ETAS LiveDevices ETAS Group Vetronix ETAS Group

Frank Tränkle / ETAS GmbH

Testing Automotive Software with TTCN-3

TTCN-3 User Conference

June 6-8, 2005

Sophia Antipolis

Outline

- Testing automotive software with LABCAR
- Evolution of automated testing
- LABCAR-AUTOMATION V2.0 and TAU/Tester
- Summary

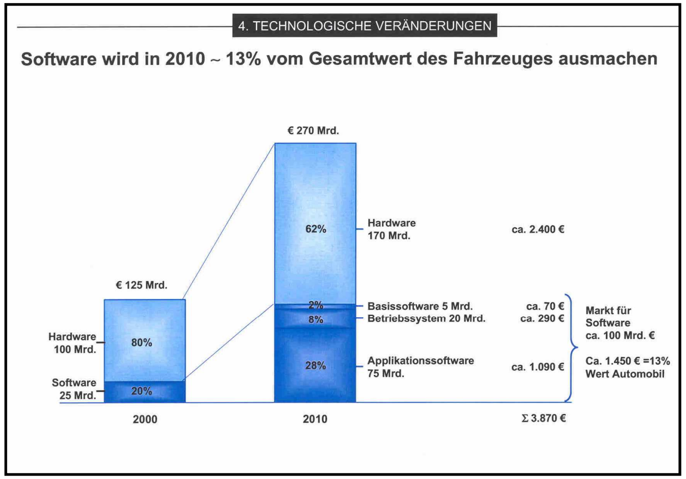
Electronics in Vehicle

Boon and Bane

- By 2010 software will make about 13% of the value of a vehicle

  Source: Mercer Consulting Munich

- Software does enable new functionality, safety features and creates competitive advantage



4. TECHNOLOGISCHE VERÄNDERUNGEN

Software wird in 2010 ~ 13% vom Gesamtwert des Fahrzeuges ausmachen

BUT

- Number of vehicle recalls is ever increasing

  Source: Celerant Consulting Munich

- Modern vehicles are “rolling software platforms” and every additional function increases the risk of an error

  Source: Prof. Dudenhöffer, FH Gelsenkirchen

Vehicle Buyer becomes Test Driver?

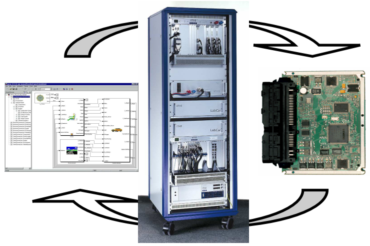
Source: dpa 11 April 03

Test of Vehicle Electronics

Needs

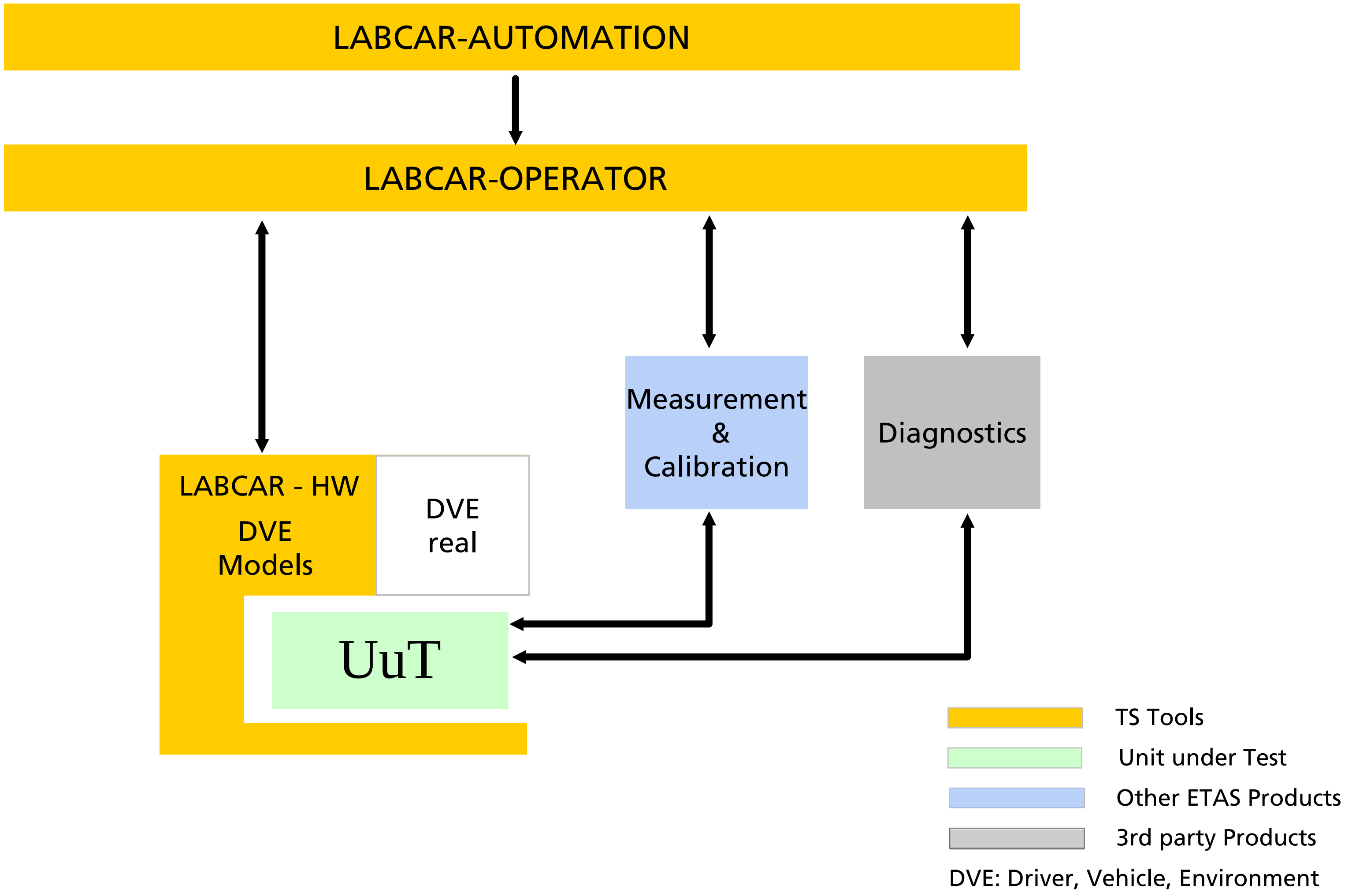
- Ensure product quality to avoid recalls

- Ensure vehicle development in time to keep budgets
- Test more vehicle variants with constant number of employees
- Test with reproducible results
- Use standard test tools fitting into existing test process



LABCAR Overview

LABCAR Software Architecture



LABCAR-AUTOMATION

LABCAR-OPERATOR

LABCAR - HW

DVE Models

DVE real

UuT

Measurement & Calibration

Diagnostics

🟨 TS Tools

🟩 Unit under Test

🟦 Other ETAS Products

⬜ 3rd party Products

DVE: Driver, Vehicle, Environment

LABCAR Hardware

Modular and Scalable System Architecture

LABCAR-ST

Software tests

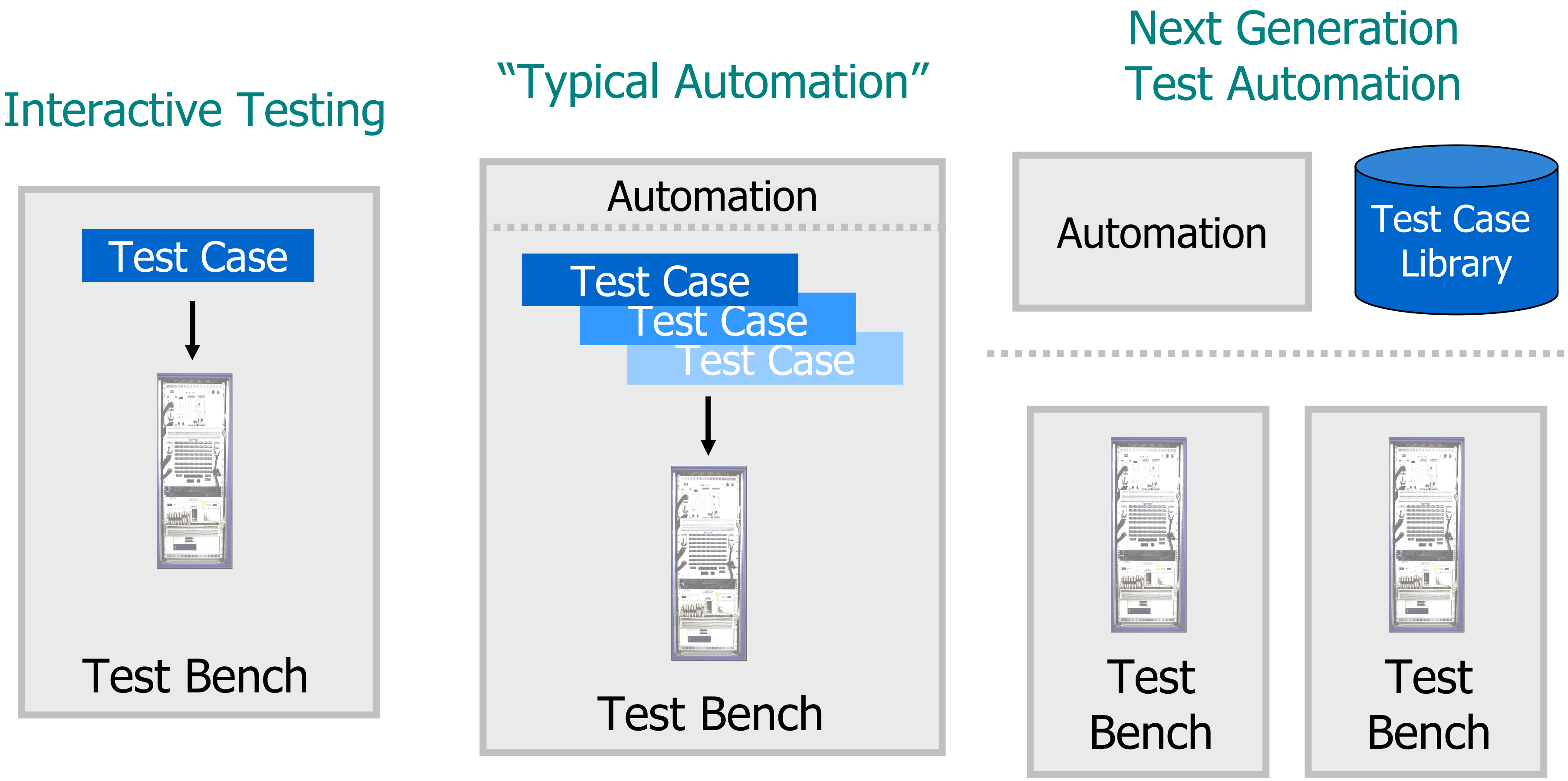
LABCAR-XT

System integration tests

LABCAR-XLT

ECU networks

Evolution of Automated Testing



Interactive Testing

Test Case

Test Bench

"Typical Automation"

Automation

Test Case

Test Case

Test Case

Test Bench

Next Generation Test Automation

Automation

Test Case Library

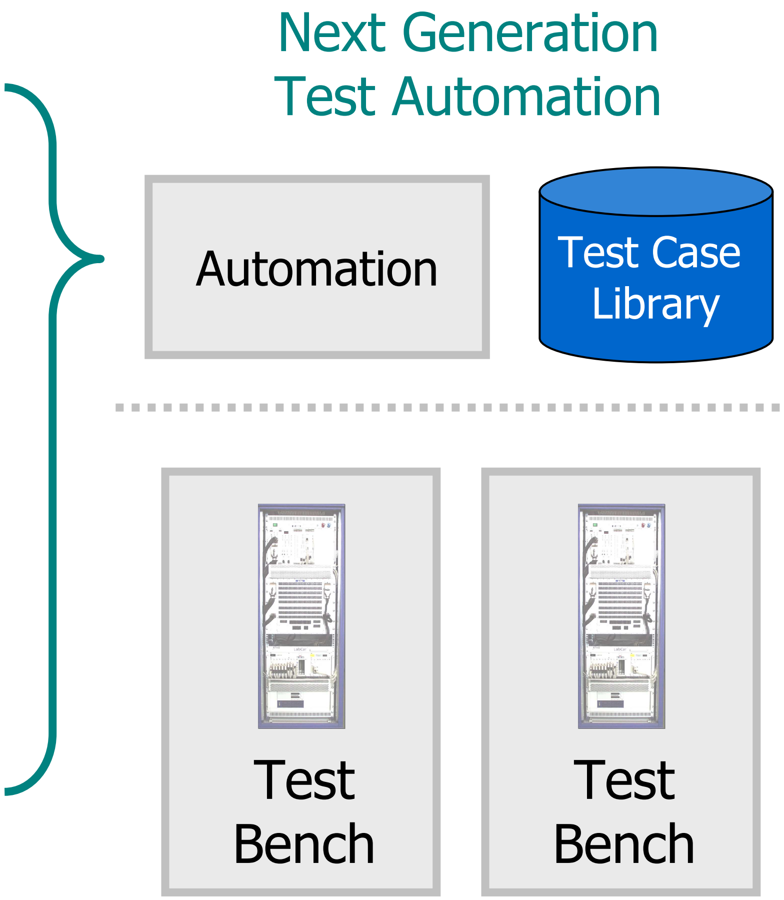
Test Bench

Test Bench

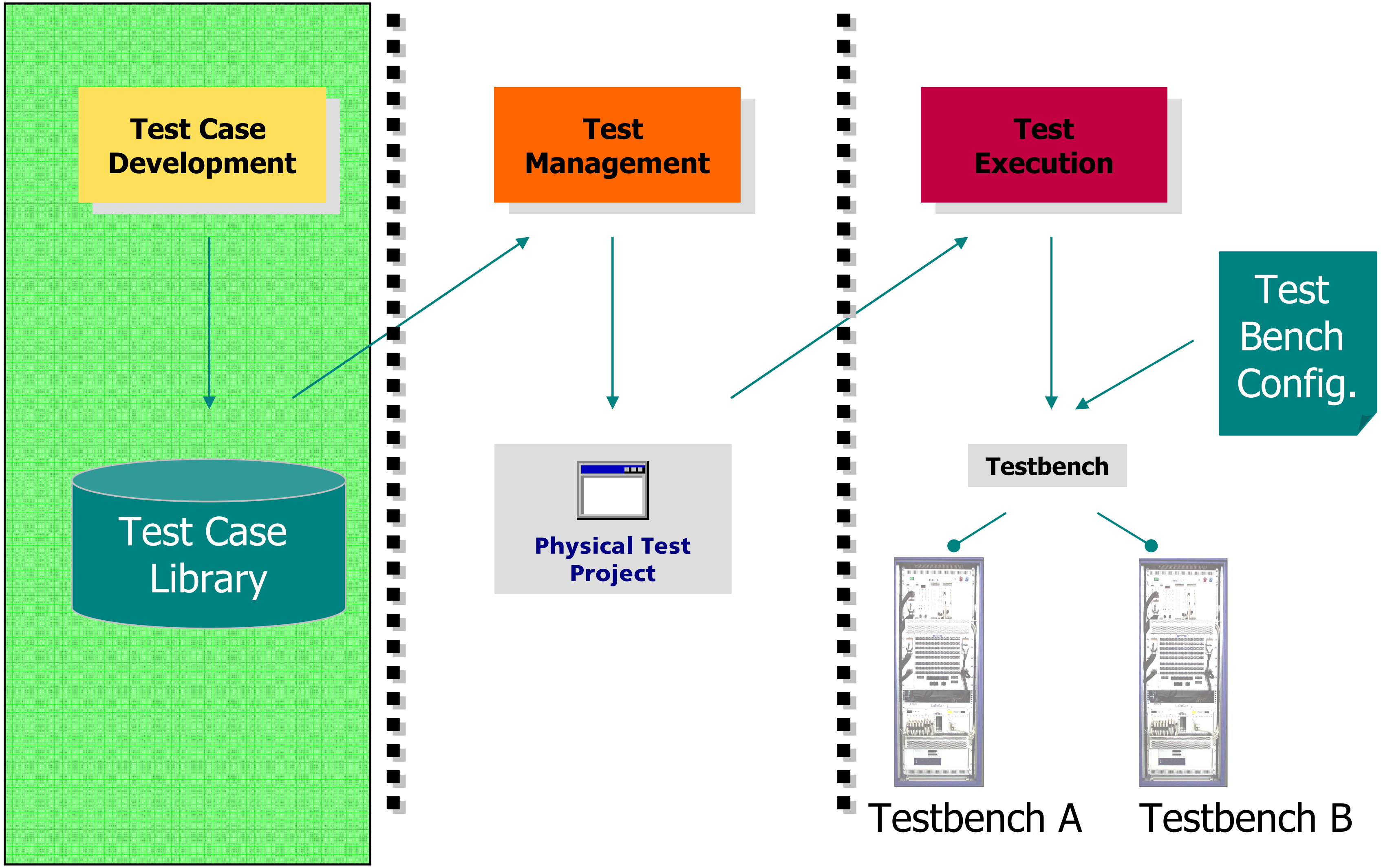
Evolution of Automated Testing

LABCAR-AUTOMATION provides:

- Efficient development, deployment, and execution of reusable test cases
- Abstraction layer between test cases and test benches (test bench independence)
- 3rd party tool integration (open interfaces)
- Connection to TAU/Tester for TTCN-3 test case development
- Test design tool independence (matching various test case developer skills)

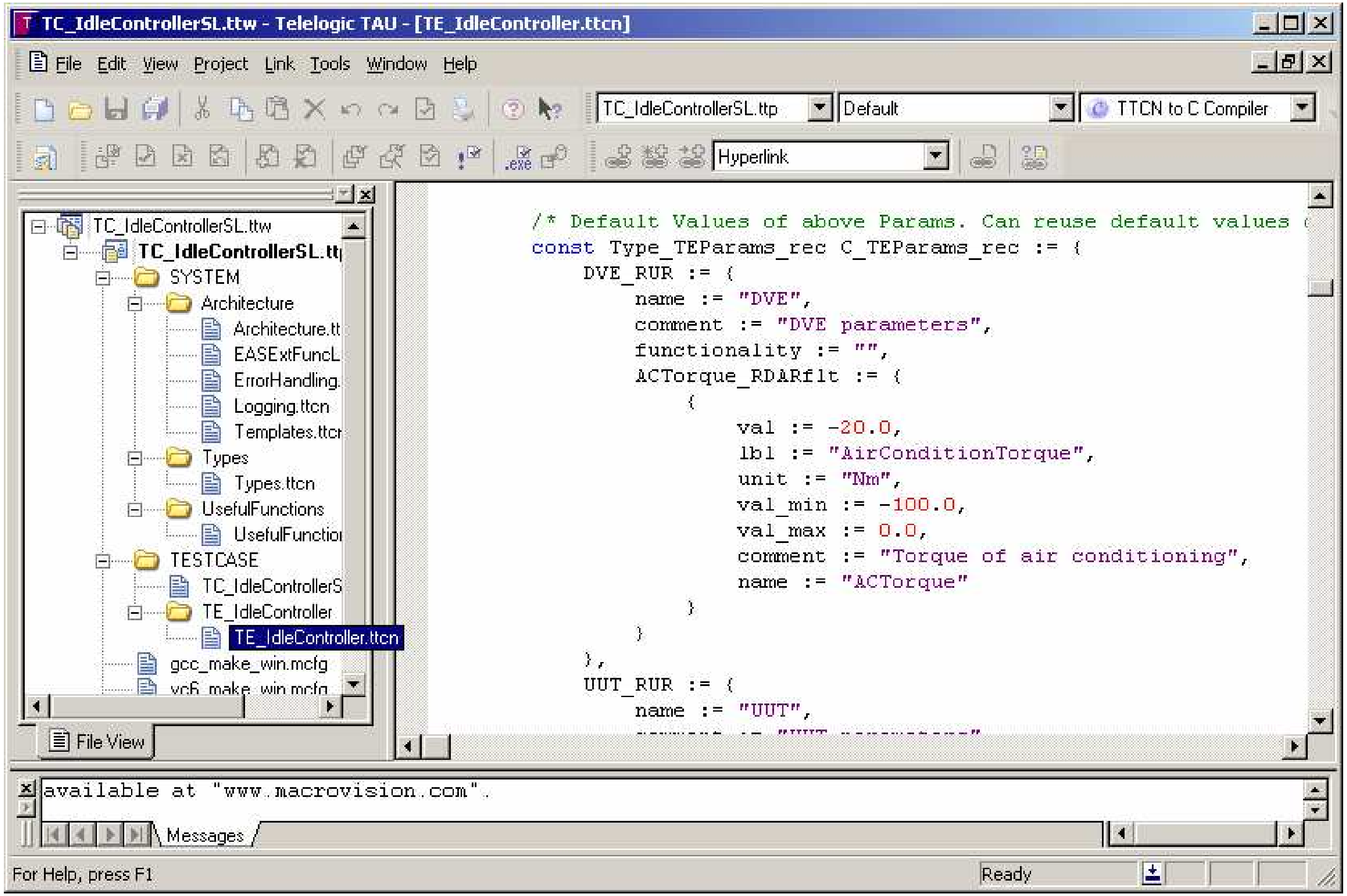


Test Case Development



Test Case Development

TTCN-3 Development with TAU/Tester



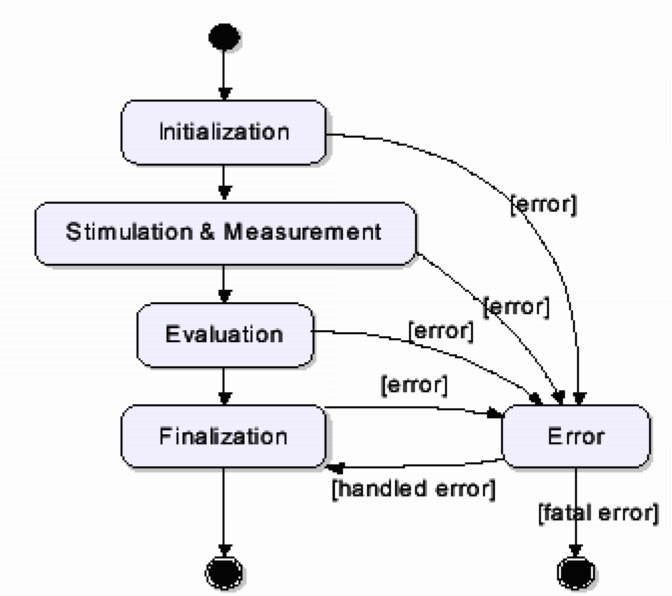
```
/* Default Values of above Params. Can reuse default values (
const Type_TEParams_rec C_TEParams_rec := {
    DVE_RUR := {
        name := "DVE",
        comment := "DVE parameters",
        functionality := "",
        ACTorque_RDARflt := {
            {
                val := -20.0,
                lbl := "AirConditionTorque",
                unit := "Nm",
                val_min := -100.0,
                val_max := 0.0,
                comment := "Torque of air conditioning",
                name := "ACTorque"
            }
        }
    },
    UUT_RUR := {
        name := "UUT",
```

```
available at "www.macrovision.com".
```

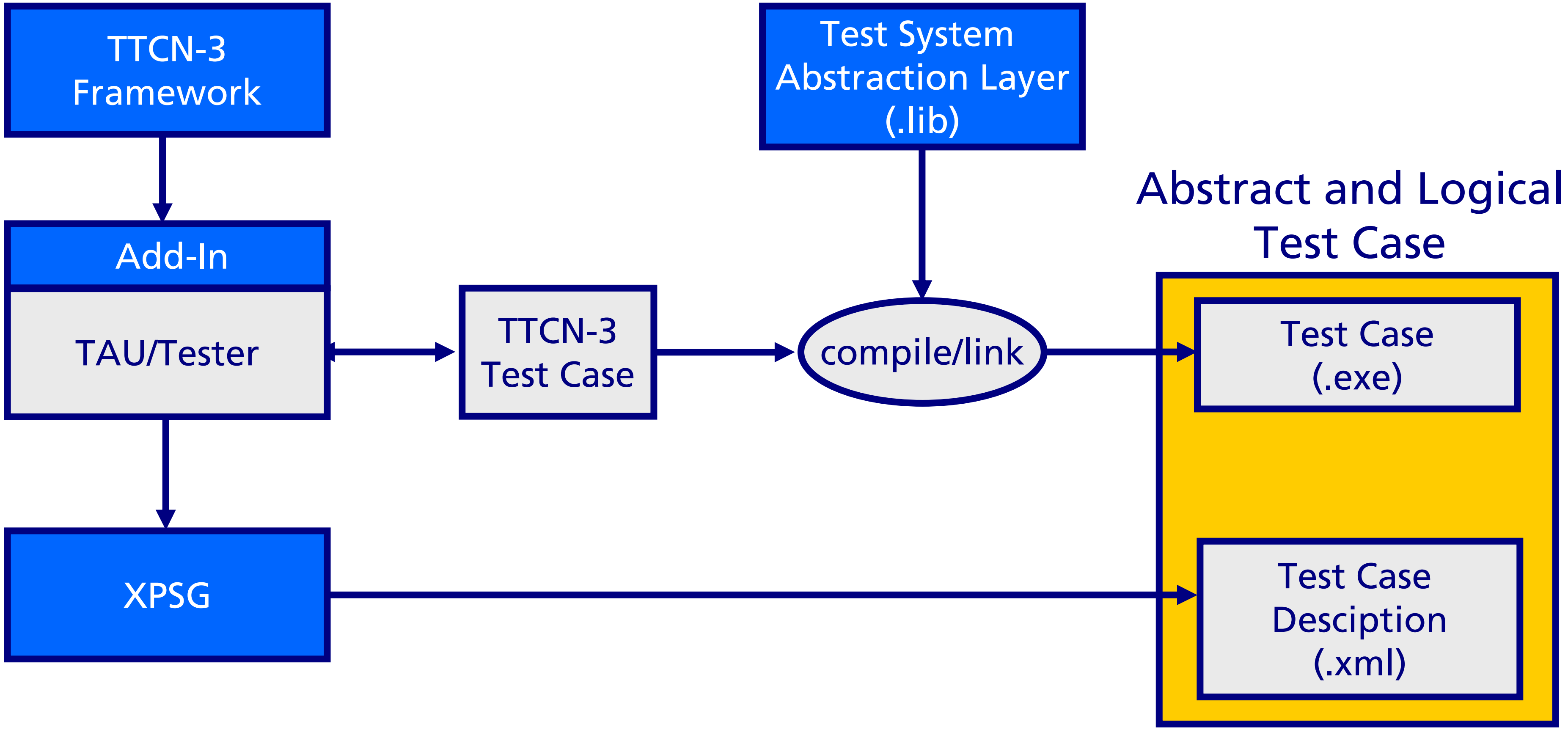
Test Case Development

TTCN-3 Framework

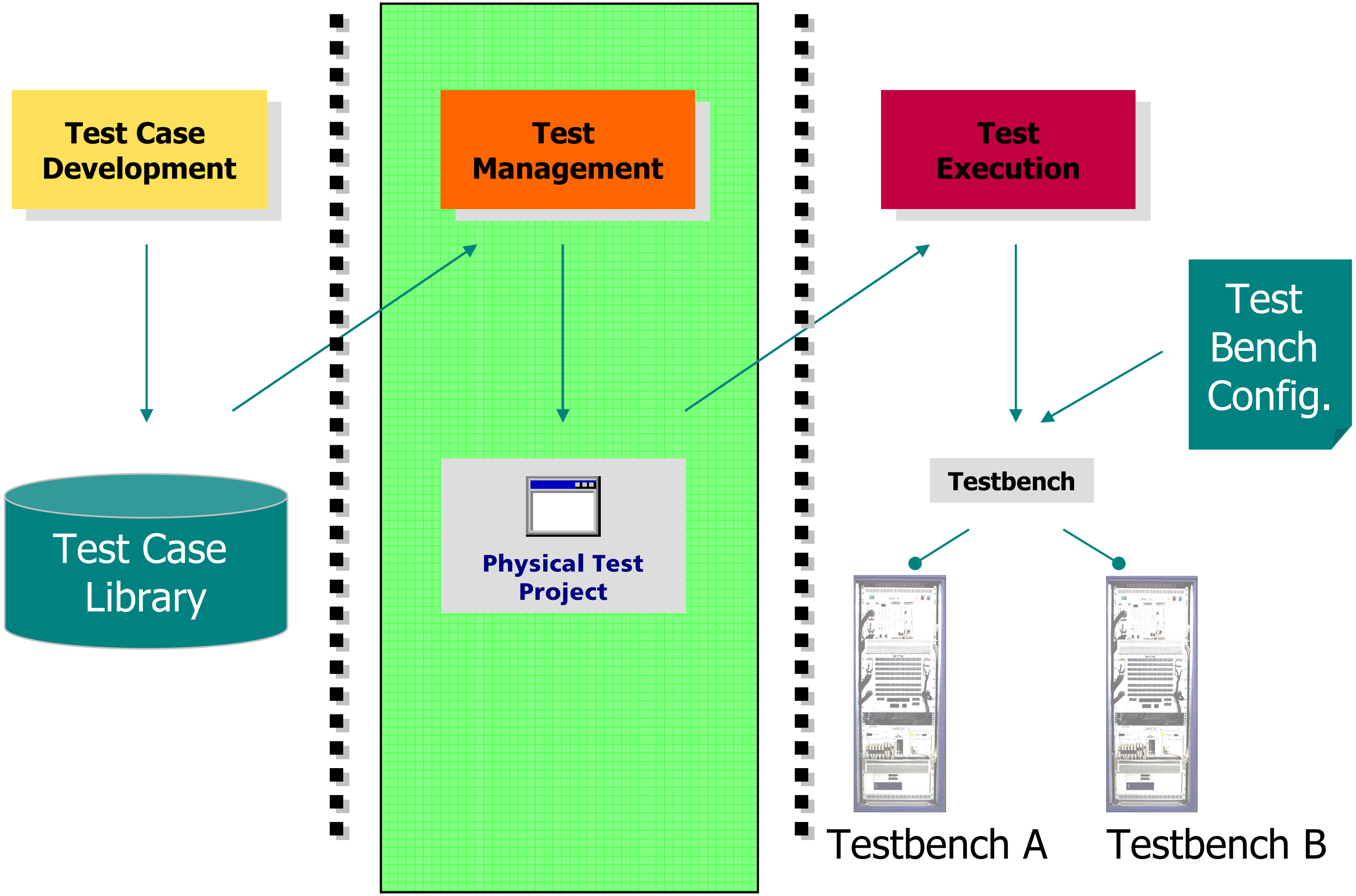
- Testbench-independent ports P_MA (simulation model access), P_EAM and P_EAC (ECU calibration access), P_DIAG (ECU diagnostics access)
- TTCN-3 data types for test parameters
- Common Test Case Architecture
  - 4-step state machine
  - Error and verdict handling
  - Implicit and explicit test execution logging and report generation



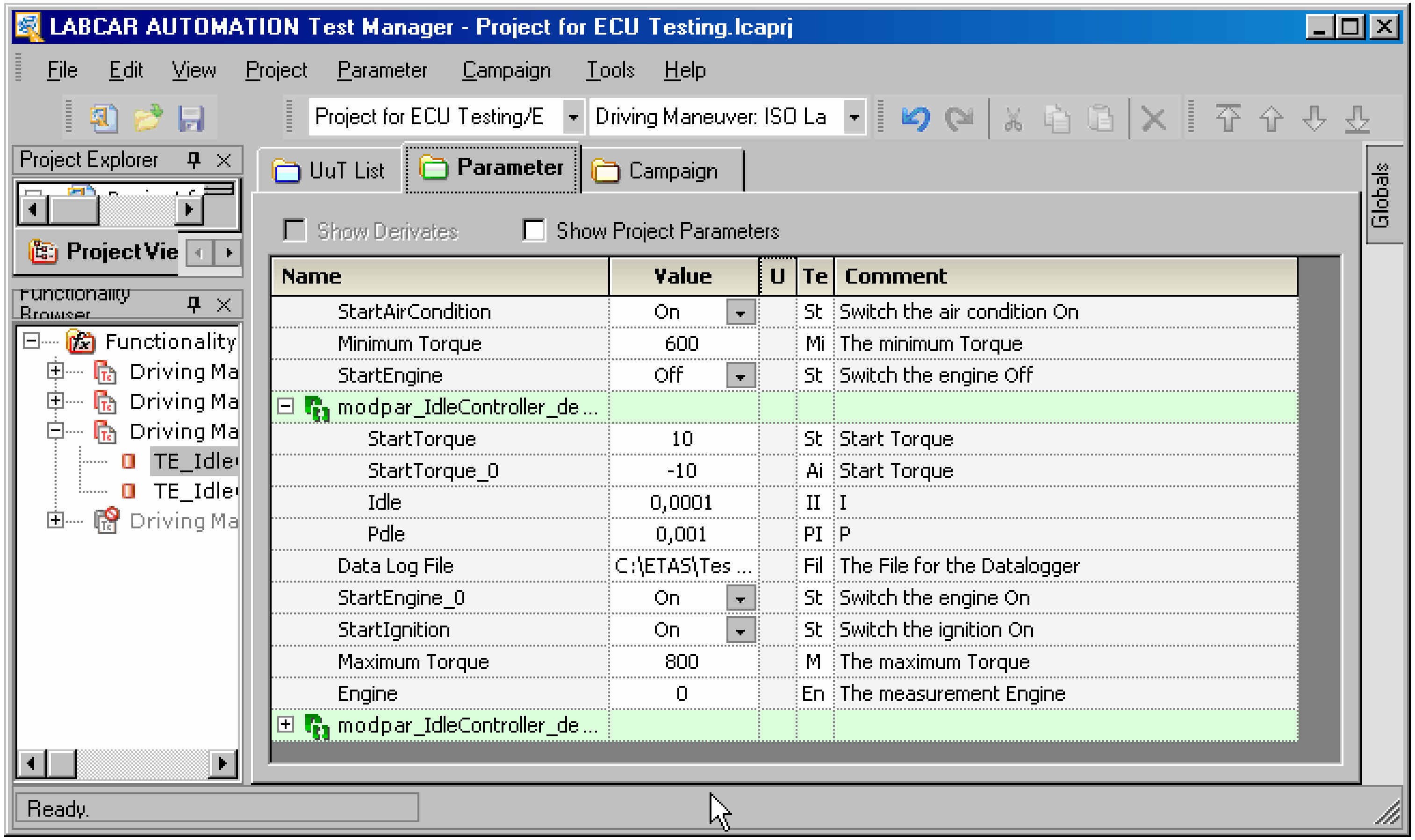
Test Case Development
with TAU/Tester



Test Management



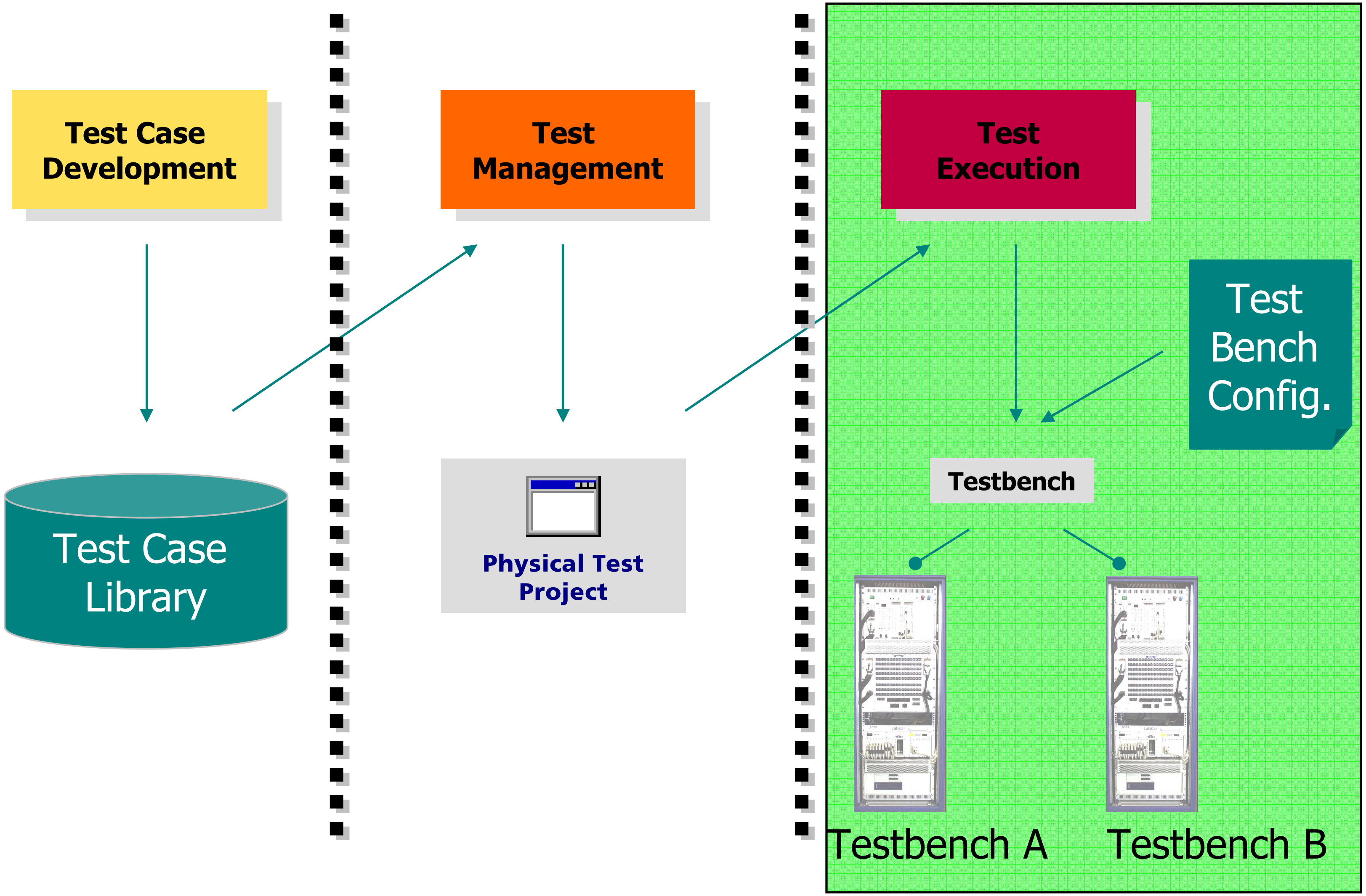
Test Management



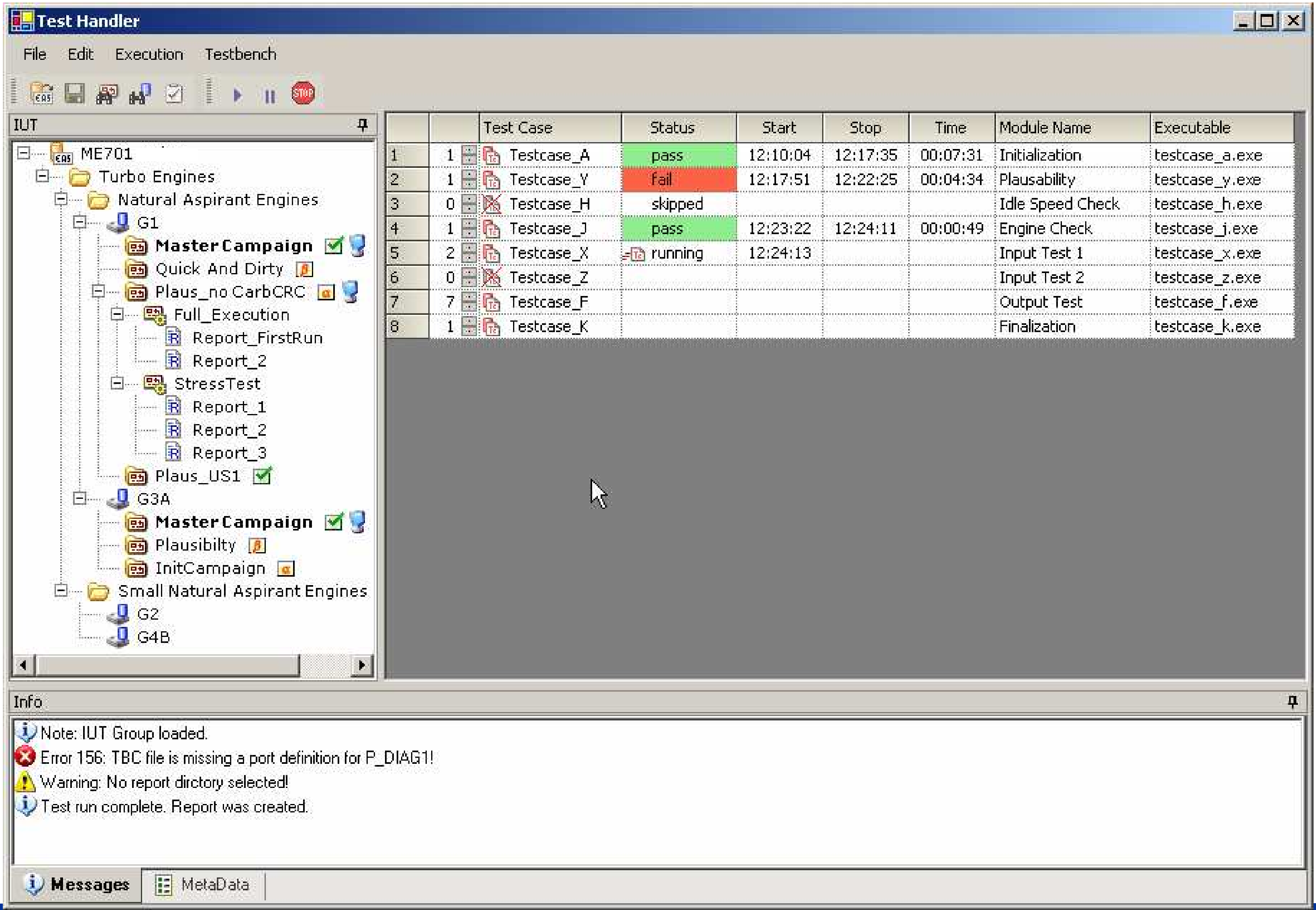
□ Show Derivates □ Show Project Parameters

Name	Value	U	Te	Comment
StartAirCondition	On		St	Switch the air condition On
Minimum Torque	600		Mi	The minimum Torque
StartEngine	Off		St	Switch the engine Off
modpar_IdleController_de ...				
StartTorque	10		St	Start Torque
StartTorque_0	-10		Ai	Start Torque
Idle	0,0001		II	I
Pdle	0,001		PI	P
Data Log File	C:\ETAS\Tes ...		Fil	The File for the Datalogger
StartEngine_0	On		St	Switch the engine On
StartIgnition	On		St	Switch the ignition On
Maximum Torque	800		M	The maximum Torque
Engine	0		En	The measurement Engine
modpar_IdleController_de ...				

Test Execution



Test Execution



- ME701
  - Turbo Engines
    - Natural Aspirant Engines
      - G1
        - Master Campaign
        - Quick And Dirty
        - Plaus_no CarbCRC
          - Full_Execution
            - Report_FirstRun
            - Report_2
          - StressTest
            - Report_1
            - Report_2
            - Report_3
        - Plaus_US1
      - G3A
        - Master Campaign
        - Plausibilty
        - InitCampaign
    - Small Natural Aspirant Engines
      - G2
      - G4B

		Test Case	Status	Start	Stop	Time	Module Name	Executable
1	1	Testcase_A	pass	12:10:04	12:17:35	00:07:31	Initialization	testcase_a.exe
2	1	Testcase_Y	fail	12:17:51	12:22:25	00:04:34	Plausability	testcase_y.exe
3	0	Testcase_H	skipped				Idle Speed Check	testcase_h.exe
4	1	Testcase_J	pass	12:23:22	12:24:11	00:00:49	Engine Check	testcase_j.exe
5	2	Testcase_X	running	12:24:13			Input Test 1	testcase_x.exe
6	0	Testcase_Z					Input Test 2	testcase_z.exe
7	7	Testcase_F					Output Test	testcase_f.exe
8	1	Testcase_K					Finalization	testcase_k.exe

Note: IUT Group loaded.

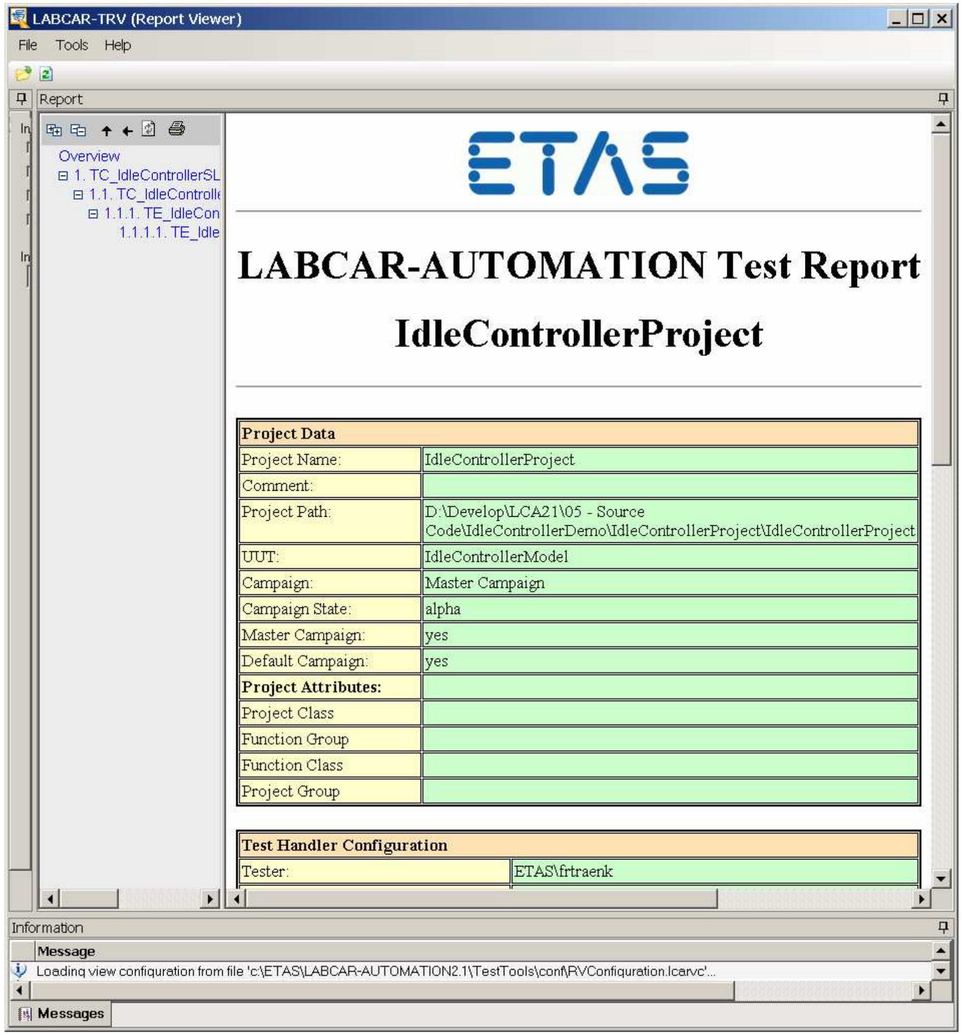
Error 156: TBC file is missing a port definition for P_DIAG1!

Warning: No report dirctory selected!

Test run complete. Report was created.

Test Execution

Hierarchical HTML View on XML Reports



LABCAR-AUTOMATION Test Report

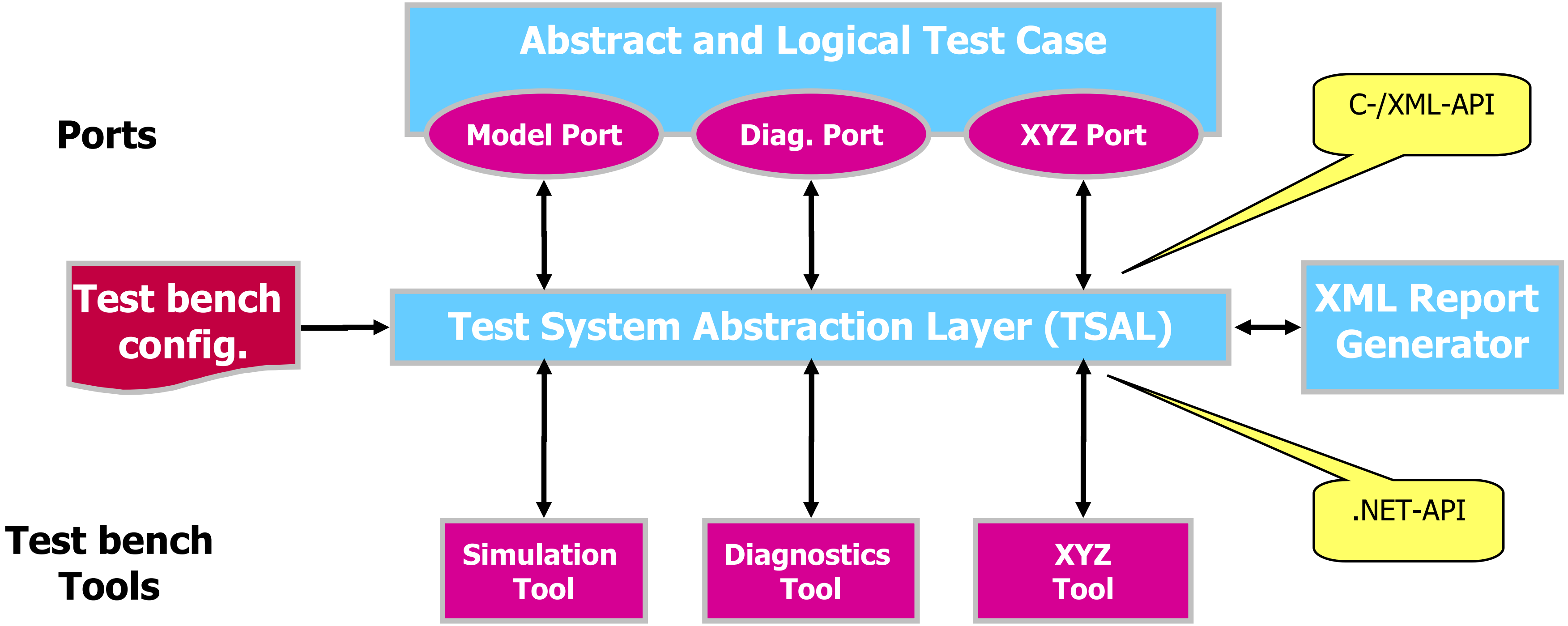
IdleControllerProject

Project Data	
Project Name:	IdleControllerProject
Comment:	
Project Path:	D:\Develop\LCA21\05 - Source Code\IdleControllerDemo\IdleControllerProject\IdleControllerProject
UUT:	IdleControllerModel
Campaign:	Master Campaign
Campaign State:	alpha
Master Campaign:	yes
Default Campaign:	yes
Project Attributes:	
Project Class	
Function Group	
Function Class	
Project Group	

Test Handler Configuration	
Tester:	ETAS\frtraenk

Message
Loading view configuration from file 'c:\ETAS\LABCAR-AUTOMATION2.1\TestTools\conf\RVConfiguration.lcarvc'...

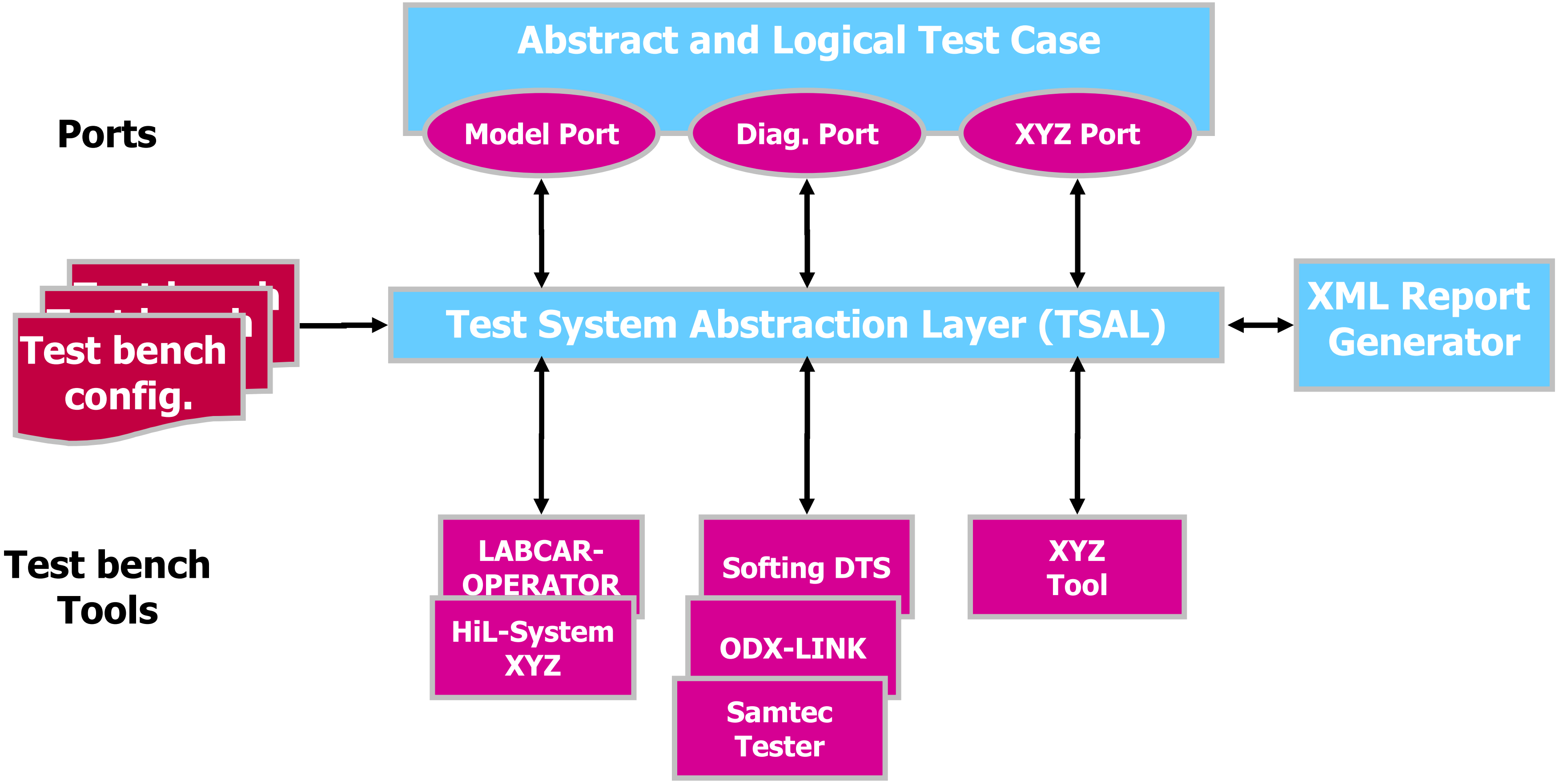
Open Interfaces



- Test-bench-independent ports for developing abstract and logical test cases
- TSAL provides open .NET API to connect to test bench tools
- TSAL provides open C-/XML-API to connect to test languages and test design tools

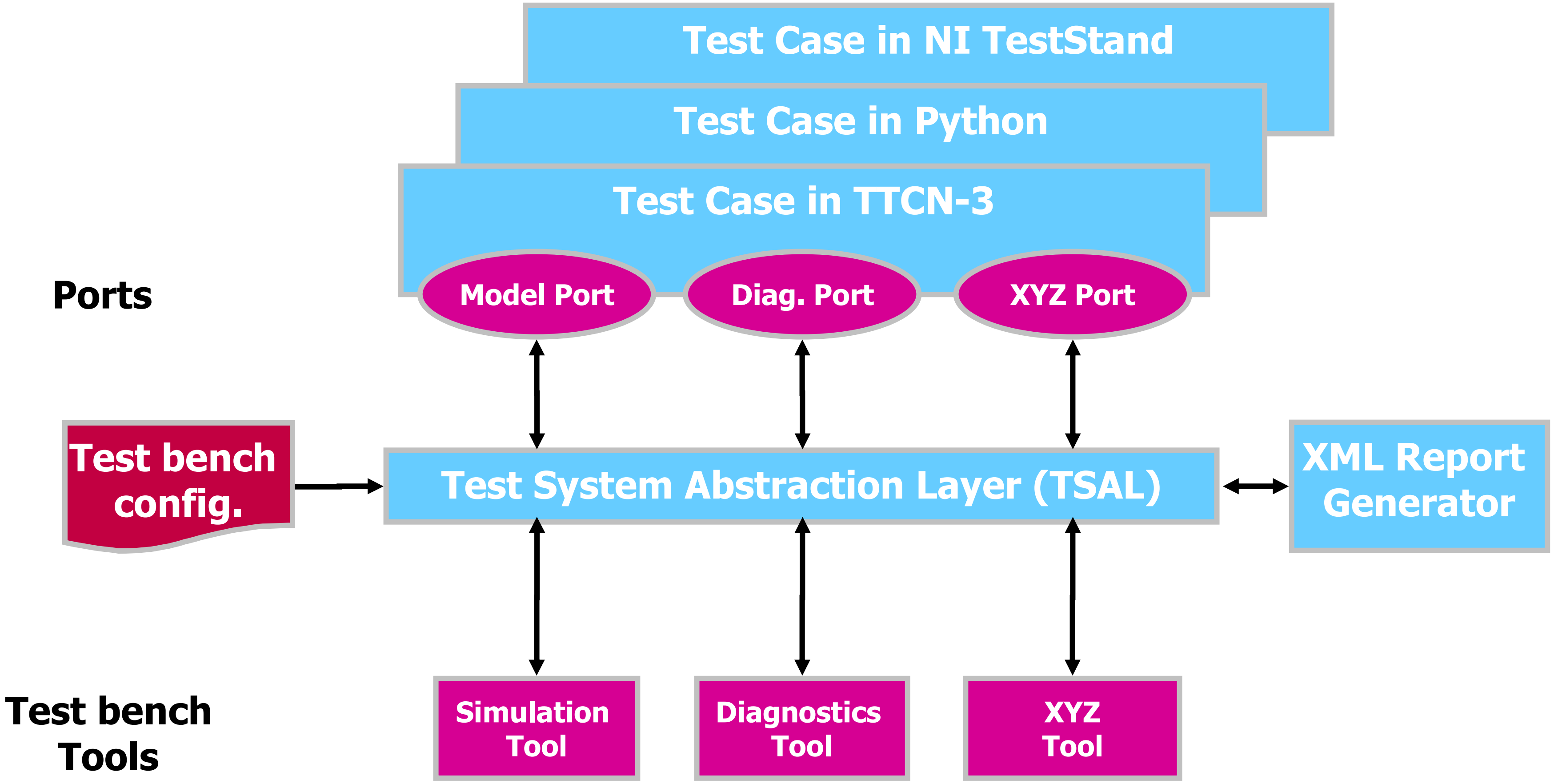
Open Interfaces

Dynamic Test Bench Configuration at Test Execution Time



Open Interfaces

Open C-/XML-API to Test Languages and Test Design Tools



Summary

LABCAR-AUTOMATION

- Graphical user front ends for
  - test case development,
  - test management and
  - test execution
  - ➢ **Process-safe test management and execution**

- Test bench- and UuT- independent test cases
  - ➢ **Improved reuse for test cases**

- Open Interfaces for
  - connection to test bench tools
  - connection to test languages and test design tools
  - ➢ **Investment protection for test case development**
  - ➢ **Investment protection for test bench tools (software + hardware)**

Thank you for your attention!

Your questions are welcome!