

Simulation- and Test-Tools for CAN XL



Agenda

1. You decided to develop a CAN XL network ...

2. CAN XL Network Interfaces

3. CAN XL Transeivers

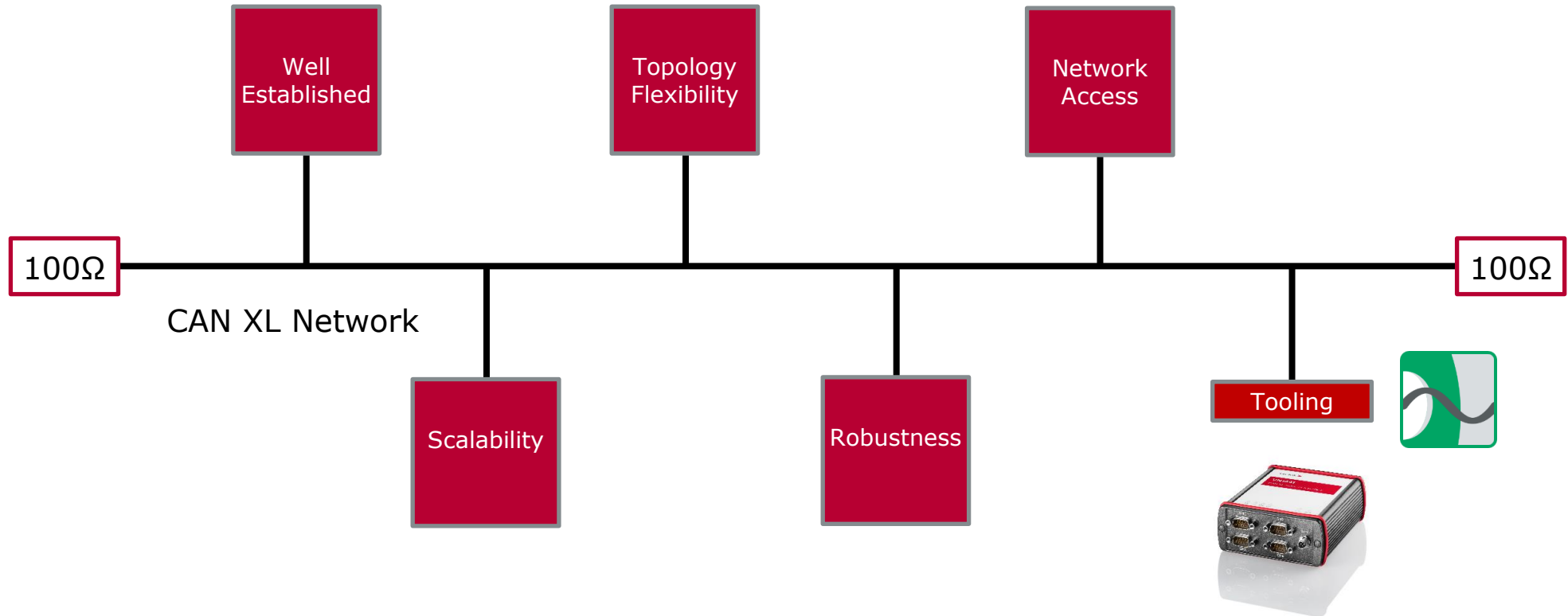
4. Vector CANoe and CAN XL

You decided to develop a CAN XL network ...

Reasons for CAN XL



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CAN XL Network Interfaces

Getting Started



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- ▶ The VN1641 is Vector's first dedicated CAN XL Network Interface (Planned Release April 2024)
 - ▶ It provides an appropriate, flexible and cost sensitive solution for analysis, test and simulation use cases
 - ▶ Full CAN XL support on all channels
 - > Protocol mode Error Signaling Enabled supported
 - > Protocol mode Error Signaling Disabled supported
 - ▶ CAN FD and CAN 2.0 Highspeed support on all channels with all latest features available
 - ▶ Time Synchronization
 - ▶ Digital / analog I/Os: "simple IO" similar to VN1640A
 - > 2 Digital In, 1 Digital Out, 1 Analog In
 - ▶ Host connection
 - > USB 3.2 Gen. 1 with USB Type C connector with screw lock
 - > Ethernet Host Connection (Gigabit Ethernet 1000BASE-T)



CAN XL Network Interfaces

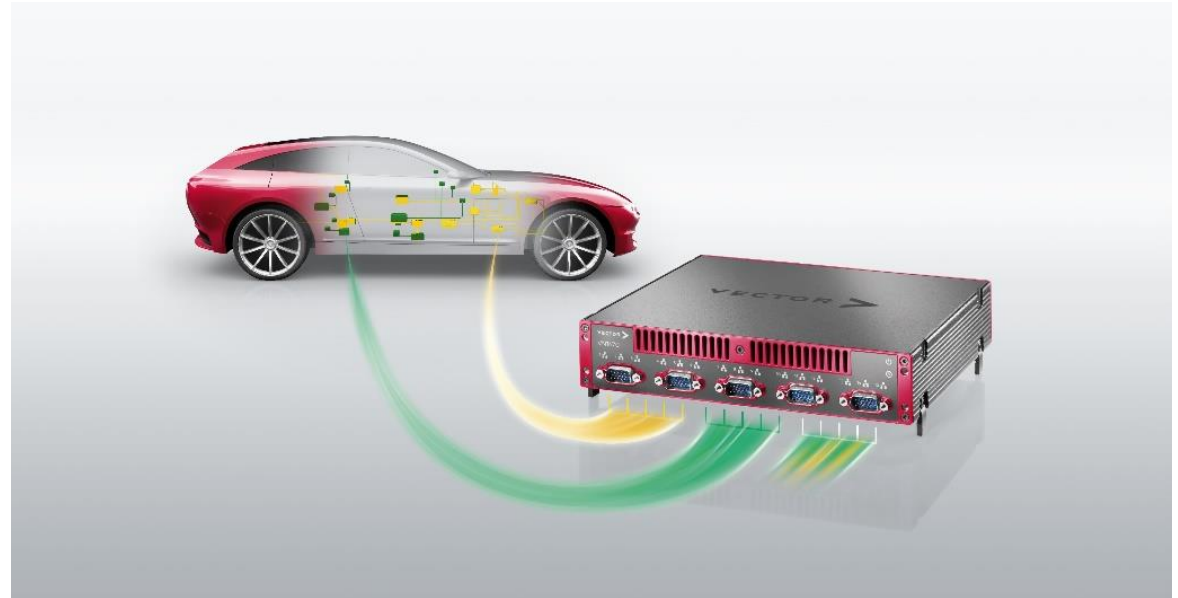
More Interfaces



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- ▶ The VN1670 – Worldwide first CAN XL capable network interface
 - ▶ CAN XL available on 5 piggyback channels
 - ▶ Same feature set as VN1641
 - ▶ Additionally
 - > 5 onboard CAN/CAN FD channels
 - > 5 onboard LIN channels
- ▶ Overall: 15 channels
- ▶ Supported with CANoe/CANalyzer 17
- ▶ Vector Driver Setup 23.20





Agenda

1.

You decided to develop a CAN XL network ...

2.

CAN XL Network Interfaces

3.





CAN XL Transceivers

4.

Vector CANoe and CAN XL

CAN Transceiver Technologies

► CAN XL Transceivers – A wide range of opportunities

	CAN High Speed 	CAN FD 	CAN SIC 	CAN SIC XL 
Max. Bit-Rate in Mbit/s	1	2 (5)	5 (8)	Up to 20
Topology	Linear bus, bus with stubs, stars	Linear bus, (peer-to-peer)	Linear bus, bus with stubs, stars, (peer-to-peer)	Linear bus, bus with stubs, stars
Description		Improved bit symmetry. Required for higher bit rates in FD data phase.	Supports ringing suppression.	Supports ringing suppression in arbitration phase. Supports mode change to use a push/pull mode in the data phase.
Vector Product	CANpiggy 1057Gcap	CANpiggy 1057Gcap	CANpiggy 1462BT	<i>In development</i>



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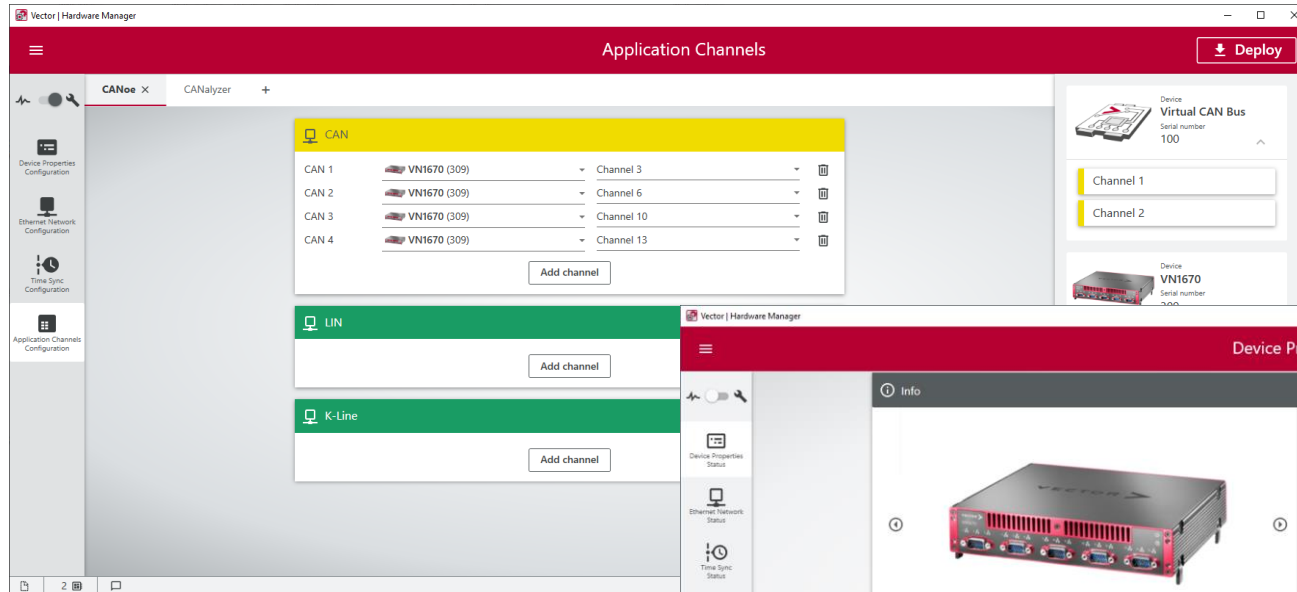
Vector CANoe and CAN XL Interface Configuration



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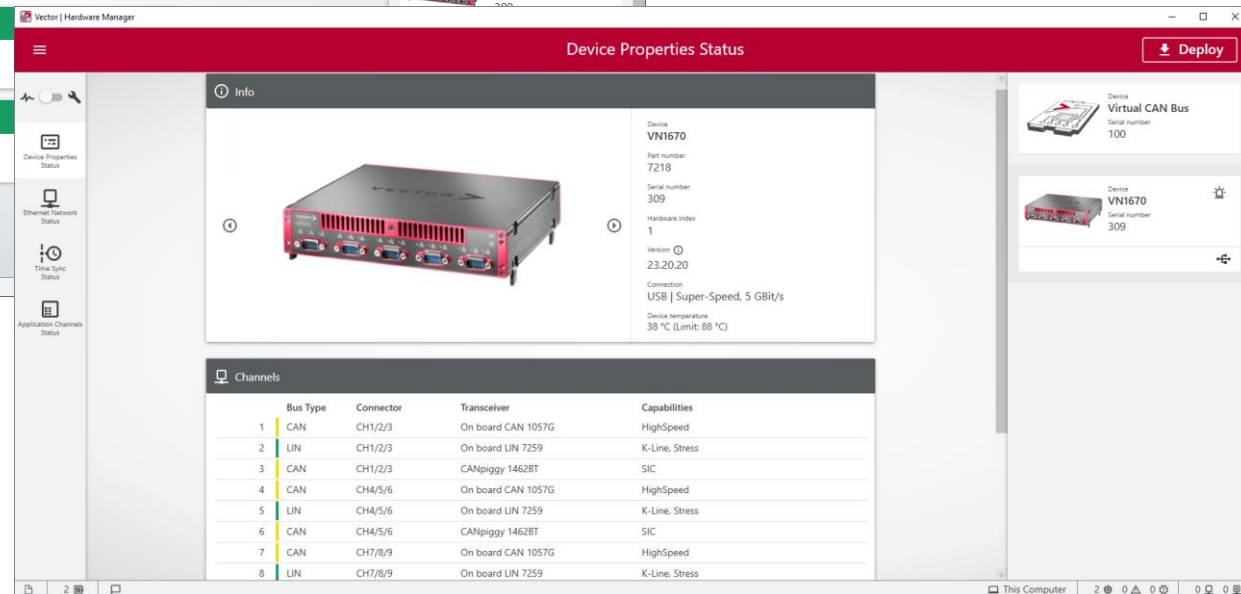


► Vector Hardware Manager



- Creation of configuration templates

- Configuration of Shared Medium Networks and Switched Networks
- Configuration of time synchronisation between interfaces



Vector CANoe and CAN XL

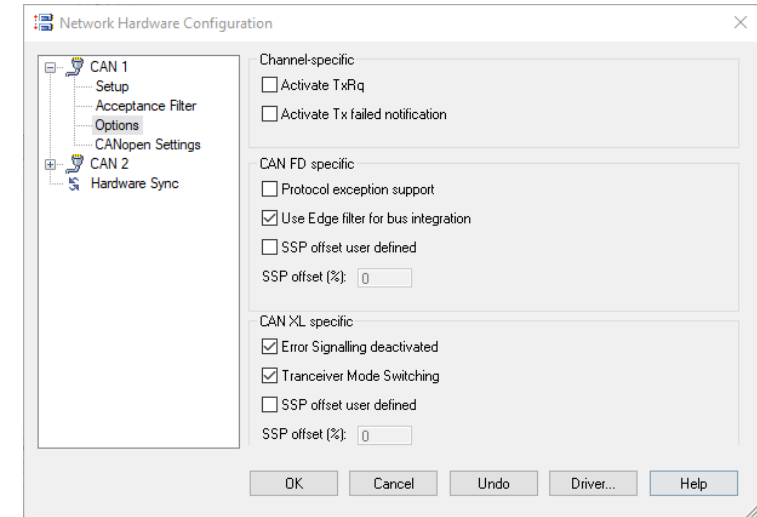
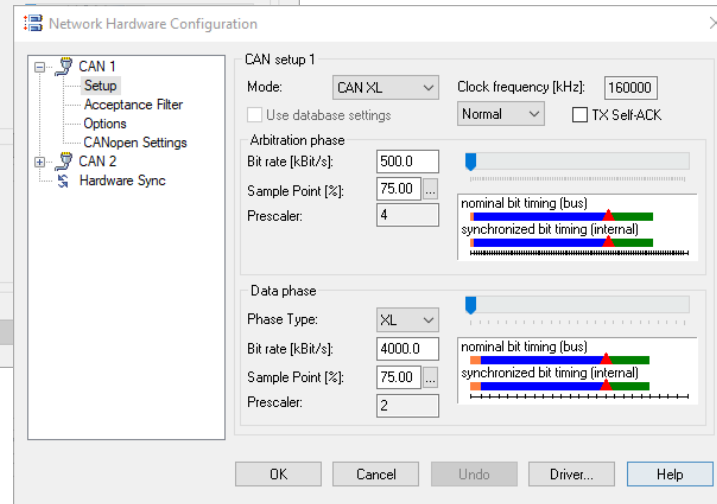
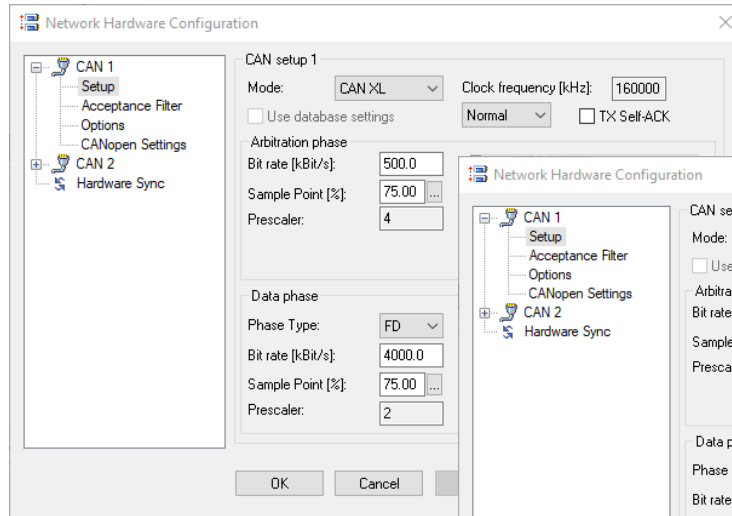
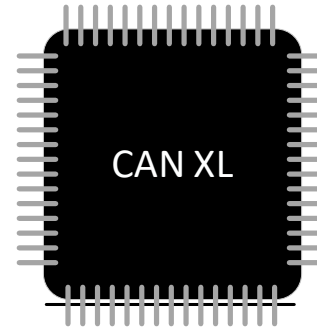
The CANoe CAN concept



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- ▶ CANoe models CAN quite simple:
- ▶ Just like a controller ...



▶ Optional parameters

Protocol Exception Event

Errors Signaling On/Off

Transceiver Mode Switching

Vector CANoe and CAN XL

The CANoe CAN concept



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- This concept is also followed in CANoes application language CAPL

```
variables
{
    // A CAN frame with ID 0
    message 0x0 canXL;
}

on key 'c'
{
    // transmit a CAN CC frame
    output(canXL);
}

on key 'a'
{
    // transmit a CAN FD frame with switched bitrate
    canXL.FDF = 1;
    canXL.BRS = 1;
    output(canXL);
}

on key 'n'
{
    // transmit a CAN XL frame
    canXL.FDF = 1;
    canXL.XLF = 1;
    output(canXL);
}
```

```
on message 0x0
{
    if (canXL.FDF == 0)
    {
        write("Received CAN CC frame. FDF: %d", this.FDF);
    }
    else if (canXL.FDF == 1 && canXL.XLF == 0)
    {
        write("Received CAN FD frame. FDF: %d XLF: %d", this.FDF, this.XLF);
    }
    else if (canXL.FDF == 1 && canXL.XLF == 1)
    {
        write("Received CAN XL frame. FDF: %d XLF: %d", this.FDF, this.XLF);
    }

    // Reset frame object to CAN CC
    canXL.FDF = 0;
    canXL.XLF = 0;
    canXL.BRS = 0;
}
```

CAN frame object

CAN frame handler

Vector CANoe and CAN XL

Analyzing CAN XL



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VECTOR

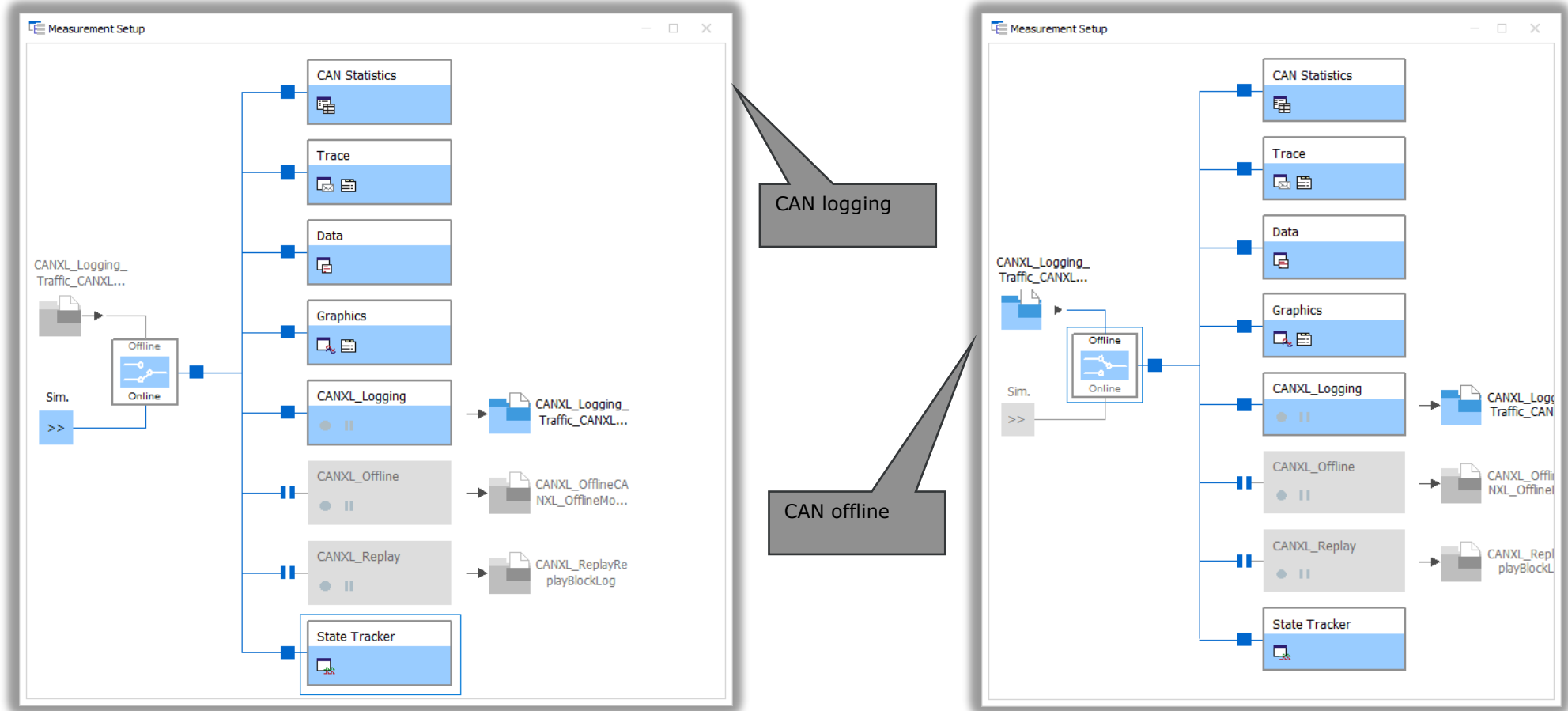
► What's up on the network?

Trace

Tracing CAN XL traffic

Interpretation of CAN XL specific frame fields

- ▶ Logging and offline analyzes for CAN XL



Vector CANoe and CAN XL

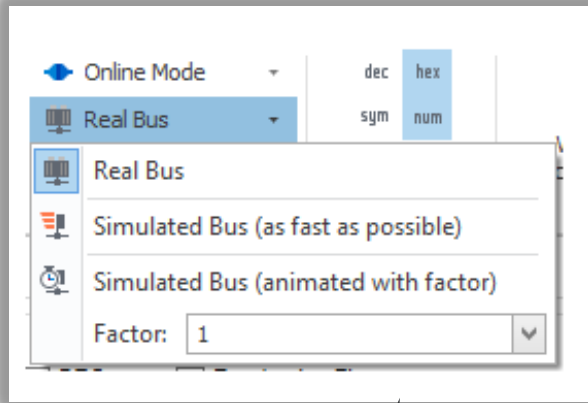
Simulating CAN XL



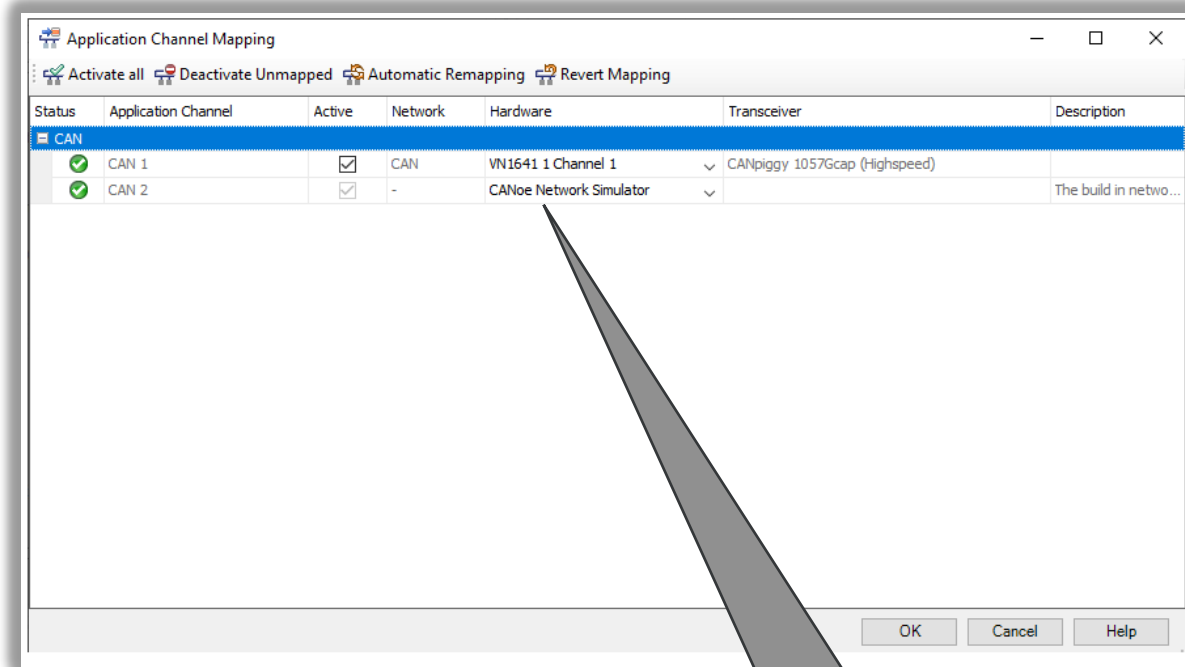
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► Simulated Mode and simulation per channel



Simulation of entire
network configuration



Simulation of a single
network

Vector CANoe and CAN XL Ethernet Tunneling

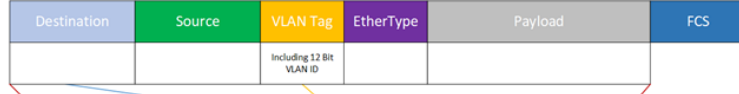


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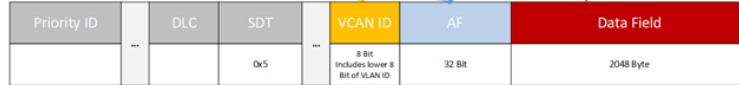
VECTOR

► CAN XL and IP? No Problem ...

Ethernet Frame (IEEE 802.3)

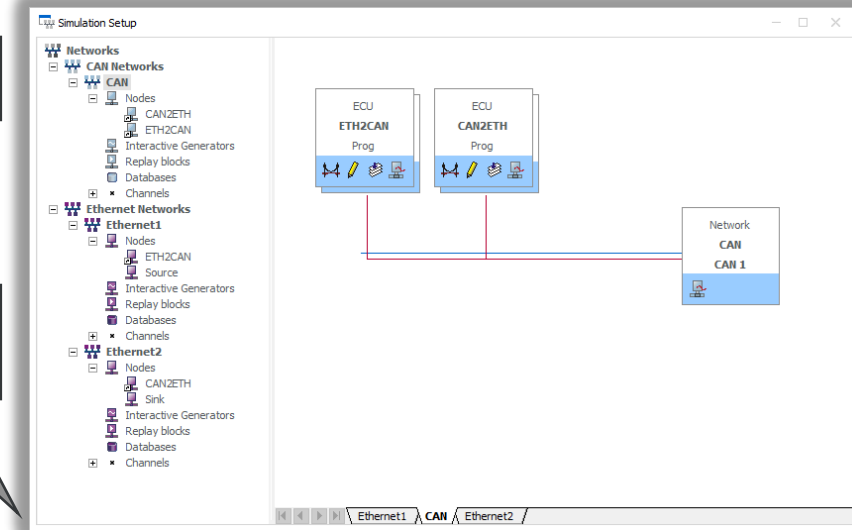
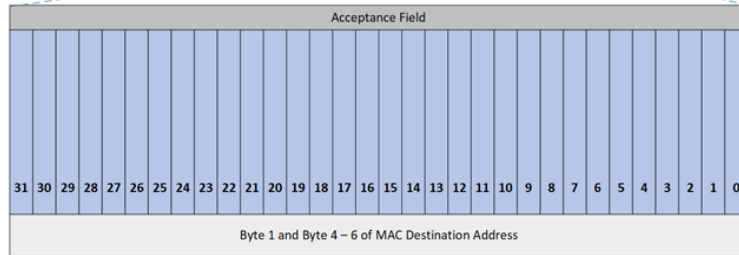


CAN XL Frame



CAN XL - ETH
Frame mapping

Implementing
ETH tunneling in
CANoe



Trace															CAN XL Layout 1														
Time	Event Type	Dir	DLC	Data length	Data															VLAN	VCID	Destination MAC	AF	SDT					
0.000000																													
4.174334	Ethernet packet	Rx	50		C5 D7 C7 04 AA C4 E5 B8 6F 8D 7F 21 5C F7 68 F6 D0 64 71 78 F9 D5 C8 01 9F 42 8A 19 15 32 D2 58 30 51 CE 2C E4 5D 92 EF D6 A0 82 97 12 E3 D2 6F 80 81															402		02:84:CF:38:BE:04							
4.174335	Ethernet packet	Tx	50		C5 D7 C7 04 AA C4 E5 B8 6F 8D 7F 21 5C F7 68 F6 D0 64 71 78 F9 D5 C8 01 9F 42 8A 19 15 32 D2 58 30 51 CE 2C E4 5D 92 EF D6 A0 82 97 12 E3 D2 6F 80 81															402		02:84:CF:38:BE:04							
4.174587	CAN XL Frame	Tx	67	68	02 84 CF 38 BE 04 02 84 CF 38 BE 03 00 81 D2 24 23 F1 C5 D7 C7 04 AA C4 E5 B8 6F 8D 7F 21 5C F7 68 F6 D0 64 71 78 F9 D5 C8 01 9F 42 8A 19 15 32 D2 58 30 51 CE 2C E4 5D 92 EF D6 A0 82 97 12 E3 D2 6F 80 81															402	D2	02:84:CF:38:BE:04	23bbe04	05					
4.174588	Ethernet packet	Rx	50		C5 D7 C7 04 AA C4 E5 B8 6F 8D 7F 21 5C F7 68 F6 D0 64 71 78 F9 D5 C8 01 9F 42 8A 19 15 32 D2 58 30 51 CE 2C E4 5D 92 EF D6 A0 82 97 12 E3 D2 6F 80 81															402		02:84:CF:38:BE:04							
4.174589	Ethernet packet	Tx	50		C5 D7 C7 04 AA C4 E5 B8 6F 8D 7F 21 5C F7 68 F6 D0 64 71 78 F9 D5 C8 01 9F 42 8A 19 15 32 D2 58 30 51 CE 2C E4 5D 92 EF D6 A0 82 97 12 E3 D2 6F 80 81															402		02:84:CF:38:BE:04							

Vector CANoe and CAN XL

Testing CAN XL

- ▶ Testing CAN XL? Just wait ...
 - ▶ Vector's vTESTstudio provides a table driven concept

Kommando	Überschrift
Test Tree	
▼ Test Case	Test CaseCheckCANXLSignal
▶ CAPL Inline	Stimulate ECU
▶ Await Value Match	Check Signal PlaybackStatus==1 Wait until CAN XL Transmitter::CANXL::MediaReceiver::MediaClientPDU::PlaybackStatus==1 with timeout 100 ms

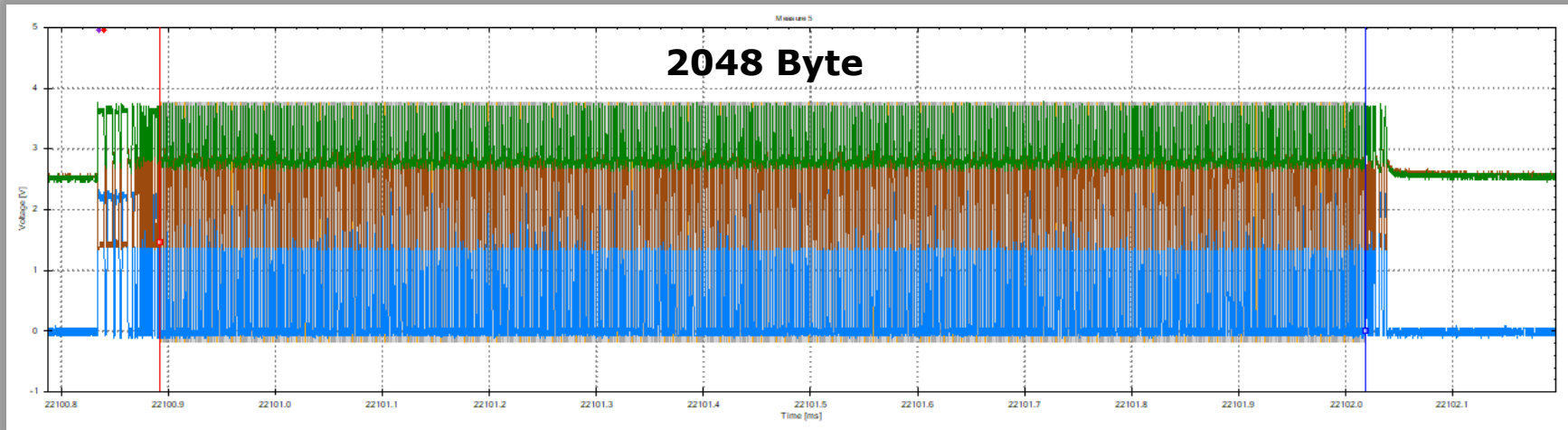
Wait functions allow for asynchronous programming

Run tests in CANoe

Test CAN XL				
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Title	Verdict	Runtime	Test Unit	
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Test CAN XL	<input checked="" type="checkbox"/>	0.044s	<input checked="" type="checkbox"/> TestUnitCANXL	
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Test UnitCANXL	<input checked="" type="checkbox"/>	0.005s		
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Test CaseCheckCANXLSignal	<input checked="" type="checkbox"/>	0.004s		
Variant properties profile: [Default]				
Name	Value	Data Type	Test Units	Dependencies
executed: 1 of 1 00:00:00 not passed: 0 Passed				

Testing CAN XL

► Getting physical – CANoe Option Scope



► Physical layer analysis of CANXL protocol

- Make usage of trigger conditions for CAN XL
 - Trigger on entire standard frame id range
 - Trigger very fast on waveform of CAN XL differential signal
 - Trigger on error frames
- Use advantages of full protocol decode of CAN XL frame format.
 - Protocol interpretation matches to voltage signal.

CAN XL Tooling – Prepared to develop your CAN XL network



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Thank you for your Attention!

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