

## J1939 Prototype and Test Development – the smart way

Vector Congress Stuttgart 2010



## > Overview J1939 Protocol

Advantages of J1939-based Tools

Automatic Generation of a J1939 Simulation

Automatic Generation of a J1939 Interoperability Test

(Semi-)automatic Generation of a J1939 Functional Test

Wrap-Up, Links and Questions

- ▶ Interoperability
- ▶ Mostly cyclic Messages
- ▶ Baud rate 250kbps (4 $\mu$ s/bit)
- ▶ Message Length
  - ▶ Typical  $\approx$ 128Bit (8 Data Bytes,  $\approx$  0,5ms T-time)
  - ▶ Shortest  $\approx$  64Bit ( $\approx$  0,25ms T-time)
  - ▶ Longest 1785 Bytes
- ▶ Various, standardized Transport Protocols
- ▶ Address Claiming

### Parameter Group Numbers (PGN)

- ▶ Consideration of priority, repetition rate, significance of data, data length and transmission mode (PDU1/PDU2)
- ▶ Position and grouping of parameters
- ▶ Subsystem, repetition rate and type of parameter

### Device Name

- ▶ NAME and Functions
- ▶ Industry Group
- ▶ Preferred device address
- ▶ Unique and fixed indication of industry branches and tools

### Suspect Parameter Number (SPN)

- ▶ Unique identification of parameters and other elements of the ECU
- ▶ Means of diagnosis

# Overview J1939 Protocol

## CAN Message Format and Meaning

SAE J1939 Message			
<b>29bit CAN-Identifer</b>			<b>Data</b>
28 ... 26	25 ... 8	7 ... 0	0 ... 8 Byte
<b>Priority</b>	<b>Parameter Group Number (PGN)</b>	<b>Quell-address</b>	<b>Protocol Data Unit (PDU)</b>

Parameter Group Number (PGN)			
25	24	23 ... 16	15 ... 8
<b>Extended Data Page</b>	<b>Data Page</b>	<b>PDU Format (PF)</b>	<b>Destination Adress / Group Extension</b>

PDU Format 1 (specific)	
23 ... 16	15 ... 8
<b>00h ... EFh</b>	<b>Destination Adresse (DA)</b>

PDU Format 2 (global)	
23 ... 16	15 ... 8
<b>F0h ... FFh</b>	<b>Group Extension (GE)</b>

# Advantages of J1939-based Tools

Differences to plain CAN → Leverage potential for Tools

## Starting point in leveraging strength of J1939

- ▶ Communication protocol well standardized (SAE)
- ▶ Messages and signals already defined per ECU type

## Expectations towards J1939 Tools

- ▶ More comfort
- ▶ More support

## Chances

- ▶ Parallel development paths
- ▶ "Executable specification"
- ▶ Cost efficiency

# Advantages of J1939-based Tools

View graph – What are we going to see in the following demos?



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Wrap-Up, Links and Questions

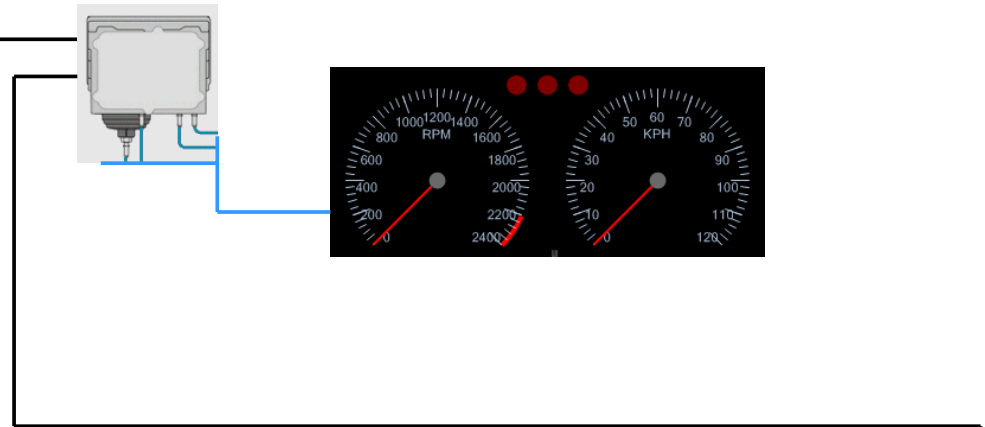
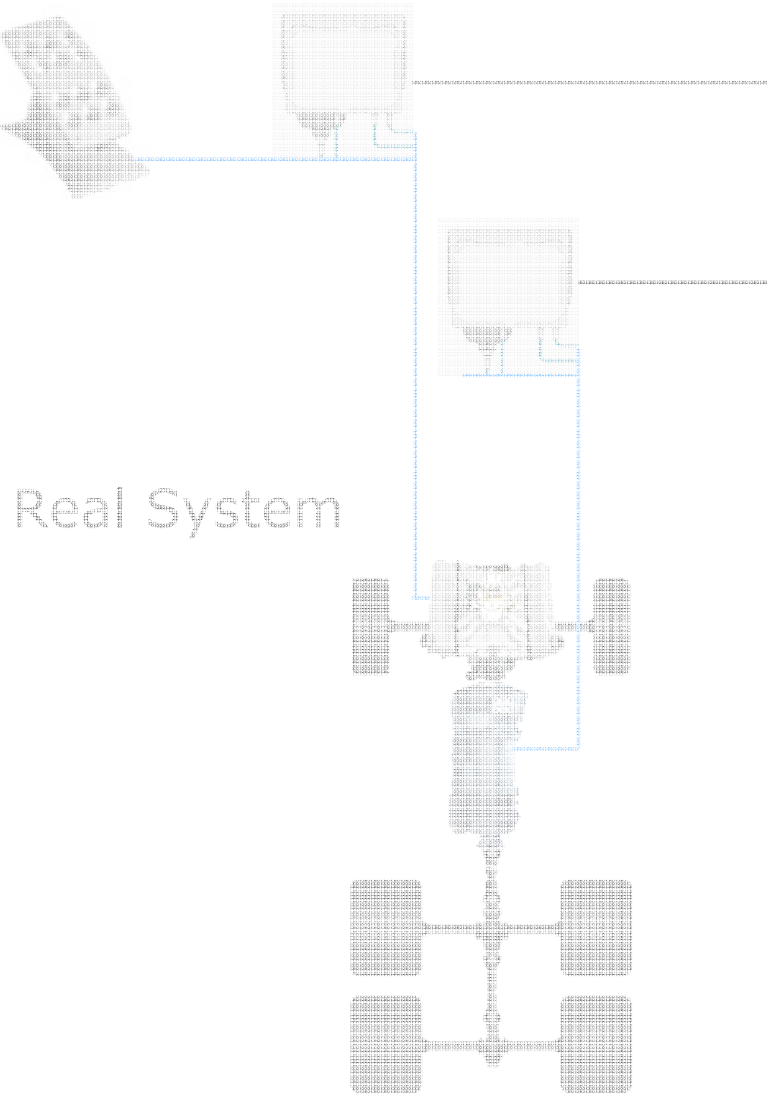
# Automatic Generation of a J1939 Simulation

How does a simulation look like?

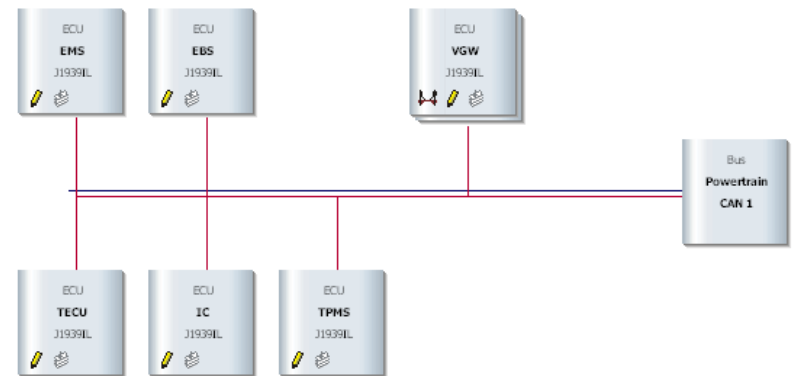
Real Sub-System

J1939

Component



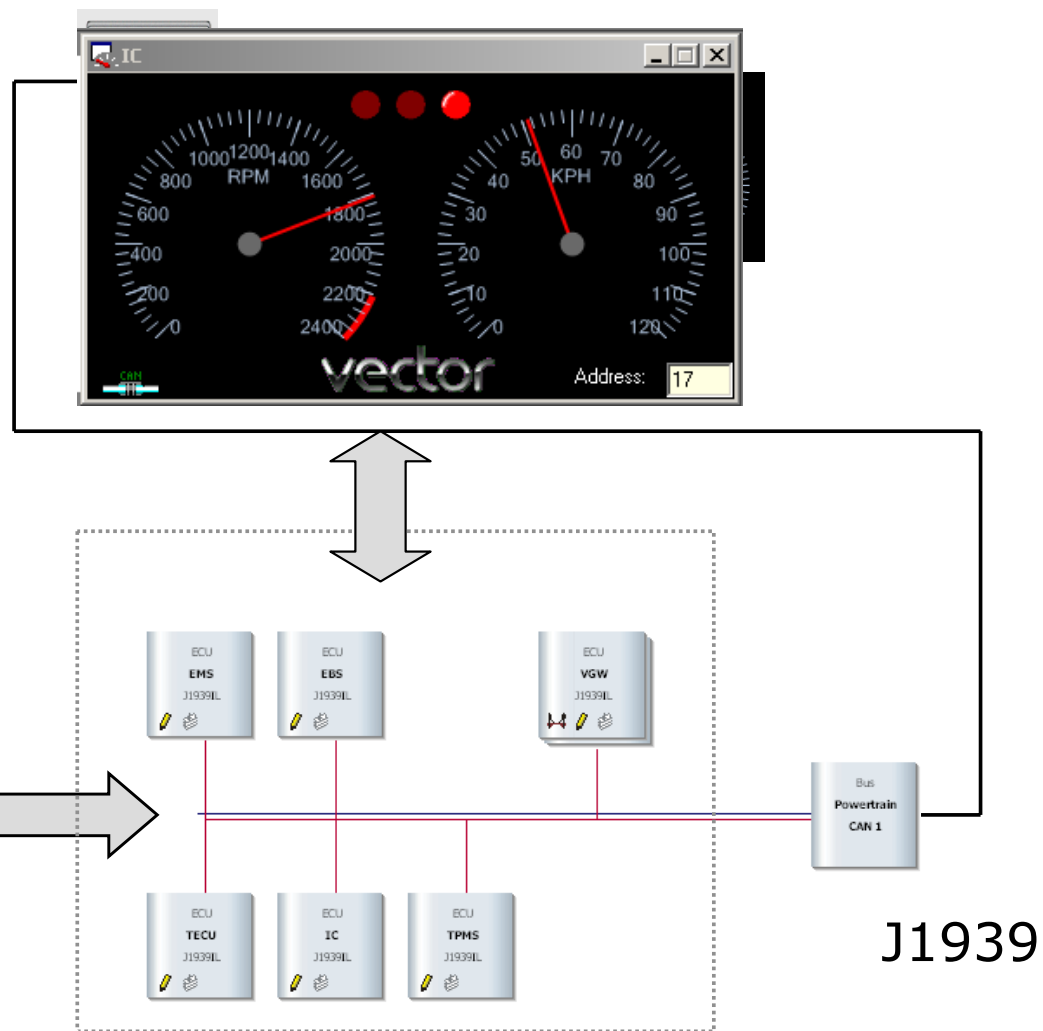
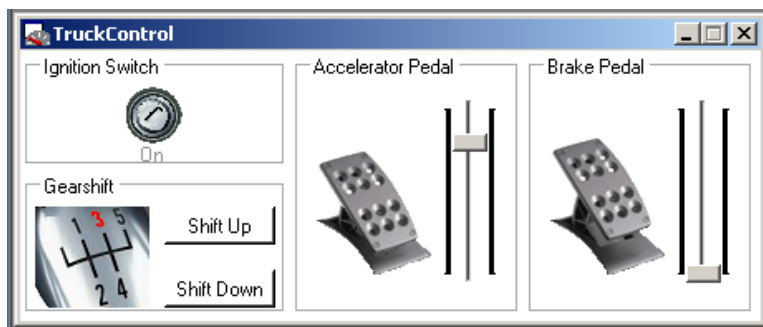
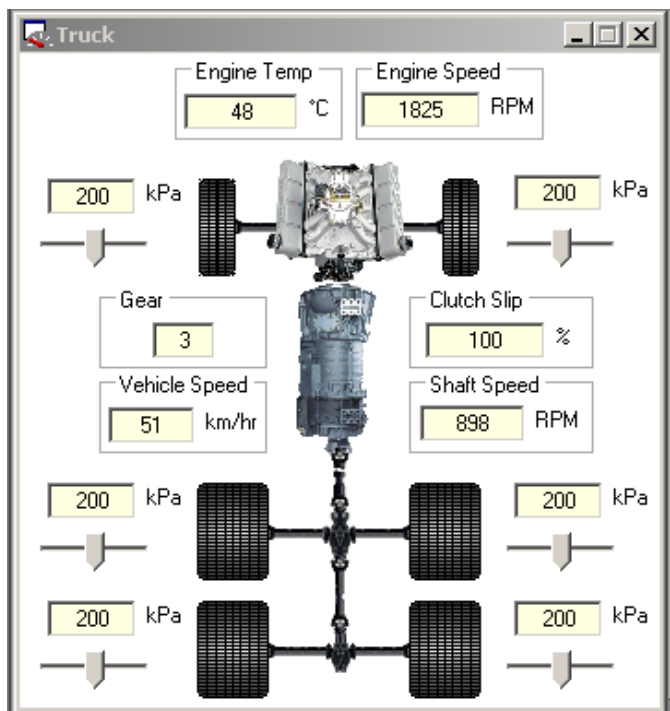
Simulation



# Automatic Generation of a J1939 Simulation

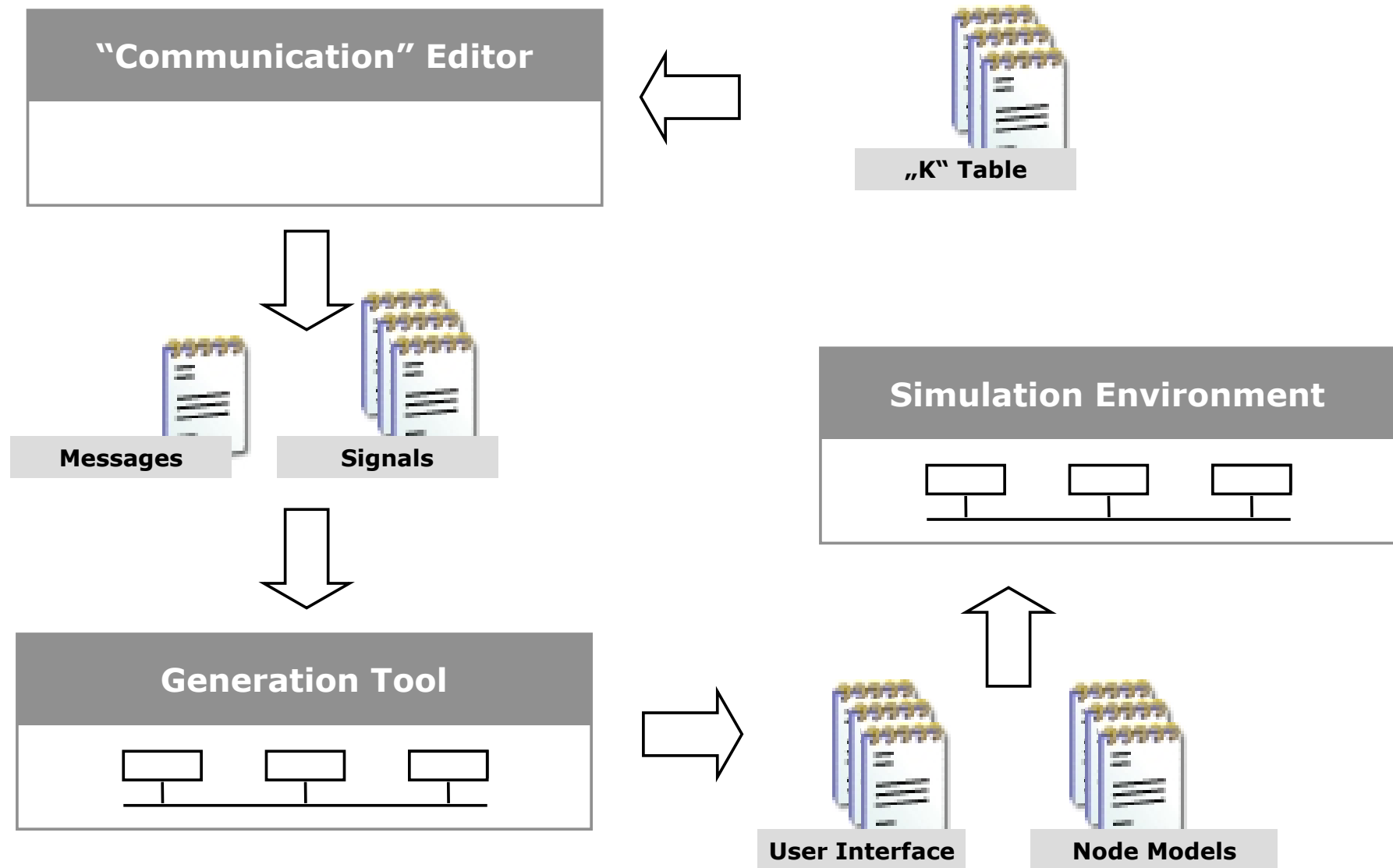
How does a simulation look like?

## Simulation



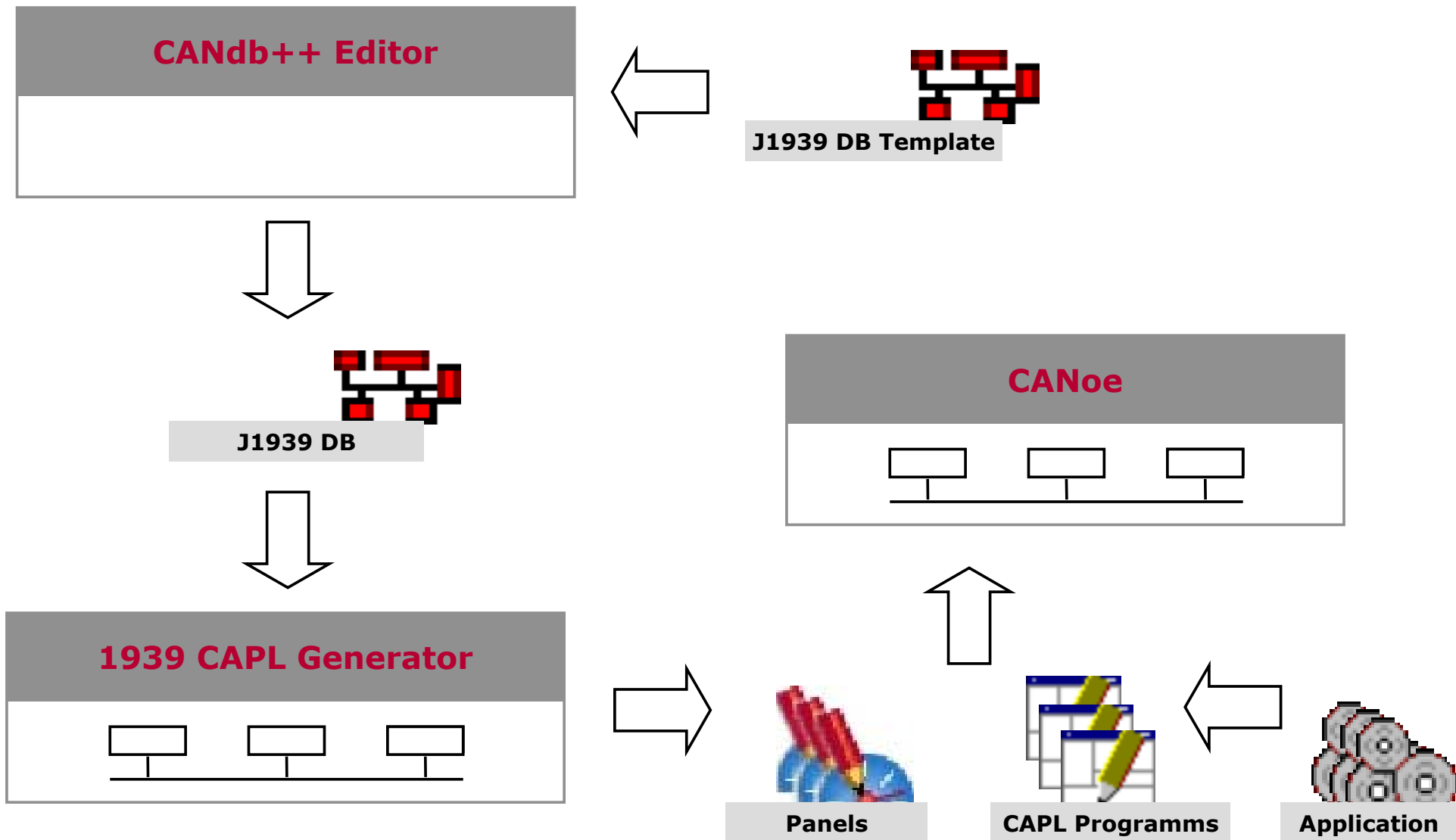
# Automatic Generation of a J1939 Simulation

How's the work flow?



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# Automatic Generation of a J1939 Interoperability Test

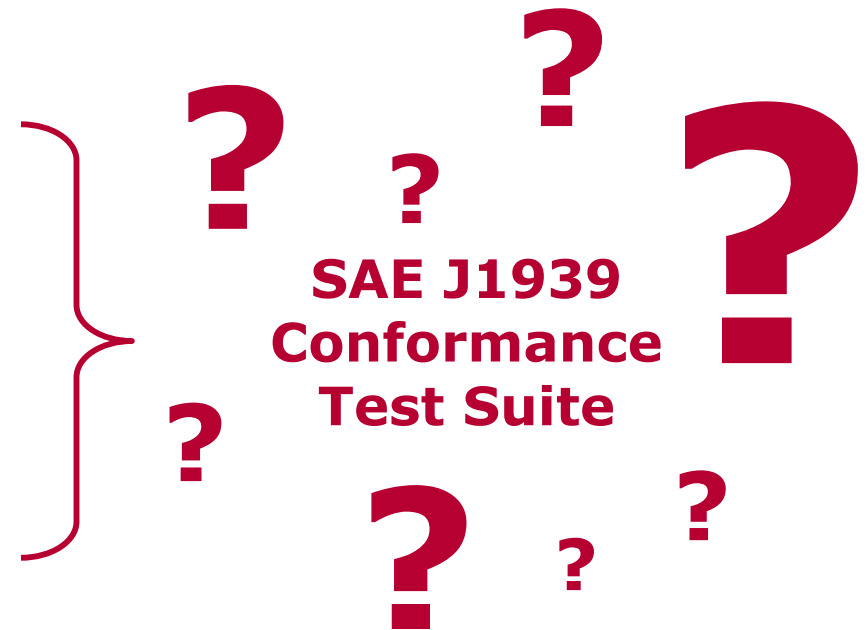
## Prerequisites and Possibilities

### Prerequisites

- ▶ Specification

### Testing Topics?

- ▶ According J1939 8x ...
- ▶ Single ECU/Device
- ▶ System
- ▶ Timing
- ▶ Cycle Times
- ▶ Monitoring Tests
- ▶ Active Tests



# Automatic Generation of a J1939 Interoperability Test

What do we want?

## J1939-82 Compliance Test

<b>Engineer:</b>	
Windows Login-Name	vishws
<b>Setup:</b>	
Version	CANoe.CANopen.CANaerospace.ISO11783.J1587.IP 7.2.72 (SP5)
Konfiguration	C:\Dokumente und Einstellungen\vishws\Desktop\myPlayGround \SimpleModel\mySimpleModel_CN_IL.cfg
Konfigurationskommentar	
Testmodul-Name	J1939Test_myj1939_IL_EMS_IL
Testmodul-Datei	C:\Dokumente und Einstellungen\vishws\Desktop\myPlayGround \SimpleModel\J1939Test_myj1939_IL_EMS_IL.xml
Letzte Änderung der Testmodul-Datei	2010-11-11, 17:03:18
Windows Computer-Name	HWS3385NBF
NodeLayer Module J1939_IL	J1939 Interaction Layer for CANoe, Version 1.4.20, C:\Programme \Vector CANoe 7.2\Exec32\J1939_IL.dll
NodeLayer Module J1939TestServiceLibraryNL	J1939 Test Service Library for CANoe, Version 1.9.39, C:\Programme \Vector CANoe 7.2\Exec32\J1939TestServiceLibraryNL.dll

J1939-82 07/04 A.3.1 Data Link Transmit Tests - General

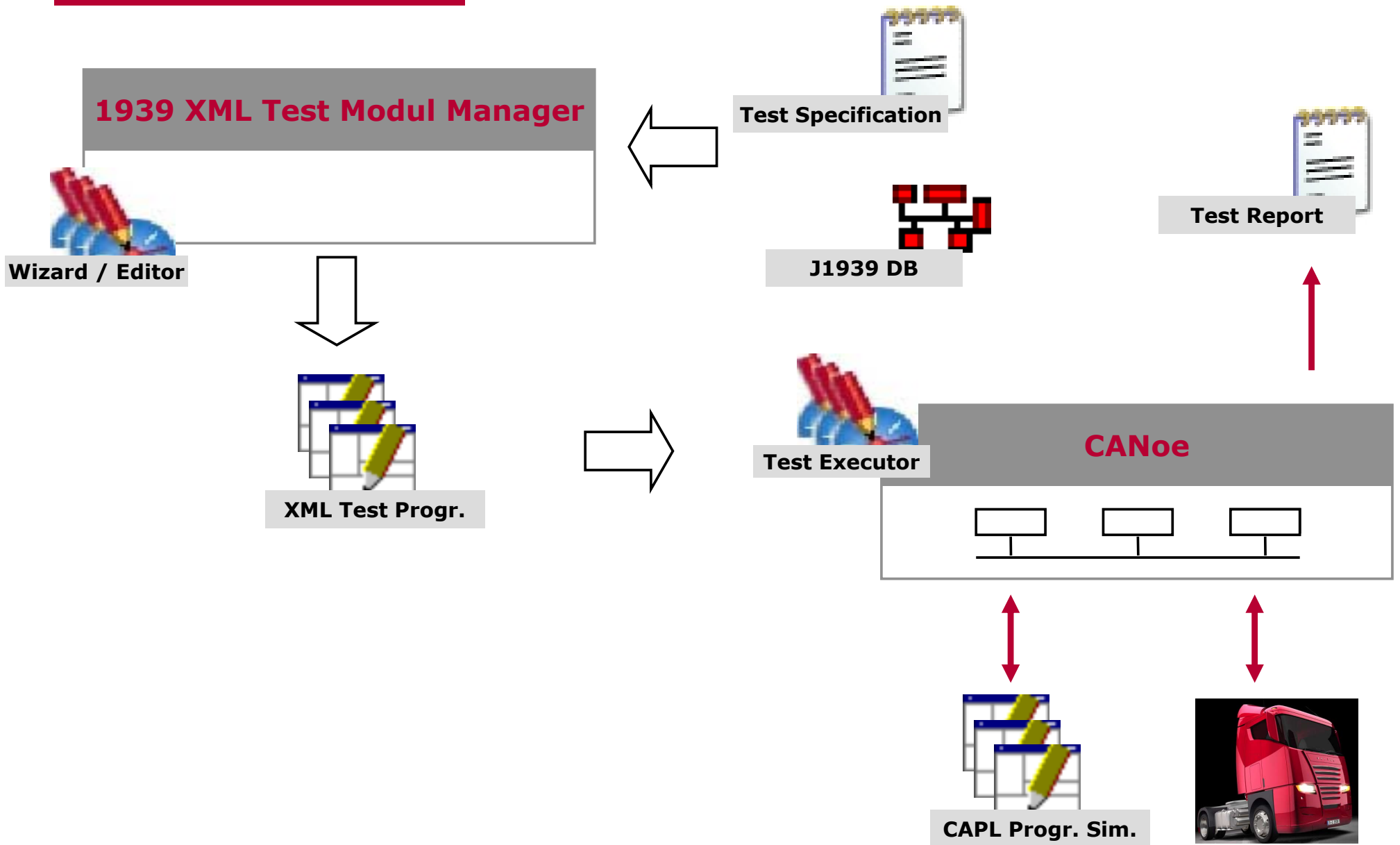
# Automatic Generation of a J1939 Interoperability Test

## What do we want?

Row	Test Name	Requiring Document	Description	SAE and User Requirements							Date Tested	Pass-Fail	Test Result Comments	
				X: Test is Recommended D: Additional Test Desired E: Test Excluded										
				ECU Classes						User				
A	B	A	C	S	T	E	Add./Excl							
L	D	G	C	C	C	O	S							
1	Position and order of PGN in the 29-bit Frame Header	J1939-82 07/04 A.3.1.1	Verify proper placement of PGN within 29-bit header of all frames	X								2010-11-19 15:52.20	P	
2	Use of EDP Bit to identify PGN	J1939-82 07/04 A.3.1.2	Verify DUT properly sets the EDP Bit for all 29-bit frames.	X								2010-11-19 15:52.34	P	
3	Use of DP Bit to identify PGN	J1939-82 07/04 A.3.1.3	Verify DUT properly sets the DP Bit for all 29-bit frames.	X								2010-11-19 15:52.48	P	
4	Data Field Byte Length	J1939-82 07/04 A.3.1.4	Verify the length of the data field for all 29-bit Frames (Page 1 and 2) is 8 bytes, except for PGN 59904 frames.	X								2010-11-19 15:53.02	P	
5	Byte Ordering within Data Field	J1939-82 07/04 A.3.1.5	Verify proper byte ordering of the parameter data for multiple byte parameters. (e.g. Verify Address Claim data, PGN 60928). This verification also applies to -7X.	X								2010-11-19 15:53.12	F	

# Automatic Generation of a J1939 Interoperability Test

How's the work flow?



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# (Semi-)automatic Generation of a J1939 Functional Test

## What do we want?

The screenshot shows a Mozilla Firefox browser window displaying test results for 'myXMLtests'. The address bar shows the file path: file:///C:/Dokumente und Einstellungen/vishws/Desktop/myPlayGround/SimpleModel/report.html. The test results are as follows:

**5 myJustCheck: Failed**

Test case begin: 2010-11-19 16:09.18 (logging timestamp [7.984716](#))  
Test case end: 2010-11-19 16:09.21 (logging timestamp [10.984716](#))

**Test Case Sequence**

Timestamp	Test Step	Description	Result
<a href="#">7.984716</a>		A most simple check for a J1939 Signal	-
<b>1. Check EngSpeed for Max Limit: Failed</b>			
<a href="#">7.984716</a>		Test primitive begin	-
<a href="#">10.984716</a>	Resume reason	Elapsed time=3000ms (max=3000ms)	-
<a href="#">10.984716</a>	1	Waited for 3000 ms	pass
<a href="#">10.984716</a>		Check value condition. CAN signal 'EngSpeed' on bus myj1939_IL: = 0 at 10.960580s, condition: > 1500	fail
<a href="#">10.984716</a>	2	Validation of the expected parameters	fail
<a href="#">10.984716</a>		Test primitive end	-

**Failed Testcases:**

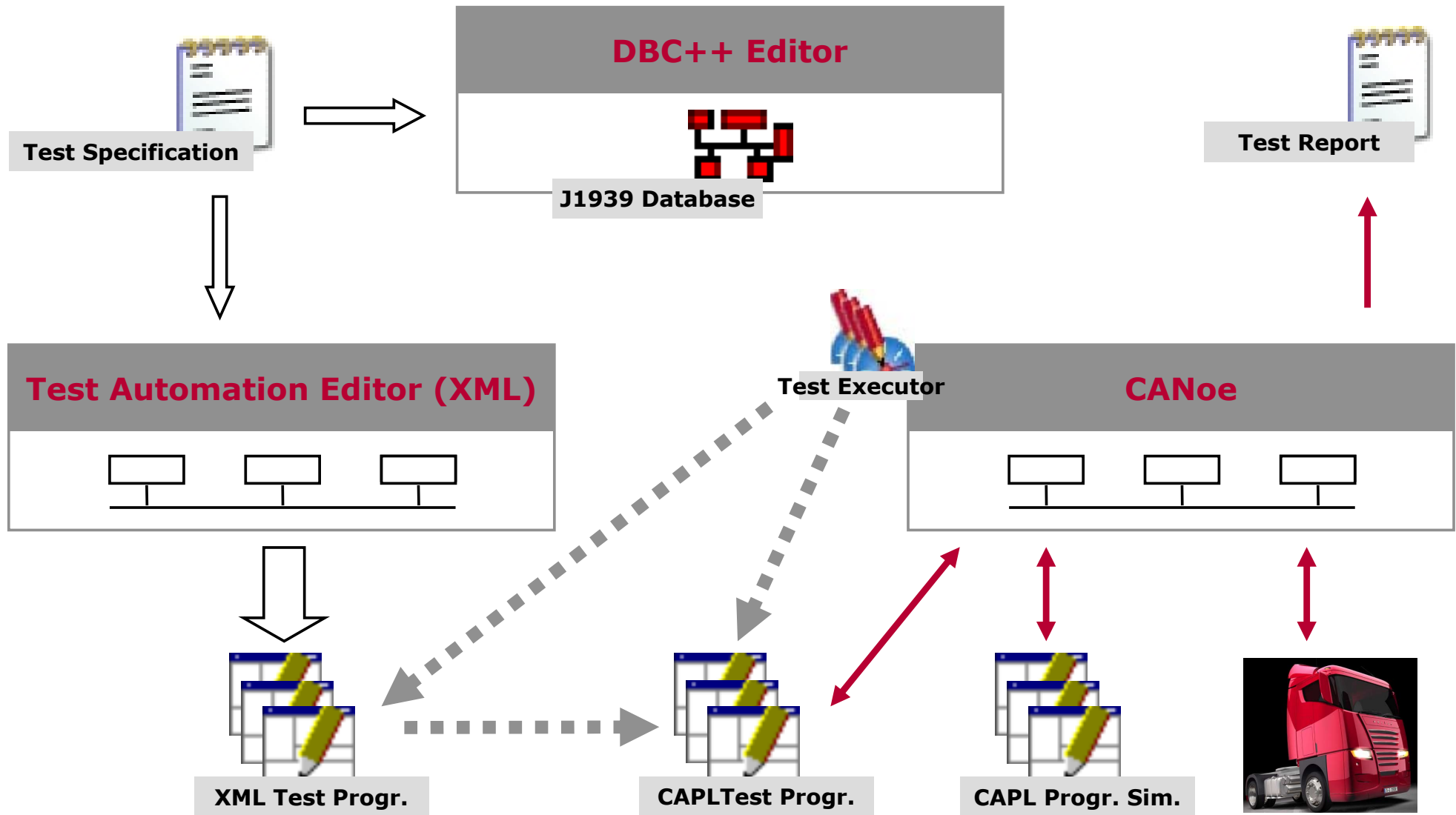
- [5 myJustCheck](#)
- [7 myCheckInput](#)
- [9 myCommandResponse](#)

**CANOE.ASC**

```
10.260580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
10.360580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
10.460580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
10.560580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
10.660580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
10.760580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
10.860580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
10.960580 1 CF00404x Tx d 8 0A 00 00 00 00 00 F0 00
11.000000 1 Statistic: D 0 R 0 XD 10 XR 0 E 0 0 0 B 0.49%
```

# (Semi-)automatic Generation of a J1939 Functional Test

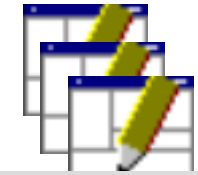
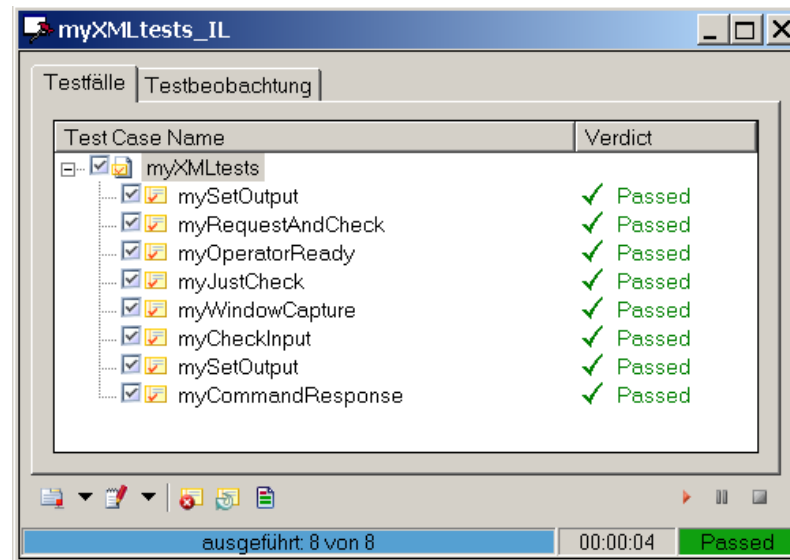
How's the work flow?



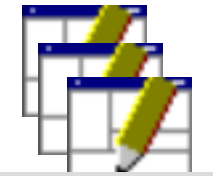
# (Semi-)automatic Generation of a J1939 Functional Test

## Examples of some simple Function Test Scenarios

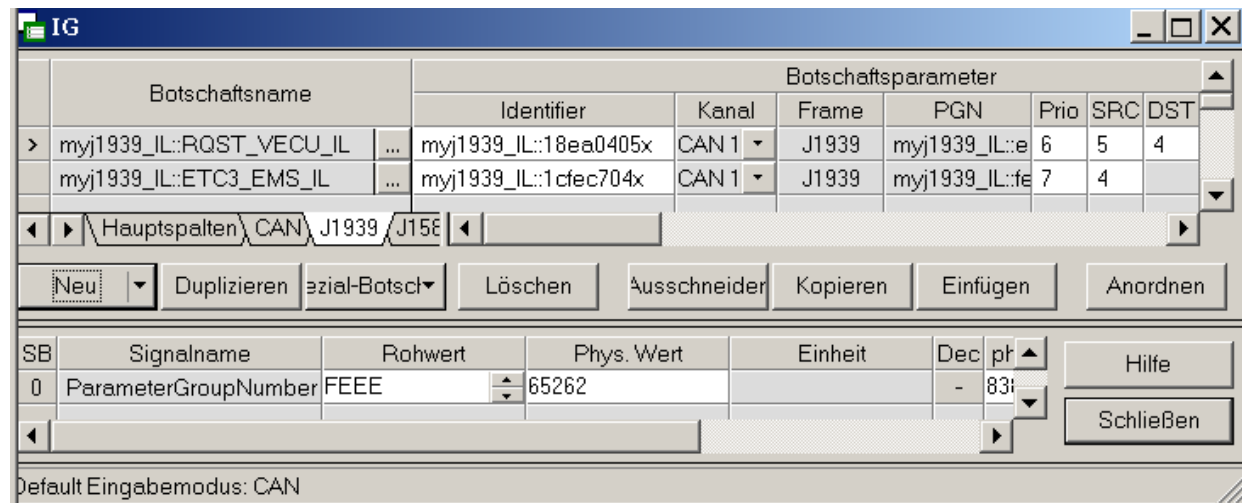
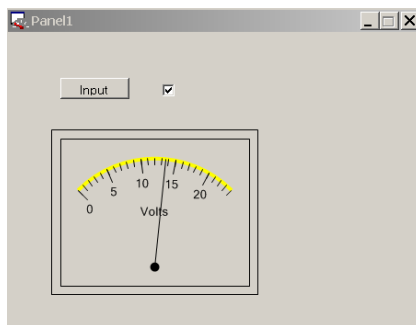
- ▶ Address Claiming (ACL)
- ▶ Request of PGN using RQST command
- ▶ Commanded Response
  - ▶ DUT receives a specific PGN
  - ▶ Is expected to send another specific PGN
- ▶ Tester reaction to input
- ▶ Output control
- ▶ User interaction



XML Test Progr.



CAPL Test Progr.



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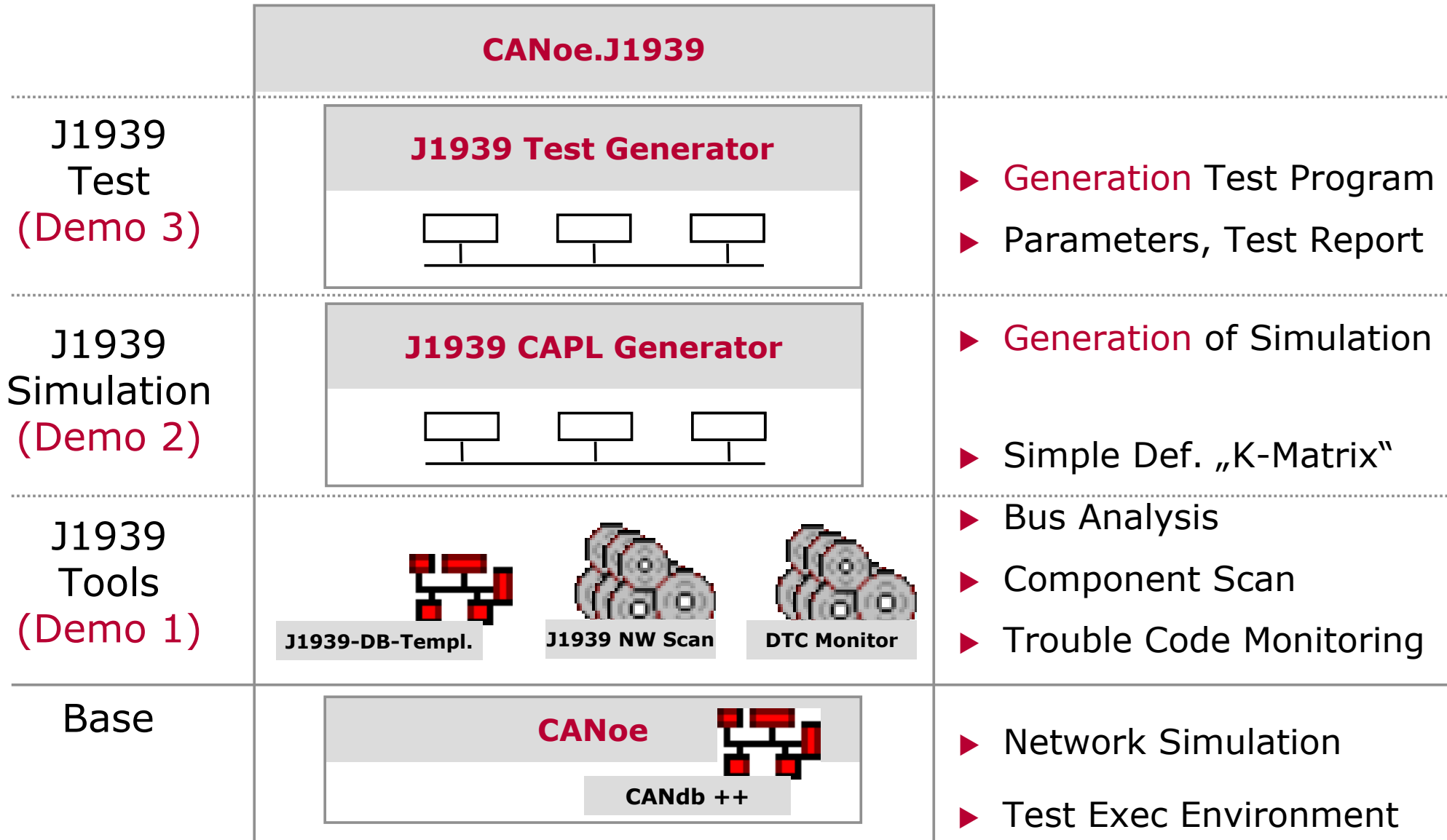
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**> Wrap-Up, Links and Questions**

# Wrap-Up, Links and Questions

## Advantages of the Option .J1939



- ▶ Overview Vector's J1939 solution:  
[www.vector.com/vi\\_j1939\\_solutions\\_en.html](http://www.vector.com/vi_j1939_solutions_en.html)
- ▶ CANoe.J1939: [www.vector.com/vi\\_canoe\\_j1939\\_en.html](http://www.vector.com/vi_canoe_j1939_en.html)
- ▶ Know-how: [www.vector.com/vi\\_j1939\\_knowhow\\_en.html](http://www.vector.com/vi_j1939_knowhow_en.html)
- ▶ Downloads J1939:  
[www.vector.com/vi\\_downloadcenter\\_en.html?busprot=J1939&formular\\_treffer\\_submit=1&sprachumschaltung=1](http://www.vector.com/vi_downloadcenter_en.html?busprot=J1939&formular_treffer_submit=1&sprachumschaltung=1)
- ▶ SAE: [www.sae.org/servlets/index](http://www.sae.org/servlets/index)

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[www.vector.com](http://www.vector.com)

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