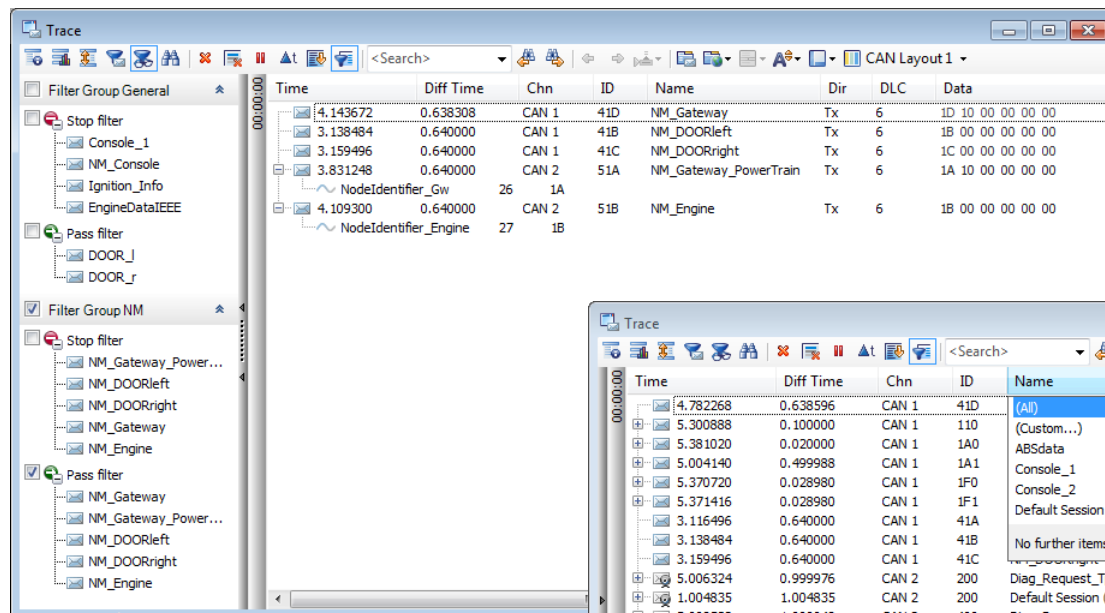
Fixed Position Display Mode



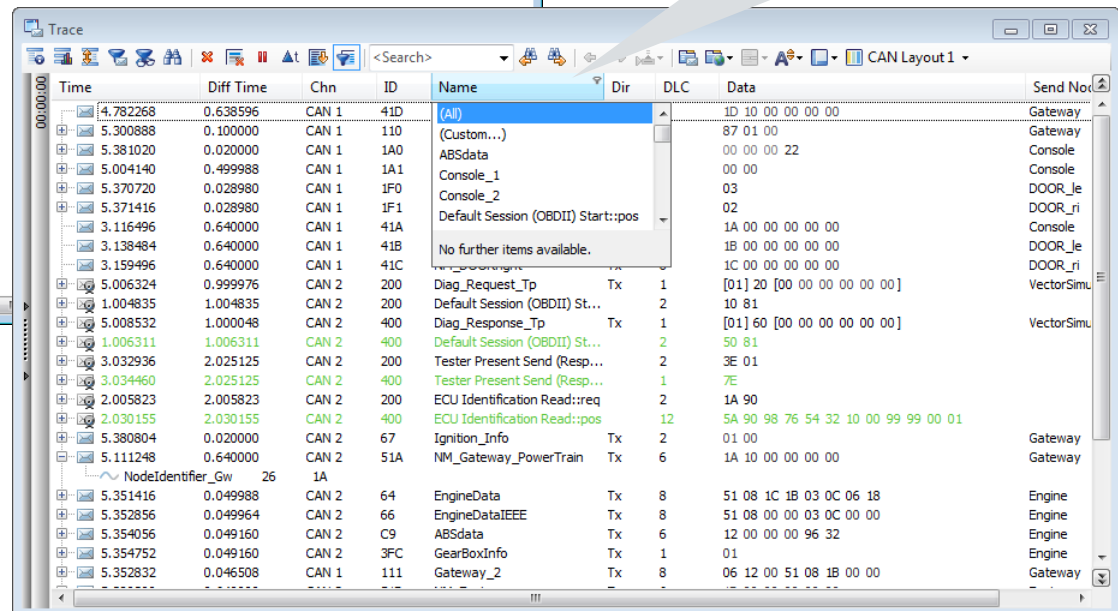
Time	Diff Time	Chn	ID	Name	Dir	DLC	Data	Send Node
5.422256	0.639988	CAN 1	41D	NM_Gateway	Tx	6	1D 10 00 00 00 00	Gateway
5.600888	0.100000	CAN 1	110	Gateway_1	Tx	3	87 01 00	Gateway
Signals of the message								
StarterKey 1 1								
Ig_15R 1 1								
Ig_15 1 1								
EngineRunning 1 1								
Gear 1 1								
5.661020	0.020000	CAN 1	1A0	Console_1	Tx	4	00 00 00 22	Console
5.504128	0.499988	CAN 1	1A1	Console_2	Tx	2	00 00	Console
5.641728	0.031020	CAN 1	1F0	DOOR_l	Tx	1	06	DOOR_le
5.642424	0.031020	CAN 1	1F1	DOOR_r	Tx	1	05	DOOR_ri
3.116496	0.640000	CAN 1	41A	NM_Console	Tx	6	1A 00 00 00 00 00	Console
3.138484	0.640000	CAN 1	41B	NM_DOORLeft	Tx	6	1B 00 00 00 00 00	DOOR_le
3.159496	0.640000	CAN 1	41C	NM_DOORRight	Tx	6	1C 00 00 00 00 00	DOOR_ri
5.006324	0.999976	CAN 2	200	Diag_Request_Tp	Tx	1	[01] 20 [00 00 00 00 00 00]	VectorSimulationNode
1.002398	1.002398	CAN 2	200	Default Session (OBD...		2	10 81	
5.008532	1.000048	CAN 2	400	Diag_Response_Tp	Tx	1	[01] 60 [00 00 00 00 00 00]	VectorSimulationNode
1.003874	1.003874	CAN 2	400	Default Session (OBD...		2	50 81	
3.032936	2.027562	CAN 2	200	Tester Present Send (...		2	3E 01	
3.034460	2.027562	CAN 2	400	Tester Present Send (...		1	7E	
2.003386	2.003386	CAN 2	200	ECU Identification Re...		2	1A 90	
2.027718	2.027718	CAN 2	400	ECU Identification Re...		12	5A 90 98 76 54 32 10 00 99 99 00 01	
5.660804	0.020000	CAN 2	67	Ignition_Info	Tx	2	01 00	Gateway
5.111248	0.640000	CAN 2	51A	NM_Gateway Power...	Tx	6	1A 10 00 00 00 00	Gateway

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

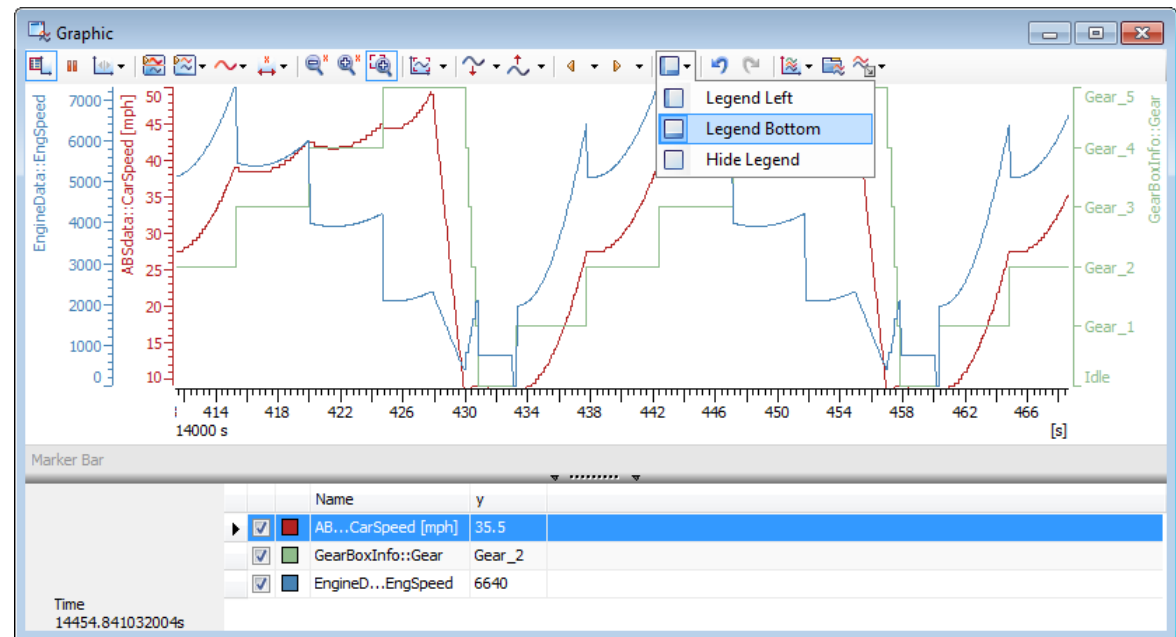


In the analysis filters area, Stop and Pass Filters can be configured

Graphics Window

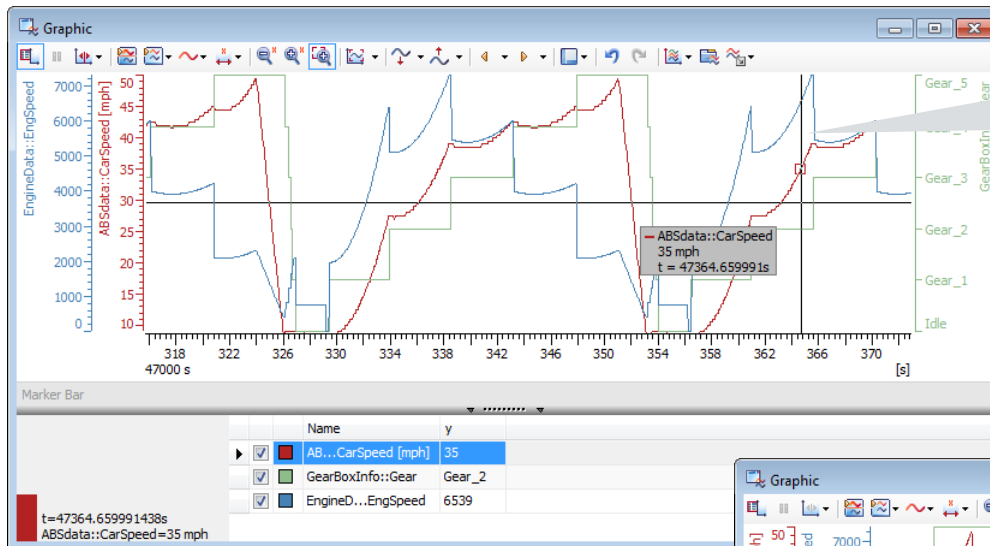
In the Graphics Window symbols are displayed graphically in an XY diagram:

- ▶ 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

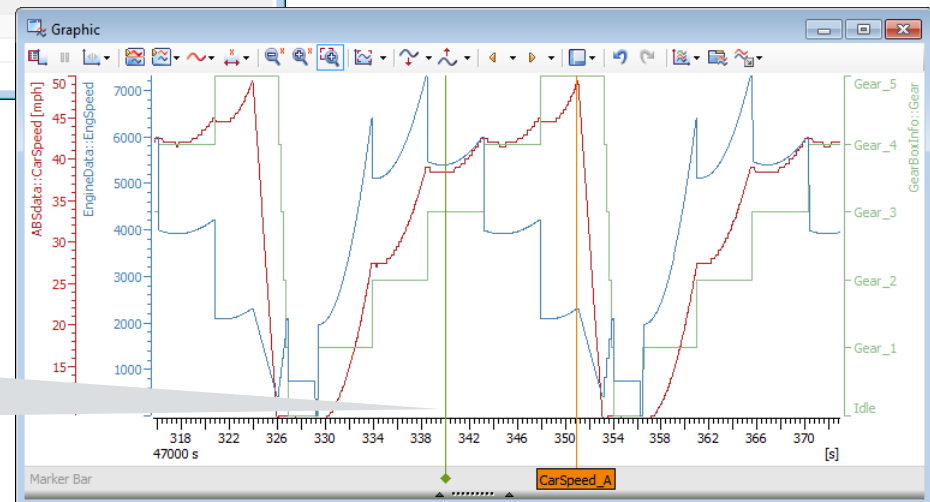


Graphics Window – Measurement and Evaluation

Various functions allow to measure and evaluate the curves:

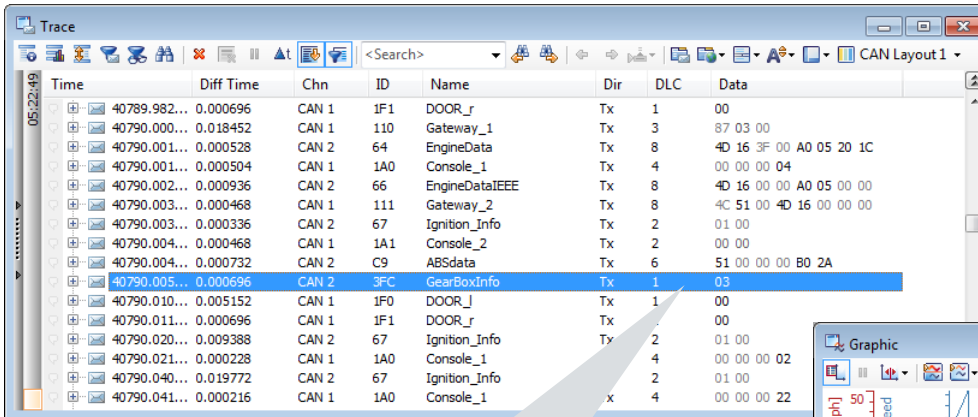


Markers can be set to easily tag and locate different points in time of a measurement



Synchronize Windows

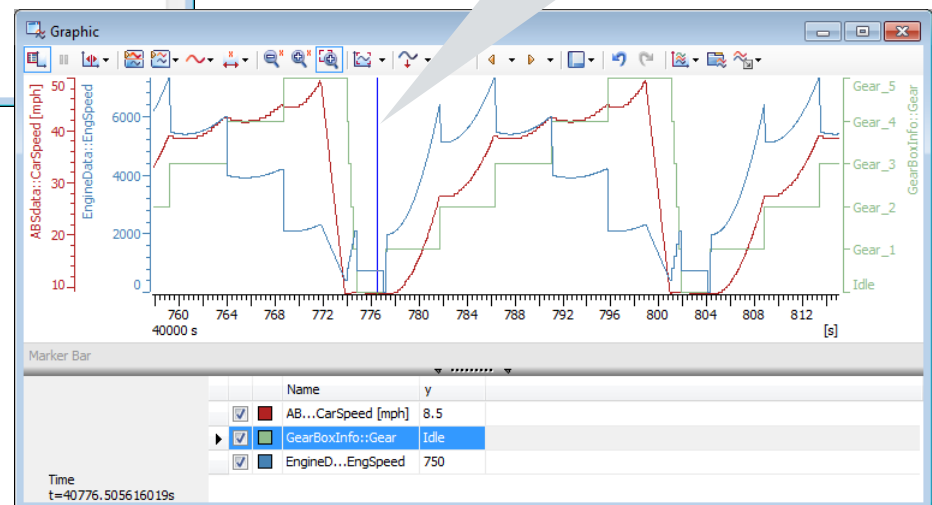
Data can be analyzed synchronously after stop of measurement. Amongst others, synchronization of analysis windows is supported in Trace and Graphics Windows.



Time	Diff Time	Chn	ID	Name	Dir	DLC	Data
40789.982...	0.000696	CAN 1	1F1	DOOR_r	Tx	1	00
40790.000...	0.018452	CAN 1	110	Gateway_1	Tx	3	87 03 00
40790.001...	0.000528	CAN 2	64	EngineData	Tx	8	4D 16 3F 00 A0 05 20 1C
40790.001...	0.000504	CAN 1	1A0	Console_1	Tx	4	00 00 00 04
40790.002...	0.000936	CAN 2	66	EngineDataIEEE	Tx	8	4D 16 00 00 A0 05 00 00
40790.003...	0.000468	CAN 1	111	Gateway_2	Tx	8	4C 51 00 4D 16 00 00 00
40790.003...	0.000336	CAN 2	67	Ignition_Info	Tx	2	01 00
40790.004...	0.000468	CAN 1	1A1	Console_2	Tx	2	00 00
40790.004...	0.000732	CAN 2	C9	ABSdata	Tx	6	51 00 00 00 B0 2A
40790.005...	0.000696	CAN 2	3FC	GearBoxInfo	Tx	1	03
40790.010...	0.005152	CAN 1	1F0	DOOR_l	Tx	1	00
40790.011...	0.000696	CAN 1	1F1	DOOR_r	Tx	1	00
40790.020...	0.009388	CAN 2	67	Ignition_Info	Tx	2	01 00
40790.021...	0.000228	CAN 1	1A0	Console_1	Tx	4	00 00 00 02
40790.040...	0.019772	CAN 2	67	Ignition_Info	Tx	2	01 00
40790.041...	0.000216	CAN 1	1A0	Console_1	Tx	4	00 00 00 22

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

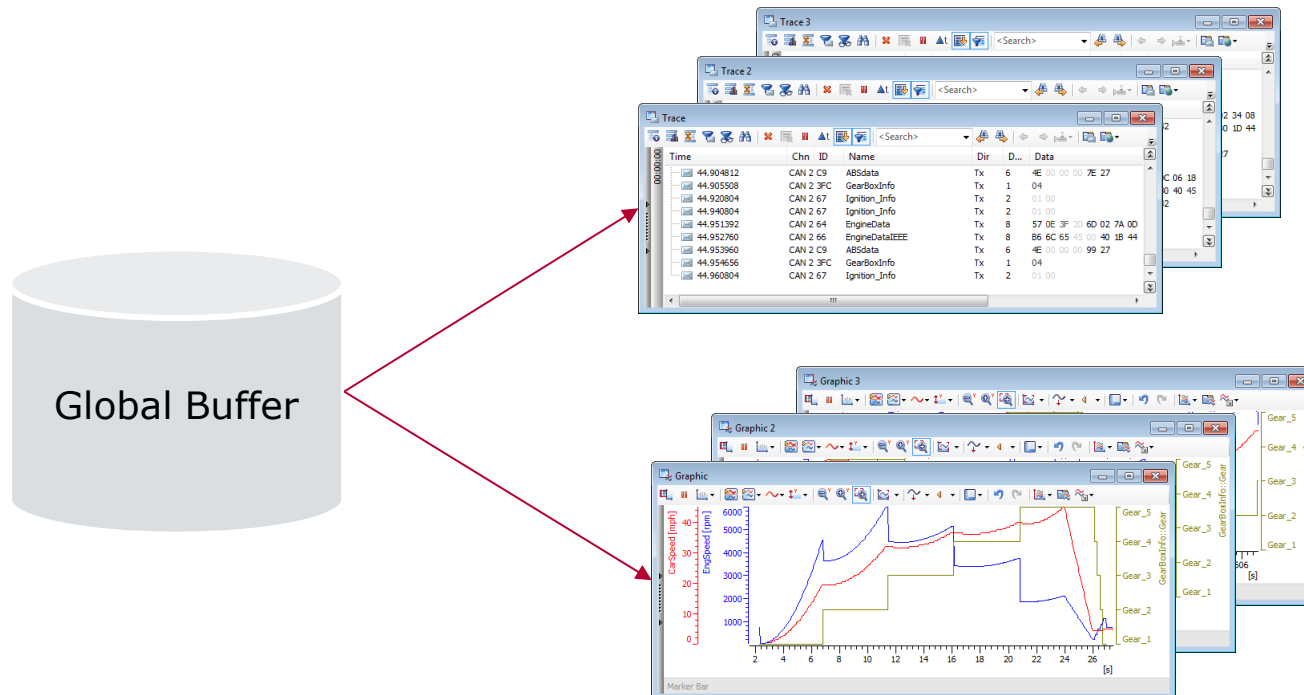
When marking a message in the Trace Window, the corresponding event in the synchronized Graphics Window is marked by a blue measurement cursor



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:

CAN Statistics
CAN Channel: CAN 1 - Comfort

Statistic	Current / Last	Min	Max	Avg
Busload [%]	15.02	11.20	16.91	14.29
Console	5.38	5.26	5.57	5.34
Dashboard	0.00	0.00	0.00	0.00
DOOR_le	2.38	2.38	2.59	2.41
DOOR_ri	2.31	2.26	2.55	2.32
Gateway	4.95	1.05	6.84	4.22
VectorSimulationNode	0.00	0.00	0.00	0.00
Unknown sender	0.00	0.00	0.00	0.00
Unknown events	0.00	0.00	0.00	0.00
Min. Send Dist. [ms]	0.000	n/a	n/a	n/a
Burst Time [ms]	6.960	1.392	7.392	2.454
Bursts [total]	4647	n/a	n/a	n/a
Console	23	n/a	n/a	n/a
Dashboard	-	n/a	n/a	n/a
DOOR_le	-	n/a	n/a	n/a
DOOR_ri	-	n/a	n/a	n/a
Gateway	19	n/a	n/a	n/a
VectorSimulationNode	-	n/a	n/a	n/a
Unknown sender	-	n/a	n/a	n/a
Frames per Burst	7	2	7	3
Std. Data [fr/s]	157	130	171	153
Std. Data [total]	17369	n/a	n/a	n/a
Ext. Data [fr/s]	0	0	0	0
Ext. Data [total]	0	n/a	n/a	n/a
Std. Remote [fr/s]	0	0	0	0
Std. Remote [total]	0	n/a	n/a	n/a
Ext. Remote [fr/s]	0	0	0	0
Ext. Remote [total]	0	n/a	n/a	n/a
Errorframes [fr/s]	0	0	0	0
Errorframes [total]	0	n/a	n/a	n/a
Chip State	Simulated	n/a	n/a	n/a
Transmit Error Count	0	n/a	0	n/a
Receive Error Count	0	n/a	0	n/a
Transceiver Errors	0	n/a	n/a	n/a

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

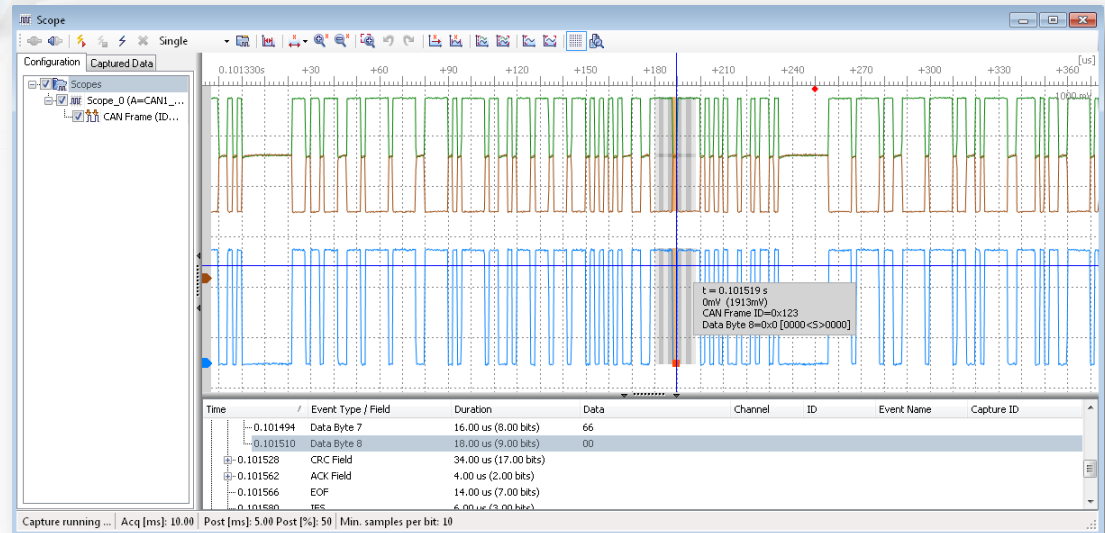
Error Statistics (Bus specific)

LIN Statistics
LIN Channel: LIN 1 - ExteriorLight

Statistic	Current / Last	Min	Max	Avg
Errors Bus [total]	24	n/a	n/a	n/a
Errors Resp [total]	0	n/a	n/a	n/a
Errors Resp Detected [total]	0	n/a	n/a	n/a
GWE	n/a	n/a	n/a	n/a
DLF_Left	0	n/a	n/a	n/a
DLF_Right	0	n/a	n/a	n/a
DLR_Left	0	n/a	n/a	n/a
DLR_Right	0	n/a	n/a	n/a
WWS	0	n/a	n/a	n/a
Diag No Resps [total]	9761	n/a	n/a	n/a
Busload [%]	43.16	0.00	43.53	42.50
Frames [fr/s]	0	0	2	0
Frames [total]	11	n/a	n/a	n/a
Frame Cycle Time [ms]	1242.46	600.00	46380.00	15381.51
Baud Rate Master [bit/s]	19202	19198	19203	19202
Baud Rate Dev. Master [%]	0.01	0.00	0.02	0.01
Tolerance Header [%]	18.20	17.62	18.21	18.20
Tolerance Resp [%]	0.02	0.02	0.02	0.02
Duration Header [ms]	2.093	2.083	2.093	2.093
Duration Resp [ms]	1.563	1.563	4.688	1.847
Resp Space [us]	0.3	0.2	0.4	0.3
Sleep Commands [total]	1	n/a	n/a	n/a
Wakeups [total]	0	n/a	n/a	n/a
Wakeups Duration [us]	-	-	-	-
Init Time Master [ms]	-	-	-	-
ETF Resps / Headers [total]	-	n/a	n/a	n/a
ETF Invalid Resps / Head...	-	n/a	n/a	n/a
ETF Collisions / Headers [t...	-	n/a	n/a	n/a
ETF Resolutions / Collisio...	-	n/a	n/a	n/a

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, CANcardXL_e, XL-Family



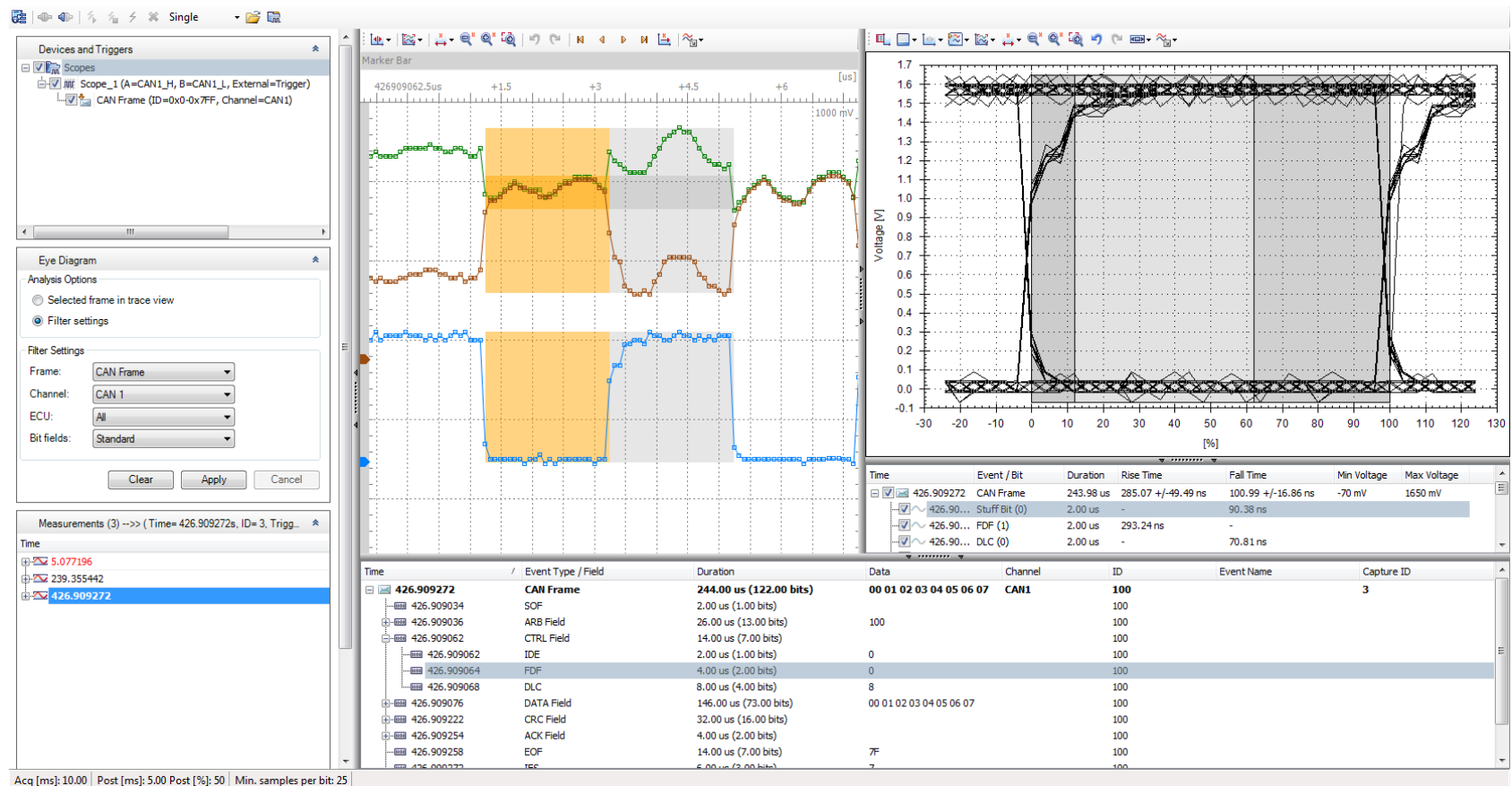
Scope Hardware

- ▶ 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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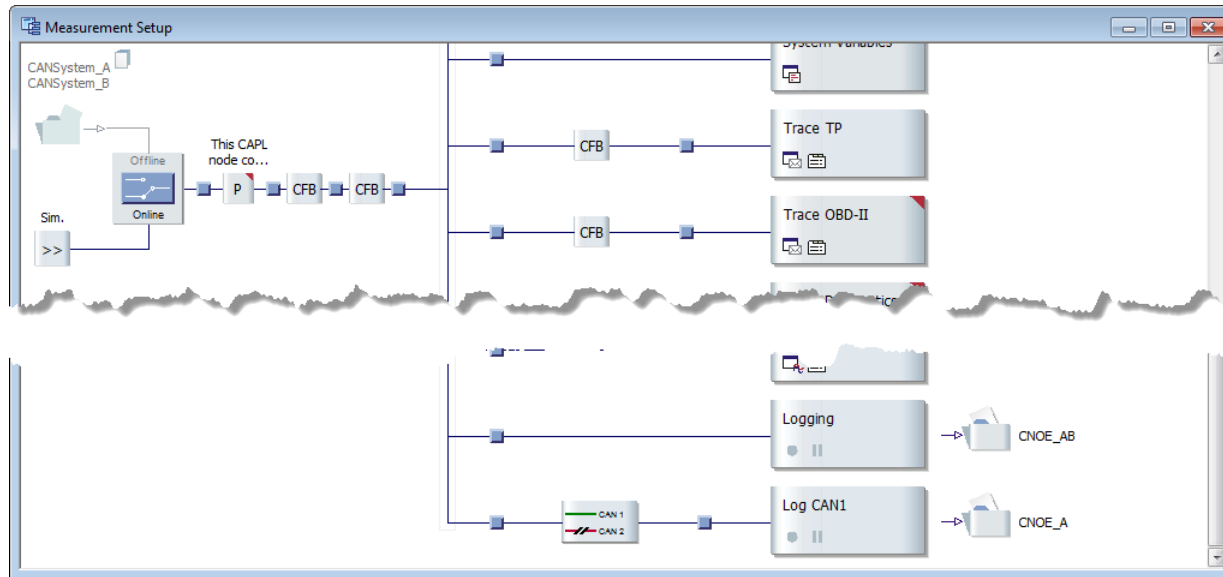
Scalability

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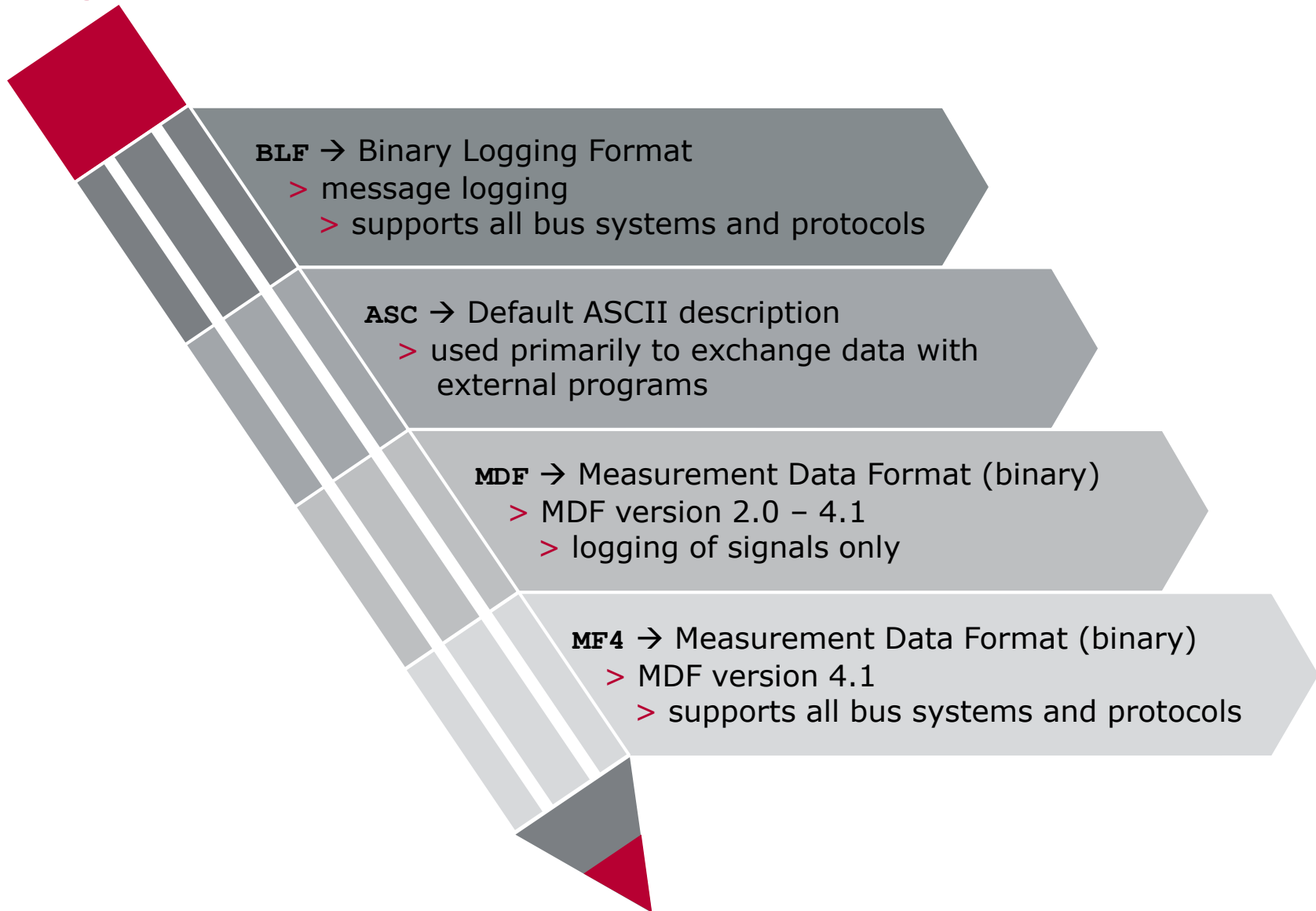
Logging Block

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

Log File Format



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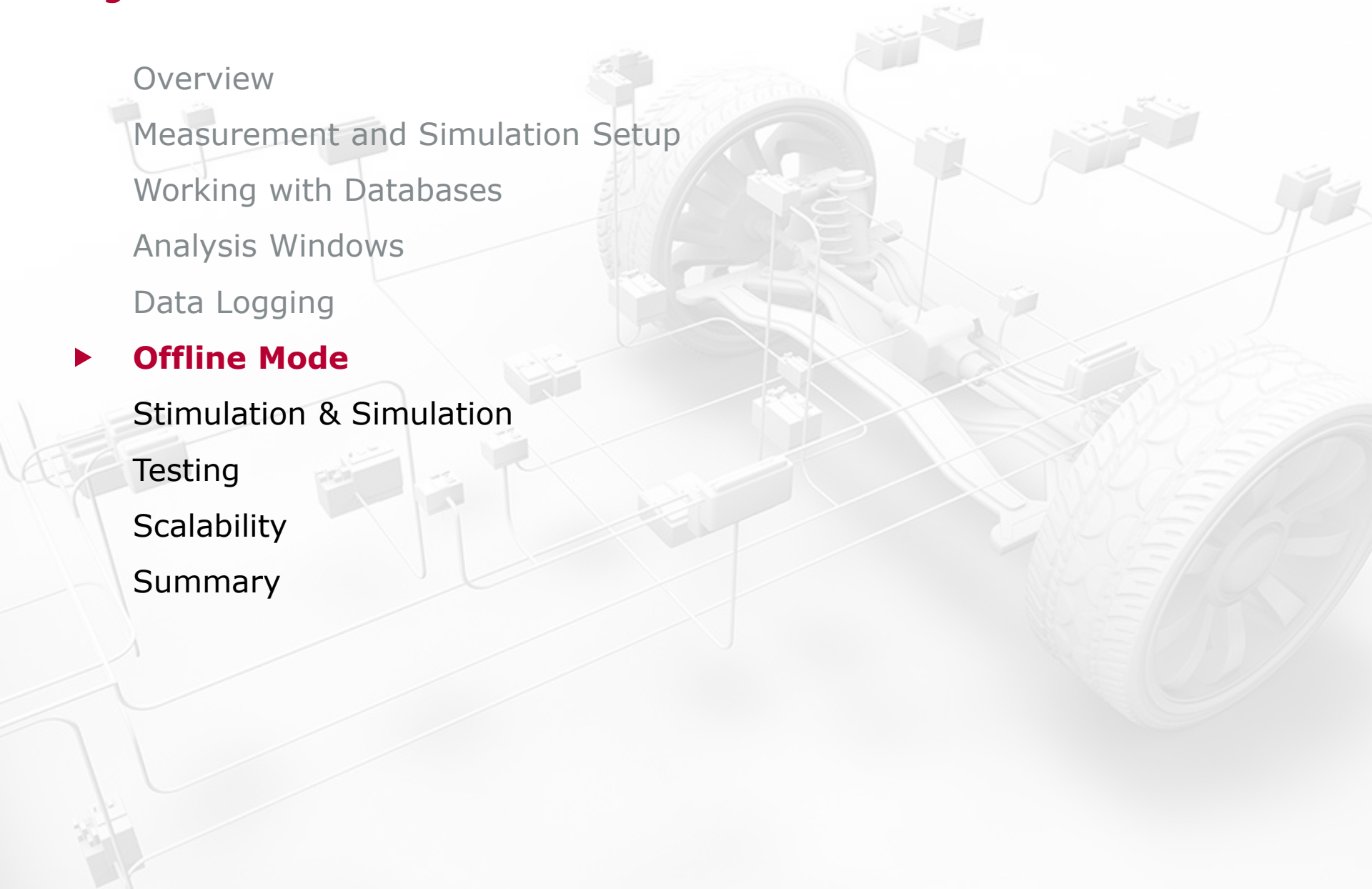
► **Offline Mode**

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Testing

Scalability

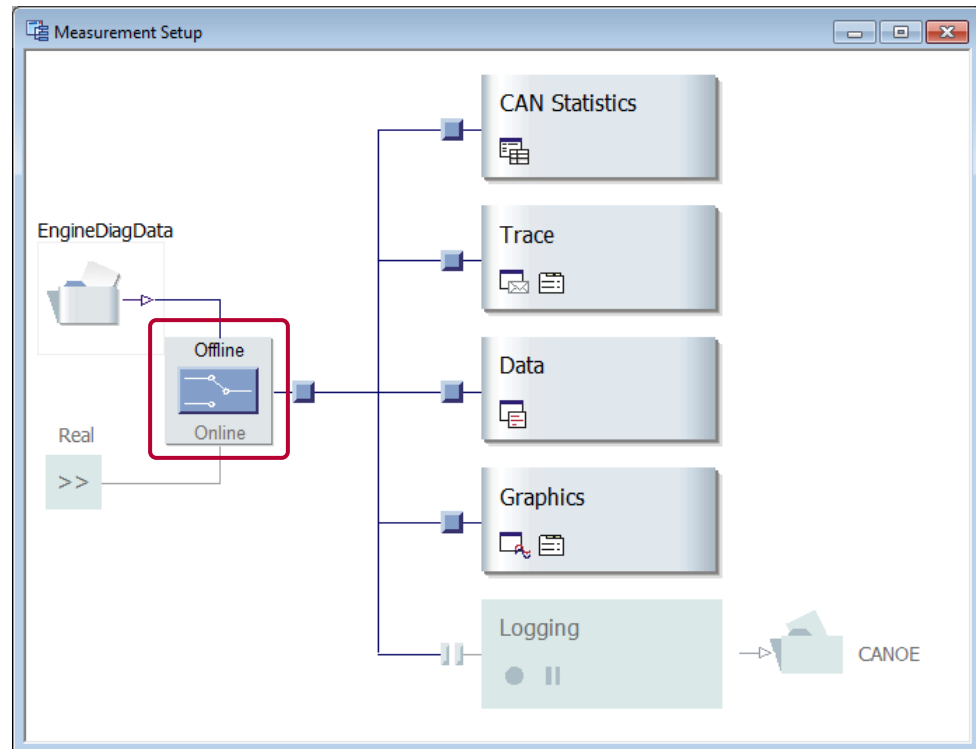
Summary



Overview

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

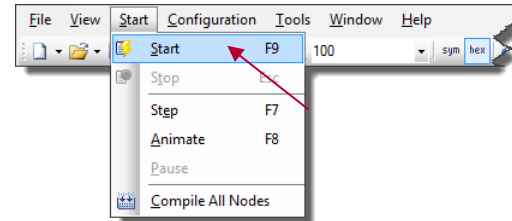
- ▶ All analysis windows can be used just like in Online Mode
- ▶ In CANoe, the Simulation Setup is not active in Offline Mode
- ▶ In CANalyzer, the send branch is not active in Offline Mode



Control Offline Mode

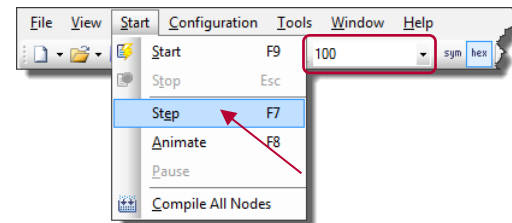
Start and Stop

- > Entire file is played back



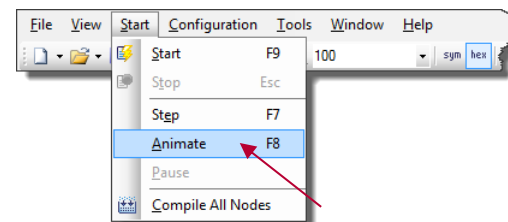
With configurable step width

- > Automatic pause at the end of the step



Animated flow

- > Slow-motion display of events



Agenda

Overview

Measurement and Simulation Setup

Working with Databases

Analysis Windows

Data Logging

Offline Mode

► **Stimulation & Simulation**

Testing

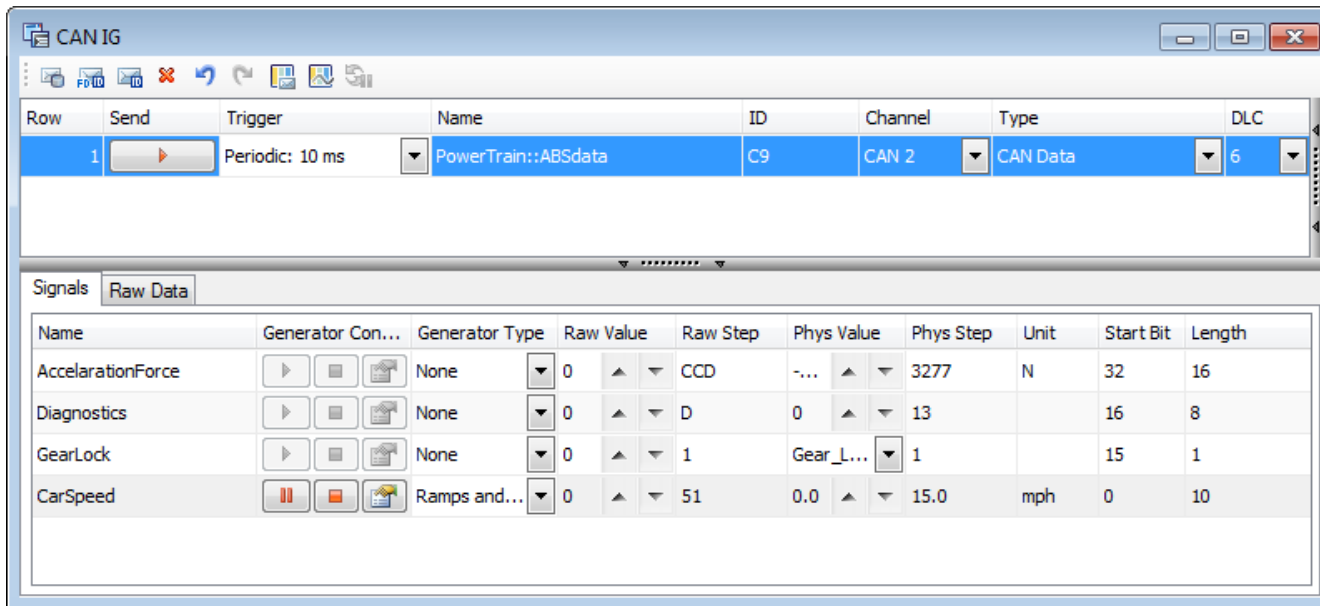
Scalability

Summary

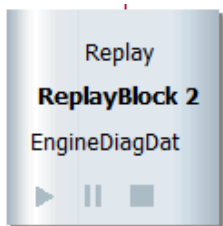


Stimulation with CANalyzer and CANoe

- Interactive Generator for interactive sending, includes signal value generation



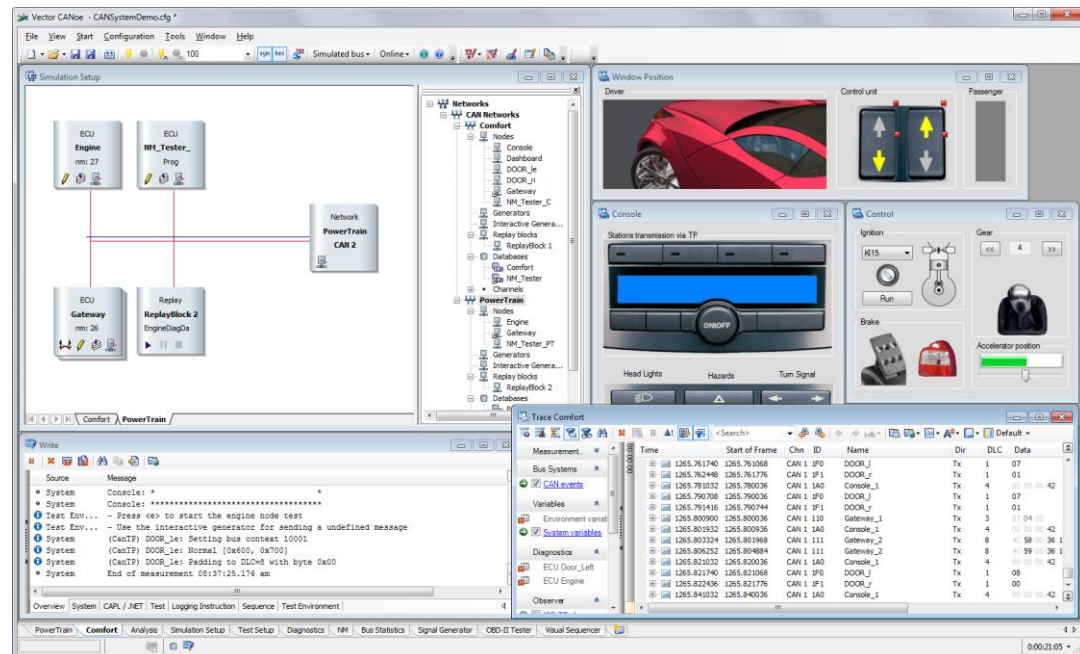
- Replay Block for replaying logged CAN data



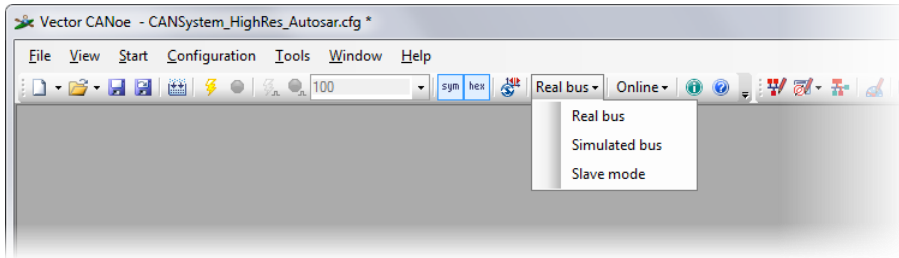
Simulation of Entire Networks or Remaining Bus

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

- ▶ Nodes automatically send their messages according to the database file
- ▶ 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

Agenda

Overview

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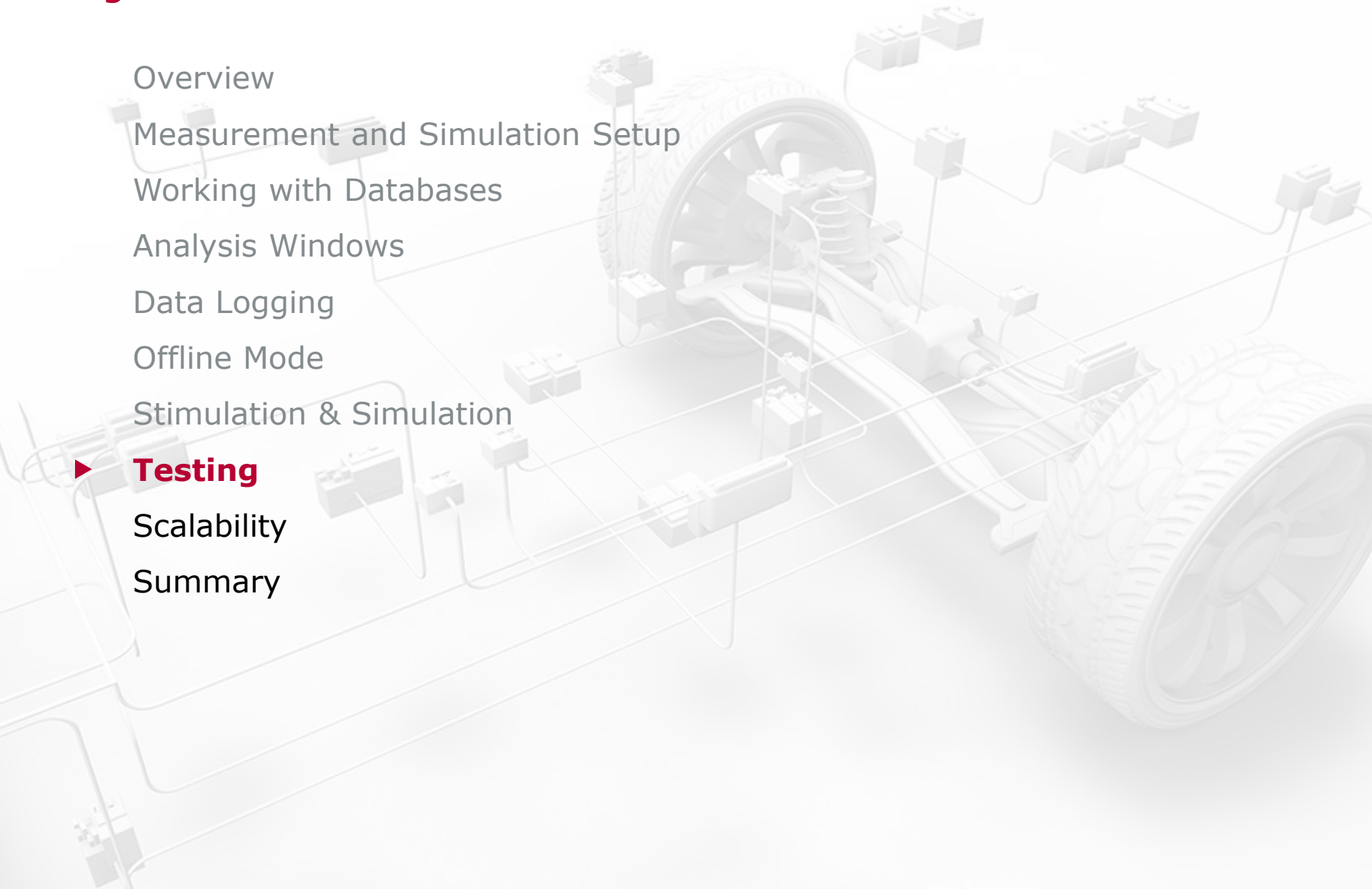
Offline Mode

Stimulation & Simulation

► **Testing**

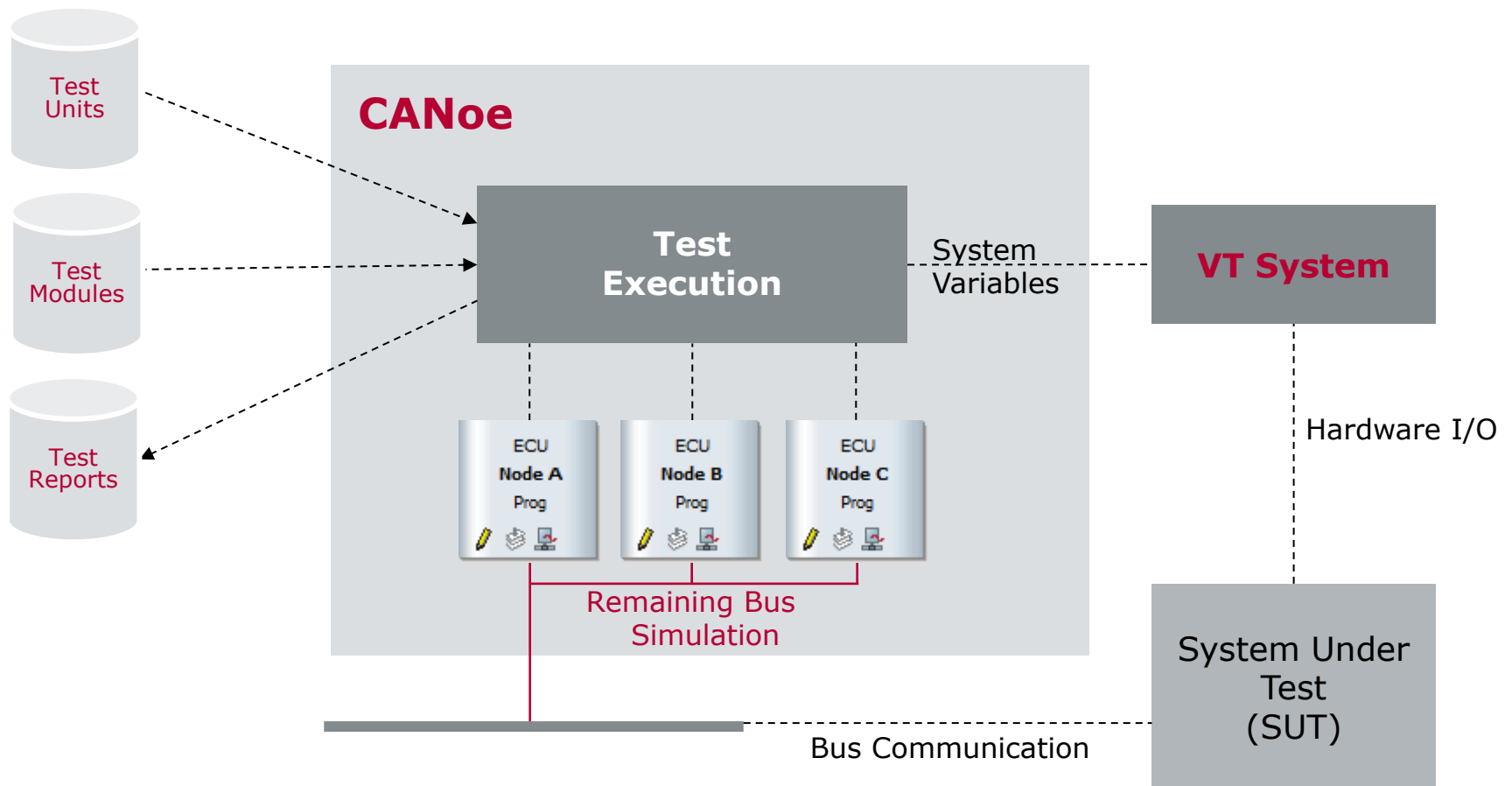
Scalability

Summary



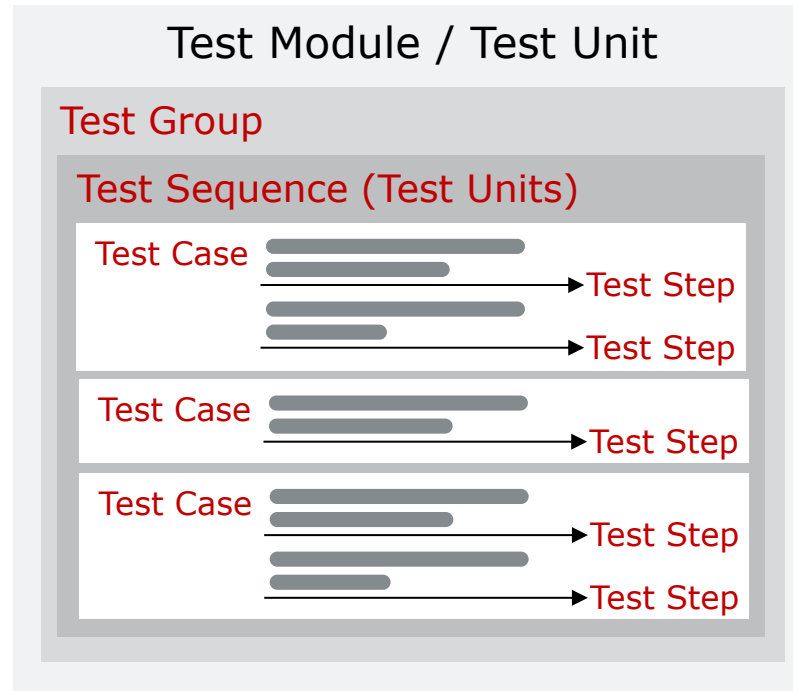
CANoe Test Environment

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



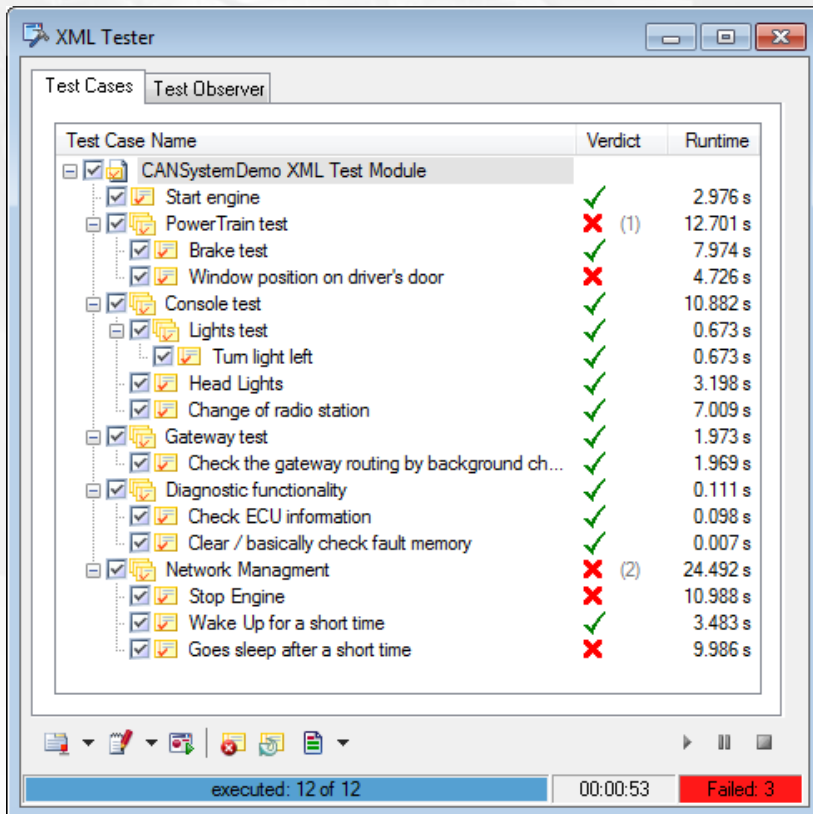
Test Specification

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



Test Execution

- ▶ Completely automated test execution
- ▶ XML test report converted into HTML or any other format

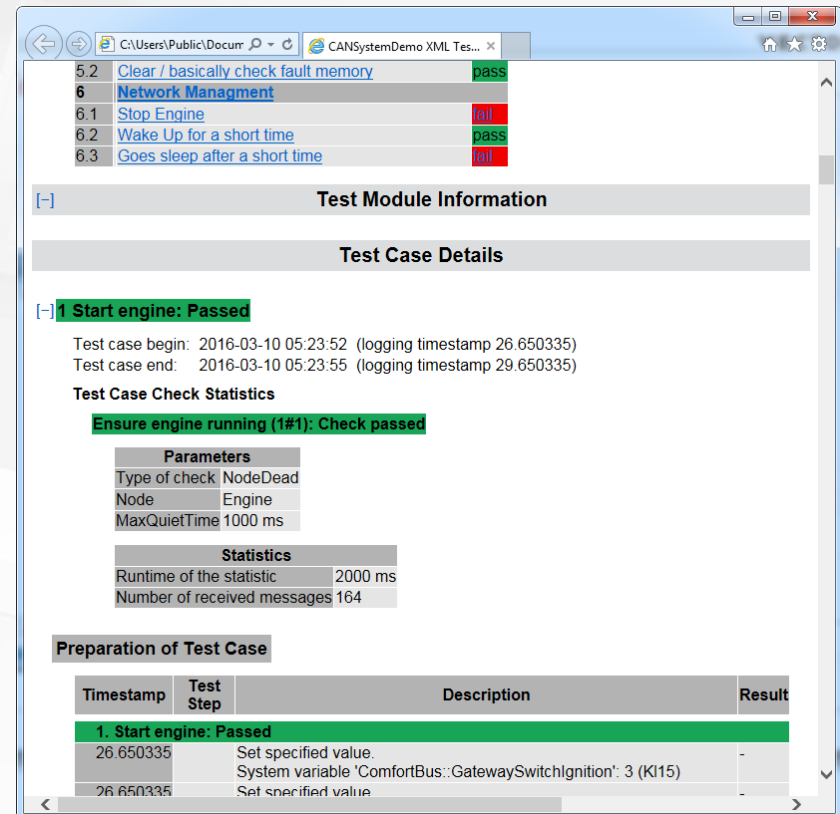


XML Tester

Test Cases Test Observer

Test Case Name	Verdict	Runtime
CANSysDemo XML Test Module		
Start engine	✓	2.976 s
PowerTrain test	✗ (1)	12.701 s
Brake test	✓	7.974 s
Window position on driver's door	✗	4.726 s
Console test	✓	10.882 s
Lights test	✓	0.673 s
Turn light left	✓	0.673 s
Head Lights	✓	3.198 s
Change of radio station	✓	7.009 s
Gateway test	✓	1.973 s
Check the gateway routing by background ch...	✓	1.969 s
Diagnostic functionality	✓	0.111 s
Check ECU information	✓	0.098 s
Clear / basically check fault memory	✓	0.007 s
Network Management	✗ (2)	24.492 s
Stop Engine	✗	10.988 s
Wake Up for a short time	✓	3.483 s
Goes sleep after a short time	✗	9.986 s

executed: 12 of 12 00:00:53 Failed: 3



C:\Users\Public\Docum... CANSysDemo XML Tes...

5.2	Clear / basically check fault memory	pass
6	Network Management	
6.1	Stop Engine	fail
6.2	Wake Up for a short time	pass
6.3	Goes sleep after a short time	fail

Test Module Information

Test Case Details

1 Start engine: Passed

Test case begin: 2016-03-10 05:23:52 (logging timestamp 26.650335)
Test case end: 2016-03-10 05:23:55 (logging timestamp 29.650335)

Test Case Check Statistics

Ensure engine running (1#1): Check passed

Parameters	
Type of check	NodeDead
Node	Engine
MaxQuietTime	1000 ms

Statistics	
Runtime of the statistic	2000 ms
Number of received messages	164

Preparation of Test Case

Timestamp	Test Step	Description	Result
1. Start engine: Passed			
26.650335		Set specified value.	-
		System variable 'ComfortBus::GatewaySwitchIgnition': 3 (KI15)	-
26.650335		Set specified value	-

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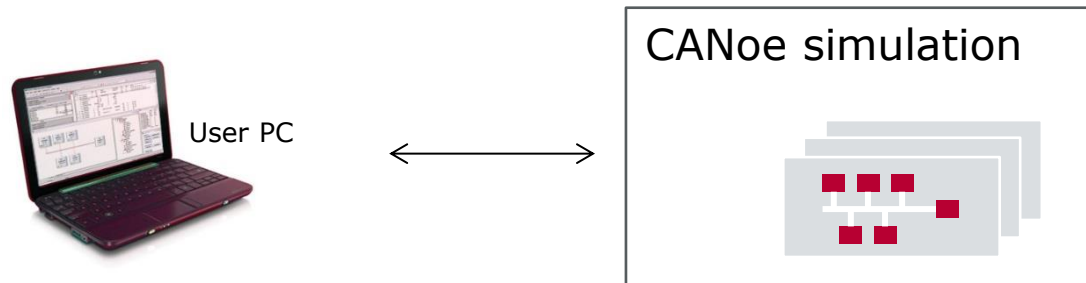
► **Scalability**

Summary



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



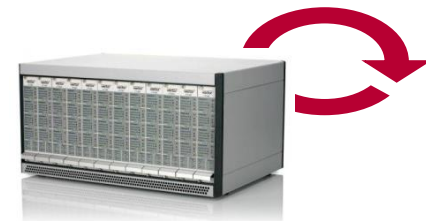
CANoe RT Rack

Special application: Simulation without
user interaction:

VN8900 standalone



VT System standalone



VT System

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► **Summary**



CANoe / CANalyzer in a nutshell

- ▶ Comprehensive Analysis of CAN networks with CANalyzer and CANoe
 - ▶ Decoding of message data using database descriptions
 - ▶ Powerful analysis features like Trace and Graphics Window
 - ▶ Busstatistic Window with errorframe and burst statistics
 - ▶ Logging of bus data
 - ▶ Option Scope for physical layer analysis
 - ▶ Stimulation features like Replay Block and Interactive Generator

- ▶ Powerful simulation and test features with CANoe
 - ▶ Simulation of complete networks
 - ▶ Automated test with reporting

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