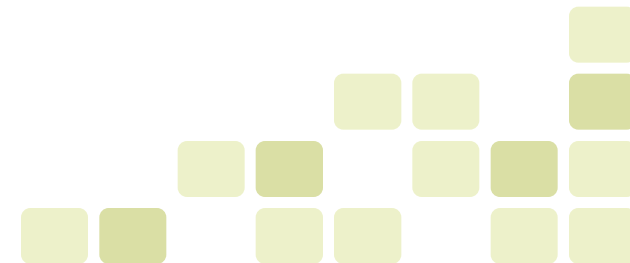




# Automatic ASAM MCD-3 supported test

PikeTec GmbH  
Dr. Jens Lüdemann

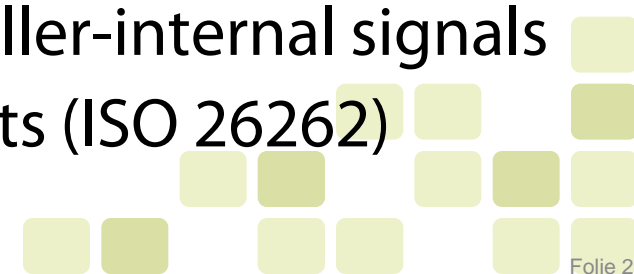


# Test challenges

## Systematic testing of control systems

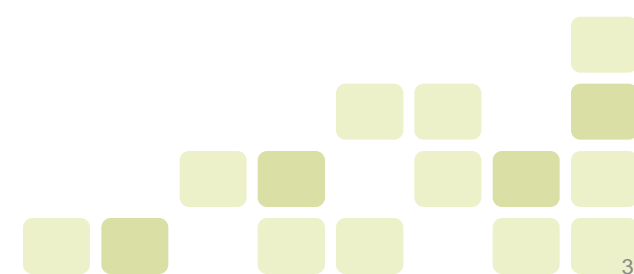
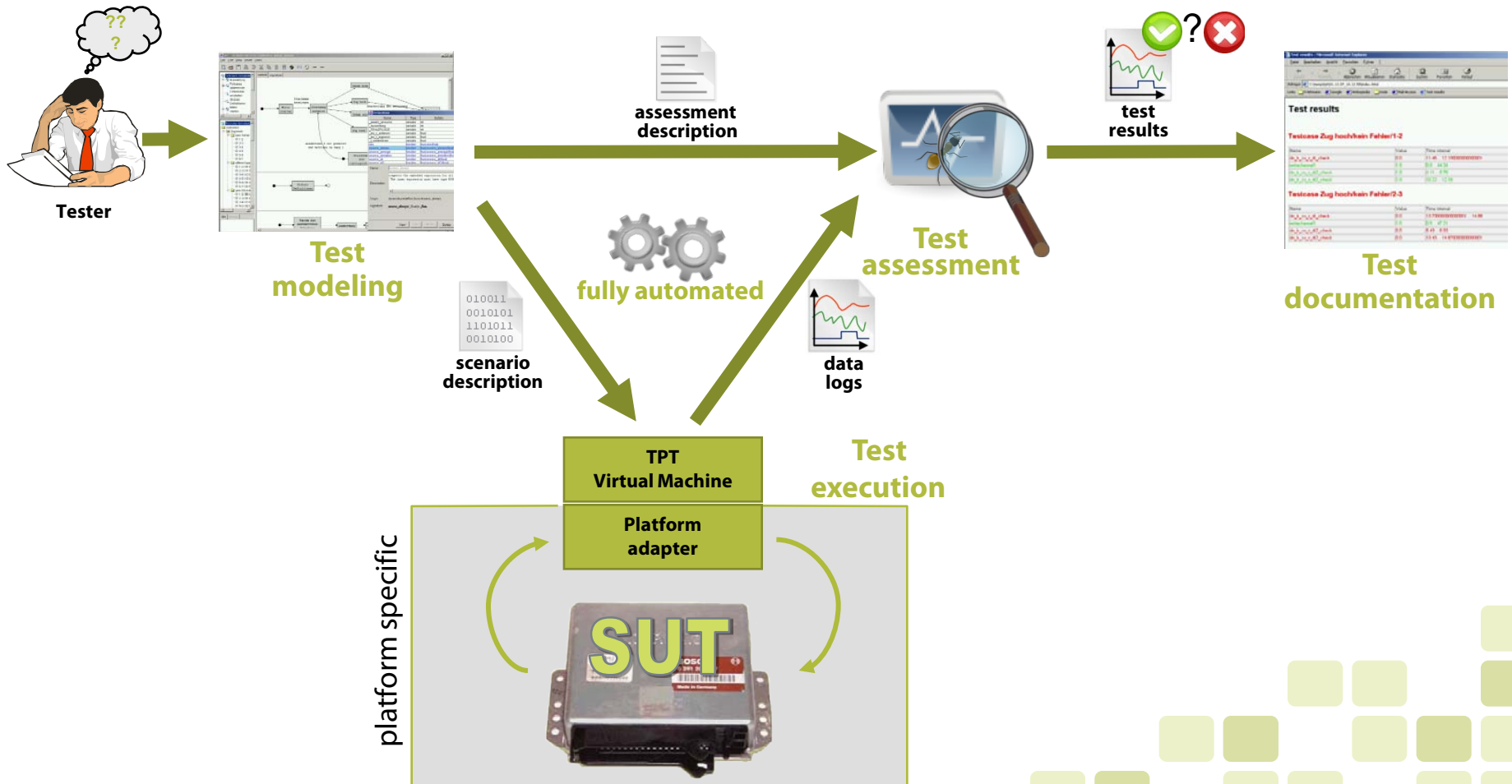


- Clear test case description (Modeling)
- Continuity and consistency at all test platforms
- Automated Execution, Assessment, Reporting
- Real-time behavior
- synchronous measurement of controller-internal signals
- Coverage and tracing of Requirements (ISO 26262)

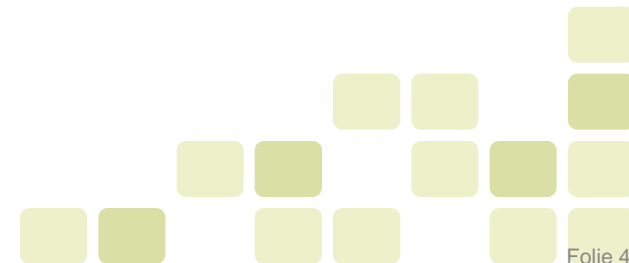


# Testing with TPT

- 1 Test modeling
- 2 Test execution
- 3 Assessment + Reporting

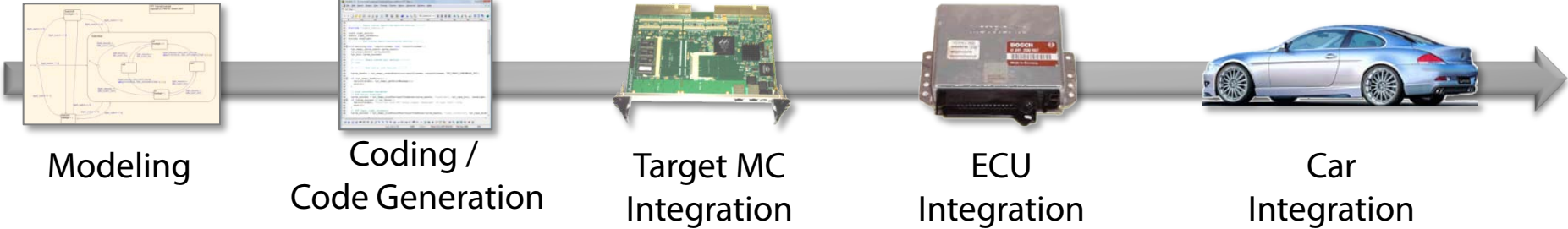


Testing control systems requires  
**special features.**



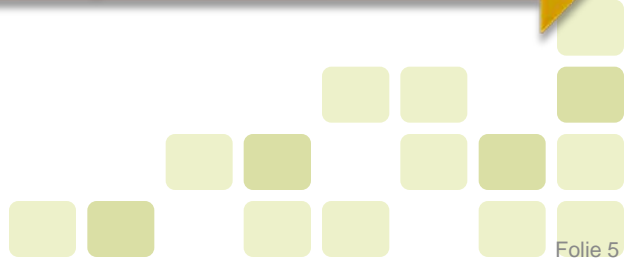
# What makes automotive testing special?

**Feature 1:**  
 Tests must be **portable** and **reusable**  
 between the integration levels and  
 technologies.



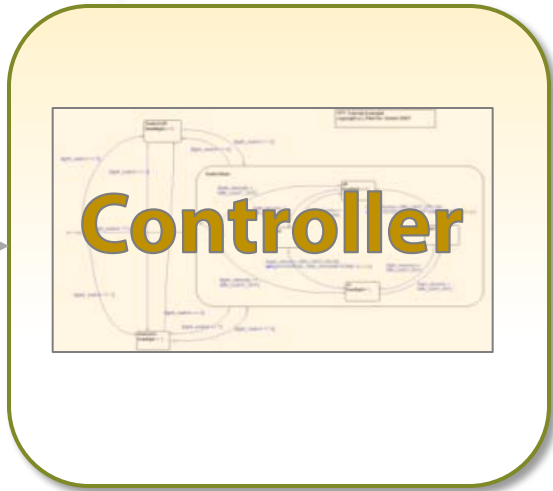
Functional refinement

Objective: Test refinement, instead of test rewriting !



# What makes automotive testing special?

System under Test



Stimulation



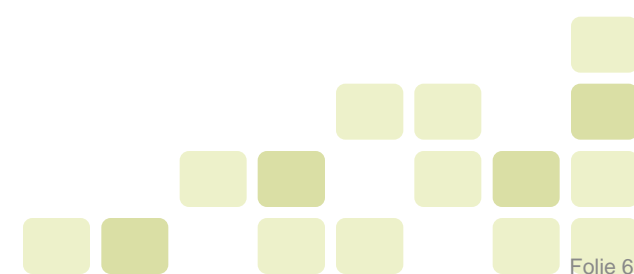
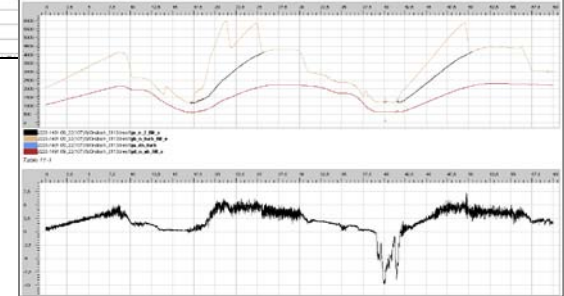
**Test Case Behavior**

## Feature 2:

Tests must handle **signals**, **parameters**, and **diagnosis** in a simple way.

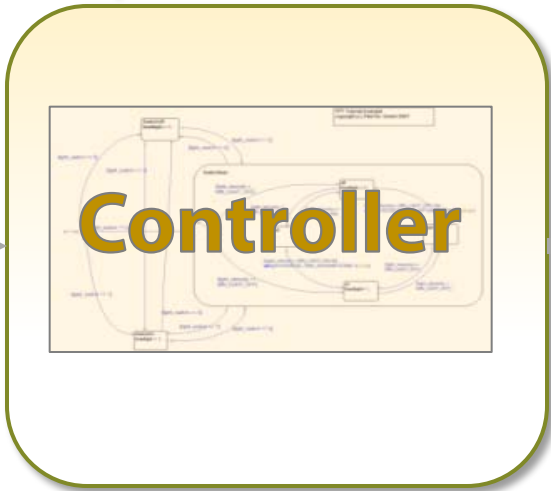
Data tables, recorded data, parameter sets

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1																		
2	gear	i	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	speed	i	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	brake	i	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
5	lever_pos	i	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50
6	light	i	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	temperature	i	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
8	pressure	i	0															
9	MTX_Mode	i	0															
10	PN_Mode	i	0															
11																		



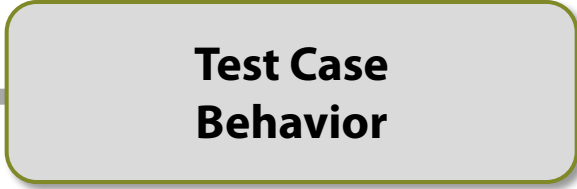
# What makes automotive testing special?

System under Test



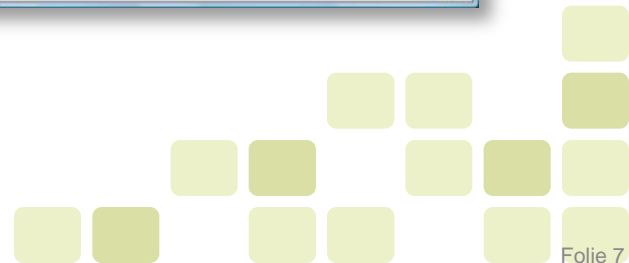
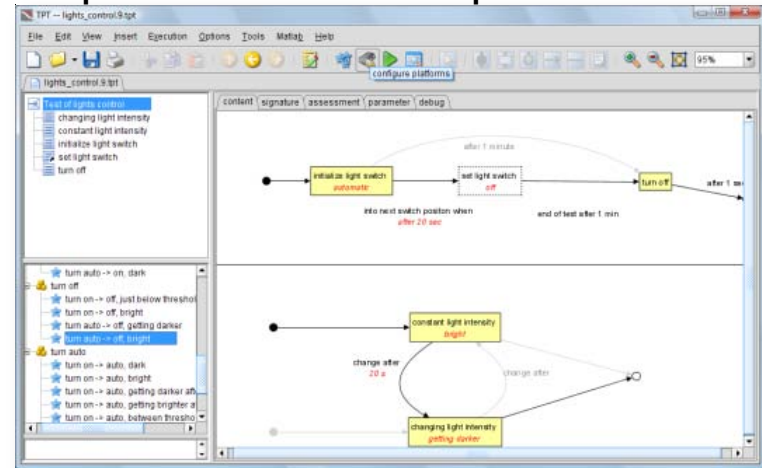
Stimulation

Observations

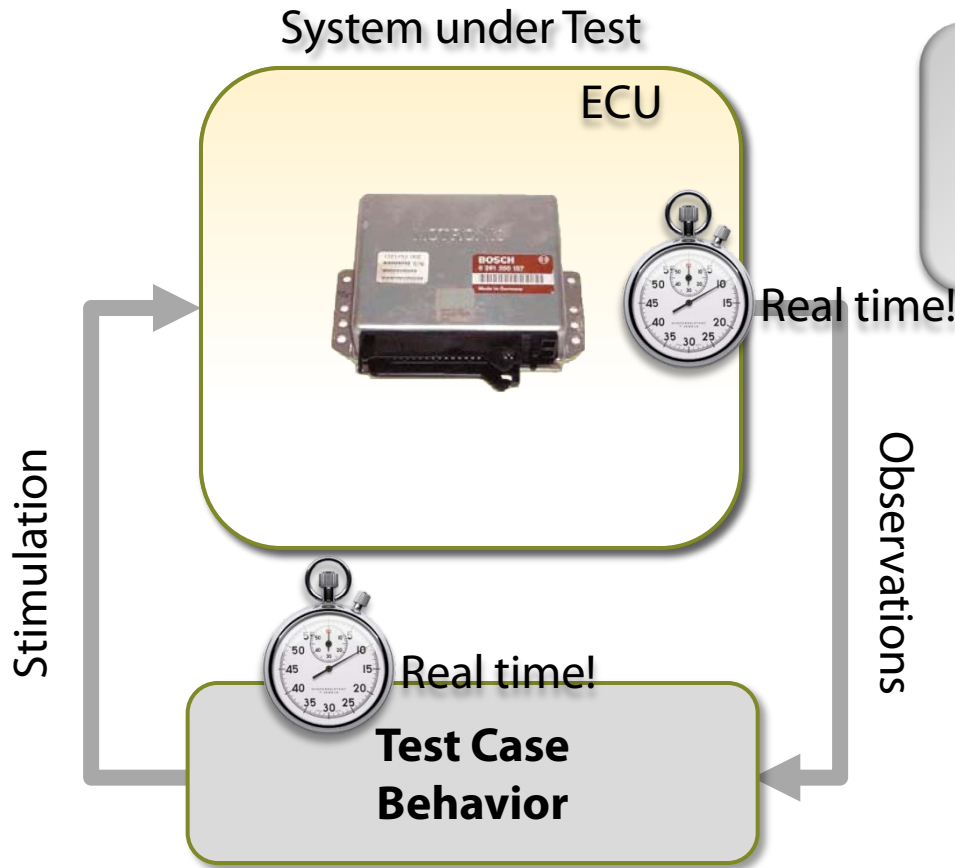


**Feature 3:**  
Tests must be able to **react** to system behavior online (**closed-loop tests**).

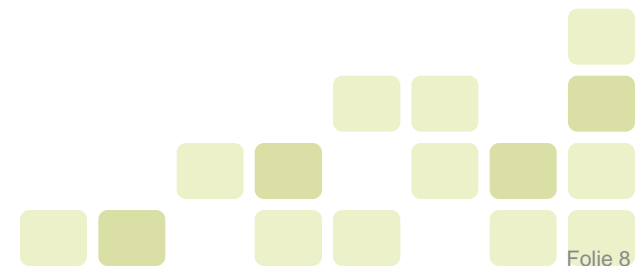
Expressive "closed-loop" test models



# What makes automotive testing special?



**Feature 4:**  
Tests must be **real-time** enabled.





# What makes automotive testing special?

System under Test

ECU

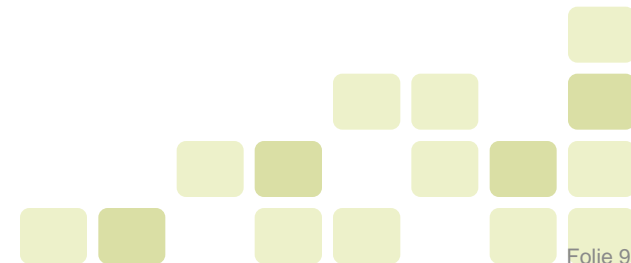


**Feature 5:**  
Tests must handle data from different sources.

Stimulation

Observations

**Test Case Behavior**



# What makes automotive testing special?

System under Test  
ECU

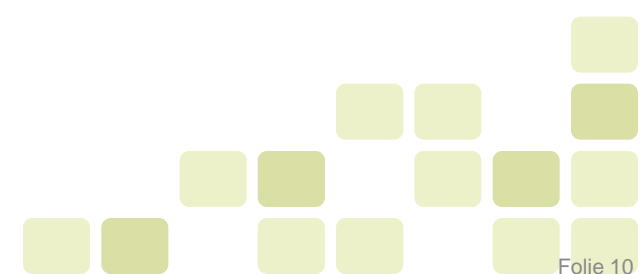
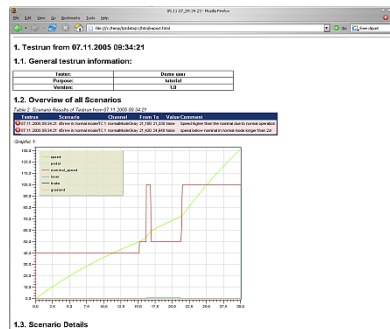
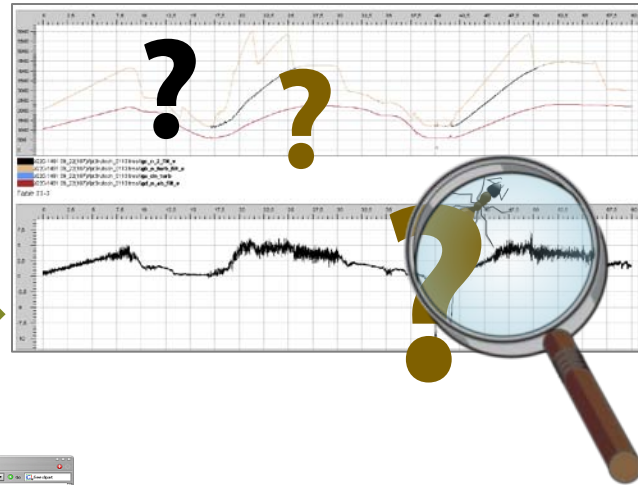


Stimulation

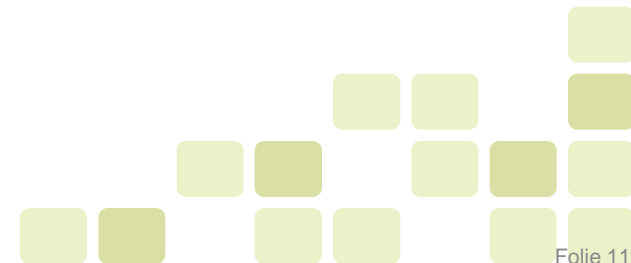
Test Case Behavior

Observations

**Feature 6:**  
Test results should be **evaluated automatically** based on the requirements.



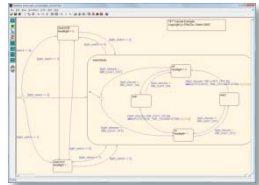
# Process Examples



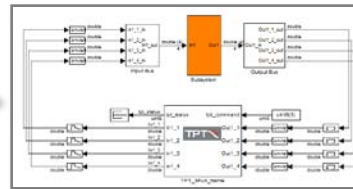
# TPT Workflow Example for MATLAB/Simulink

- 1 Test modeling
- 2 Test execution
- 3 Assessment + Reporting

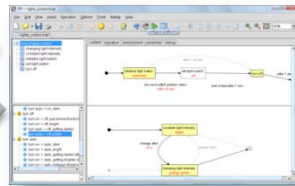
Simulink Model



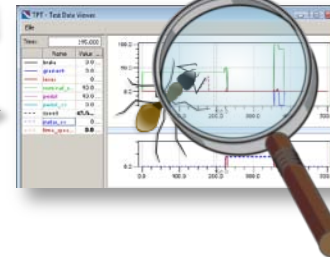
Instrumented Model



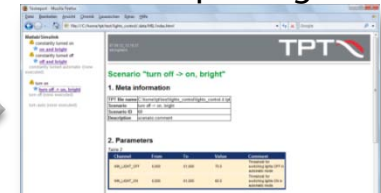
TPT Test Model



Automated Test Assessment



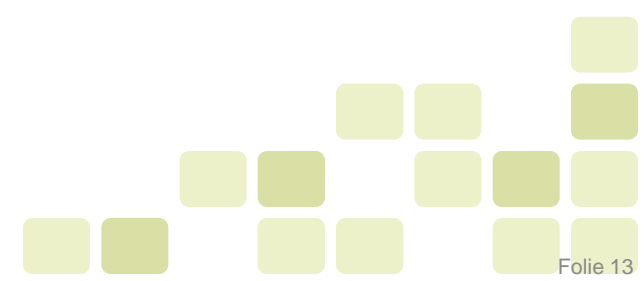
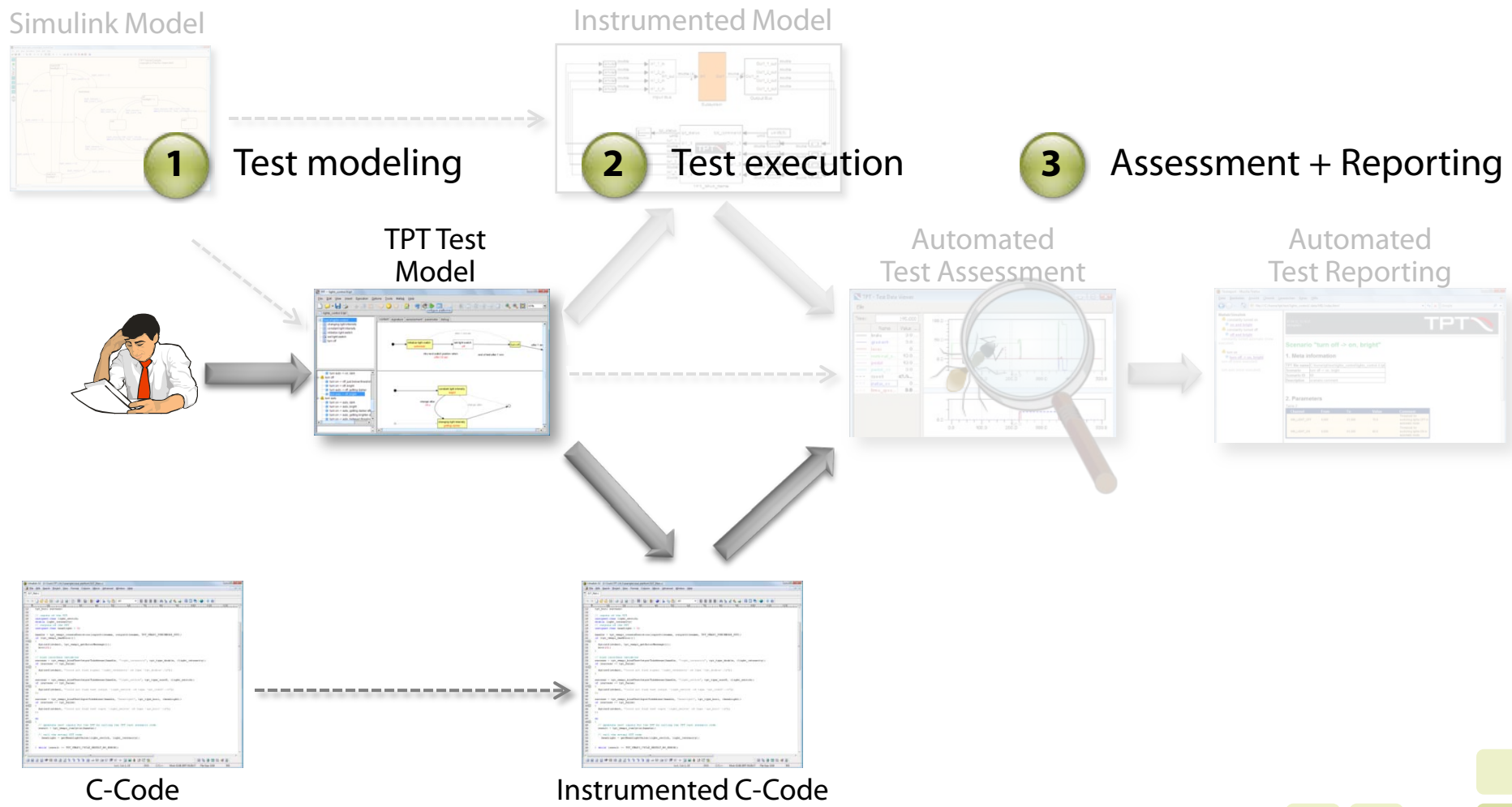
Automated Test Reporting



All signals can be accessed during simulation

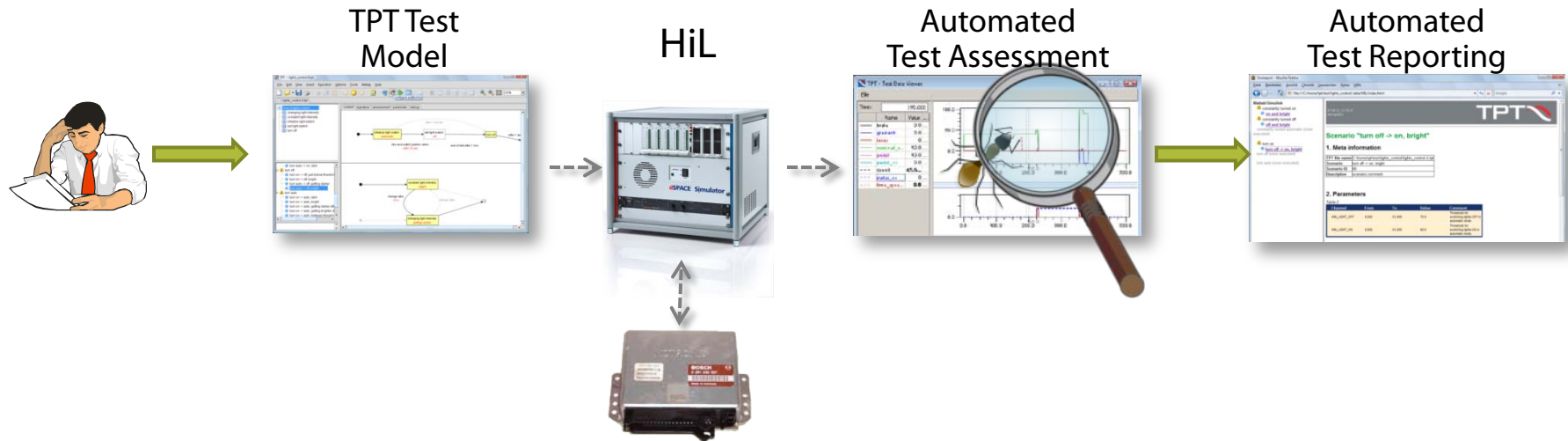


# TPT Workflow Example for C-Code

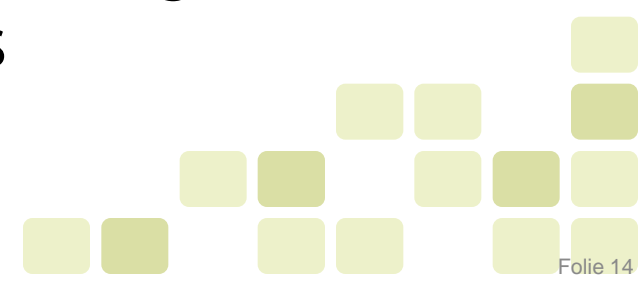


# TPT Workflow Example for HiL Test Execution

- 1
Test modeling
- 2
Test execution
- 3
Assessment + Reporting



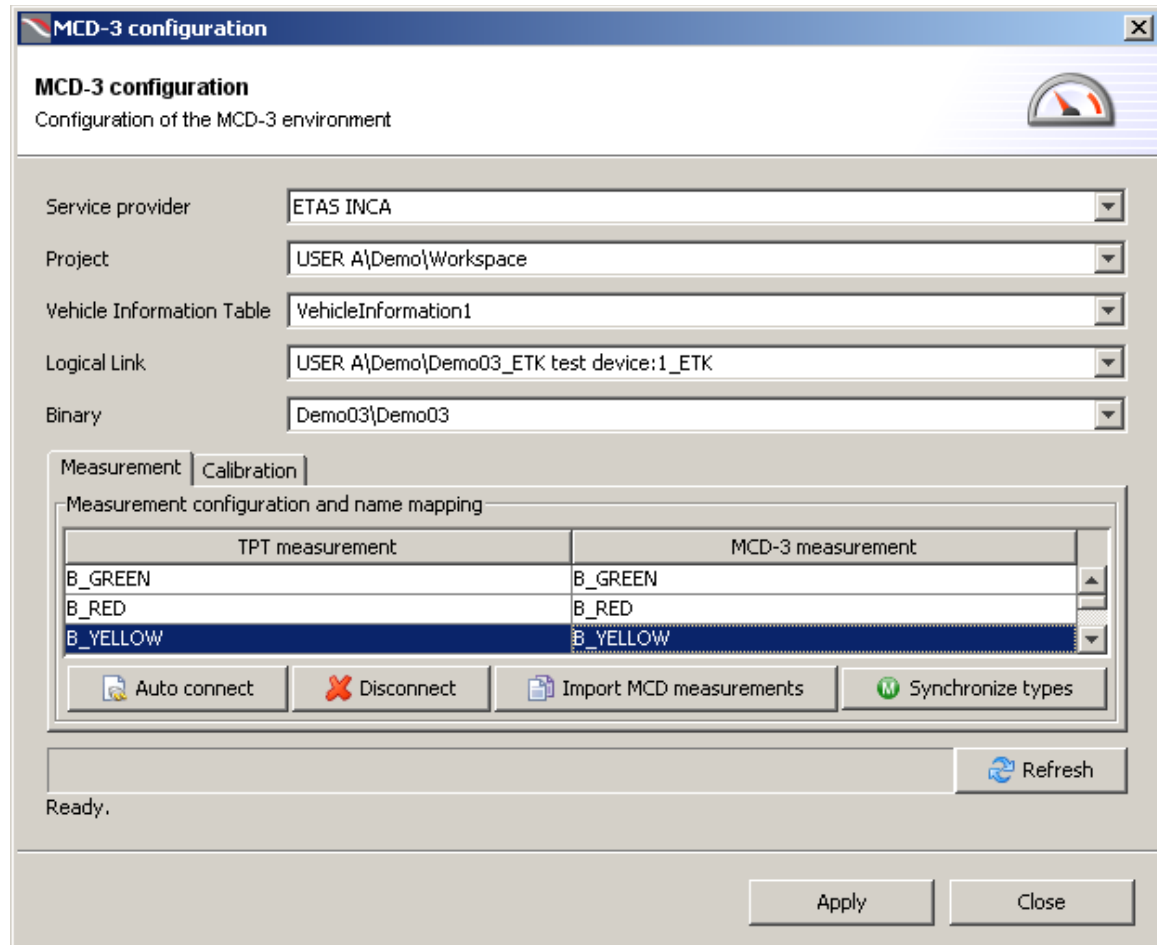
Only HiL-signals can be accessed during simulation.  
Missing controller-internal signals



# Access controller internal signals via separate tools

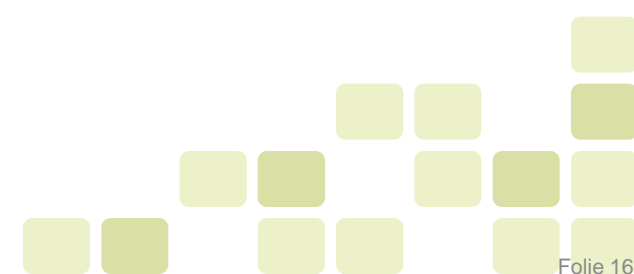
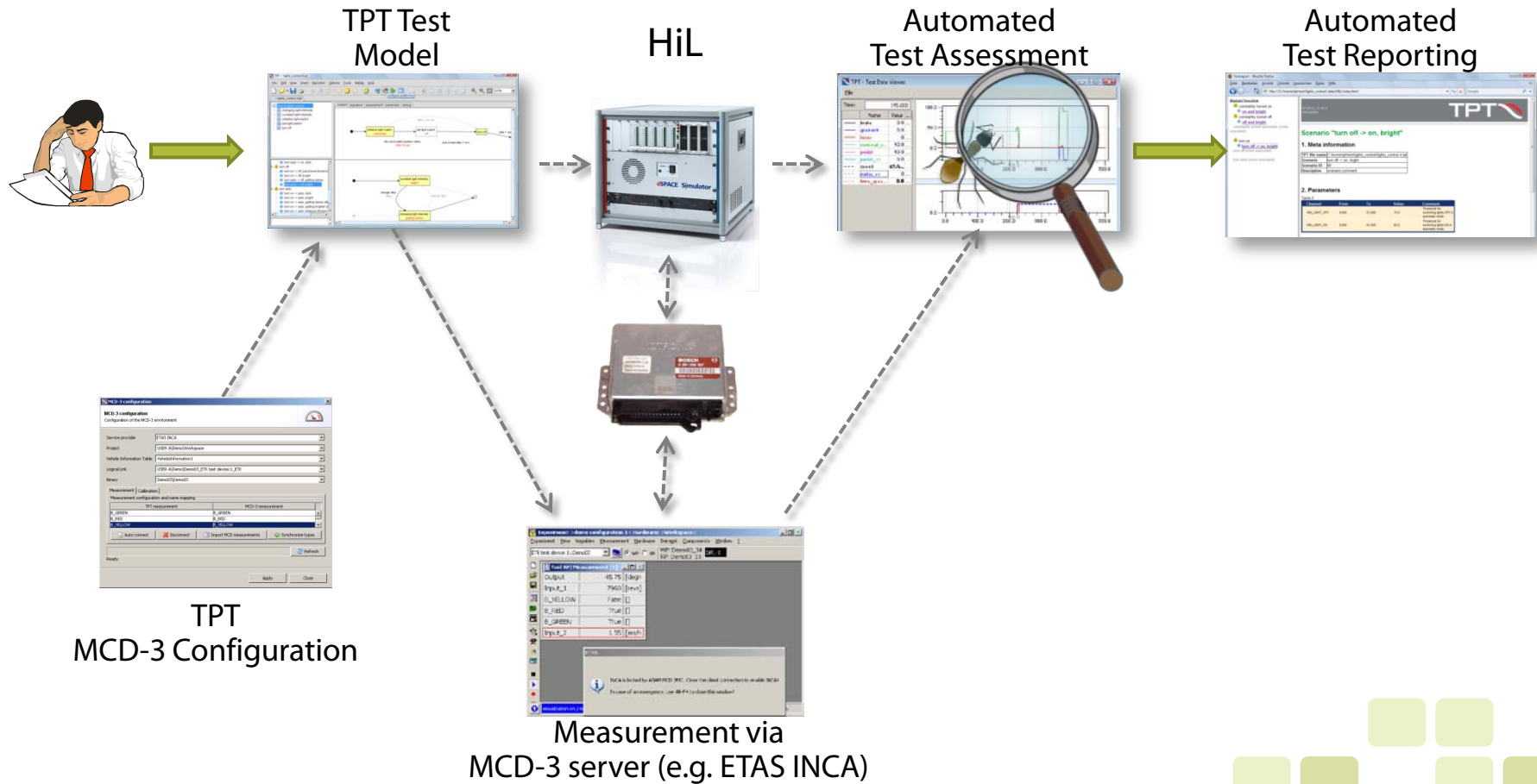
## Remote control via ASAM MCD-3

- ETAS INCA
- Vector CANape



# Process Example HiL Test Execution

- 1** Test modeling
- 2** Test execution parallel measurement
- 3** Assessment + Reporting

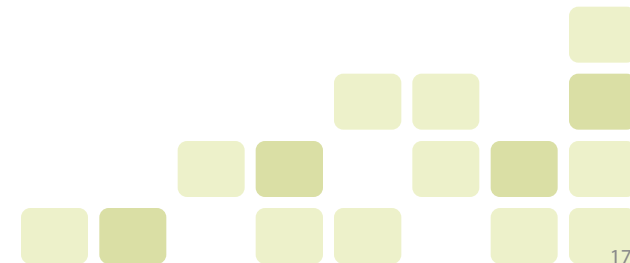




# Summary



- Platform independent test models
- Consistency from model to assessment and report
- Automated tests (from test execution to test report)
- Closed loop tests supported
- Abstract test language
- Systematic test case definition using Intuitive graphical models
- ASAM MCD 3 measuring and access to signals



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