



# Realization of a TTCN-3 Framework for Generic Automotive Test Cases

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## Outline



- Automotive Testing Requirements
- TTCN-3 Framework
- Testing Workflow
- LABCAR-AUTOMATION
- Extensions to standard TTCN-3

## Automotive Testing Requirements

### **Investment protection into Test Cases and Test Benches**

- 24 hours 7 days operation of test benches
- Automated tests independent of test benches
- Flexible composition of test benches from test tools
- Exchange of Test Bench tool vendors and version

### **Test efficiency**

- Test cases must be re-used and adapted across Test Projects
- High rates of different ECU releases must be managed
- Process-safe administration of Test Projects for ECU variants

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## Automotive Testing Requirements

### What does it mean?

### **Investment protection into Test Cases and Test Benches**

- 24 hours 7 days operation of test benches
- Automated tests independent of test benches
- Flexible composition of test benches from test tools
- Exchange of Test Bench tool vendors and version

- ➔ Abstraction layer between Test Cases and Test Bench
- ➔ Test Cases can be executed on different Test Benches

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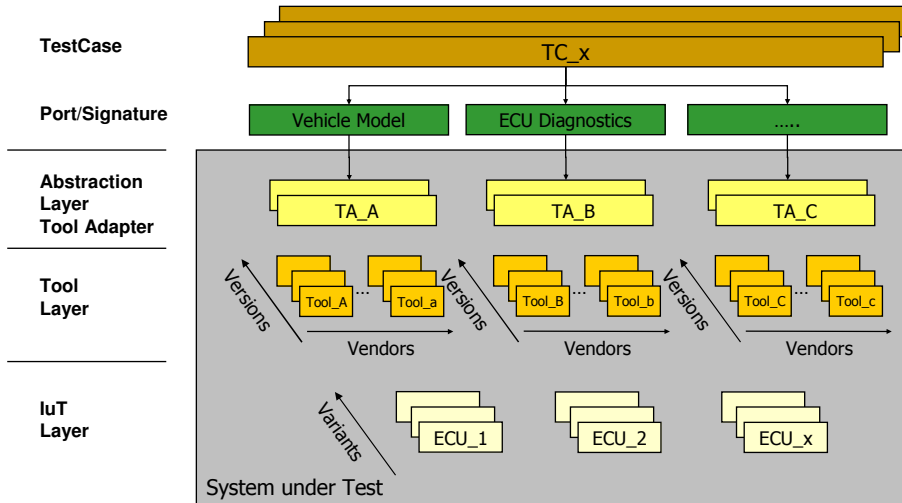
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## Automotive Testing Requirements Test Bench Architecture



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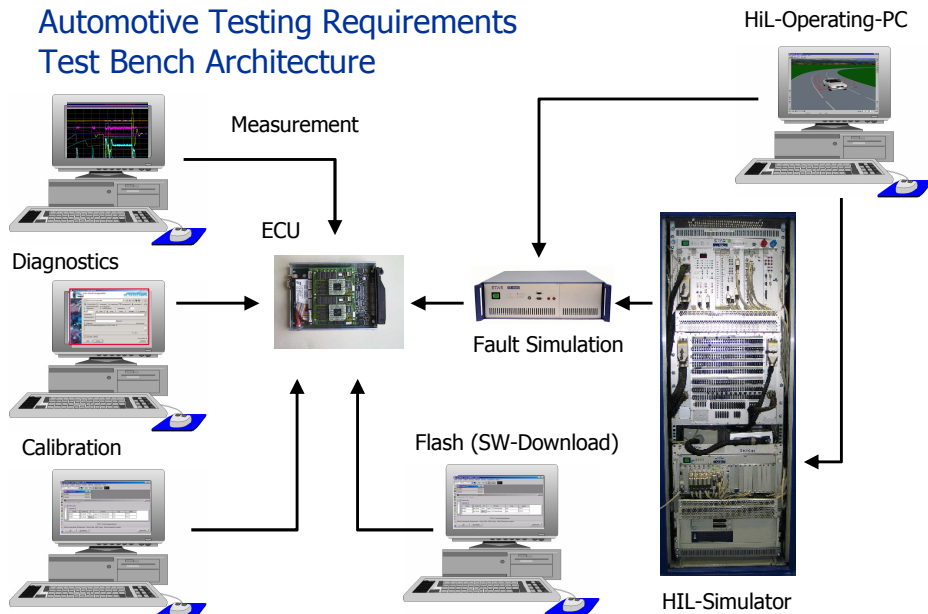
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## Automotive Testing Requirements Test Bench Architecture



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## Automotive Testing Requirements What does it mean?

### Test efficiency

- Test cases must be re-used and adapted across Test Projects
  - High rates of different ECU (software / hardware) releases must be managed
  - Process-safe administration of Test Projects for ECU variants
- 
- ➔ Few logical Test Cases are transformed into many physical Test Cases by Test Parameterization
  - ➔ Encapsulation of ECU project specific implementation of functional actions (e.g. ECU "ON" can be done in different ways)
  - ➔ Definition of a standard TTCN-3 framework
  - ➔ Test Management and Test Execution tools (LABCAR-AUTOMATION)

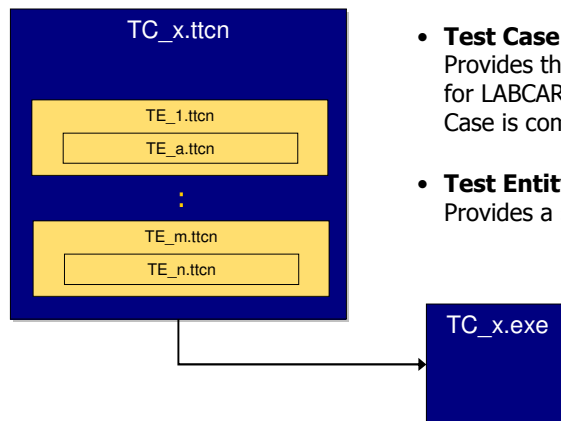
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## TTCN-3 Framework

### • General Test Case Architecture



- **Test Case (TC)**  
Provides the parameter interface for LABCAR-AUTOMATION. Test Case is composed of Test Entities.
- **Test Entity (TE)**  
Provides a single test scenario

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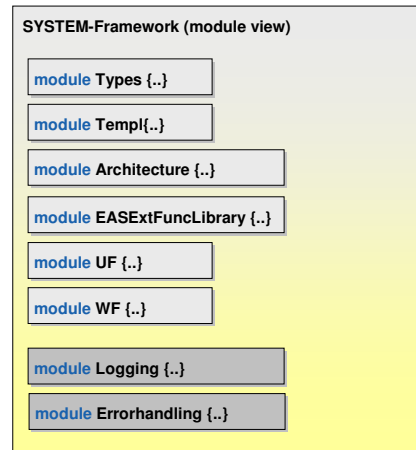
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## TTCN-3 Framework

### • Libraries

- Types
- Templates
- Test bench architecture
- Mathematical functions
- Useful functions
  - Functions to encapsulate TTCN port signatures
  - Convenience Functions to provide a standard SUT access
- Wrapper functions
  - E.g. Switching ECU on / off
- Support functions
  - For logging
  - For error handling



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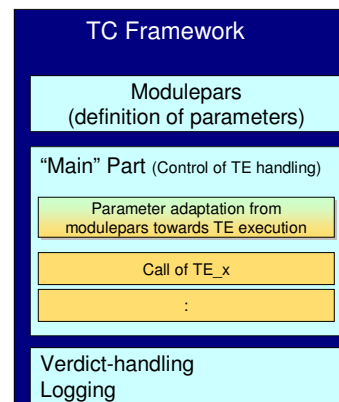
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## TTCN-3 Framework

### • Test Case (TC) Framework ensures

- standardized TTCN module usage
- standardized structure to code a TTCN test case
- standardized modulepars (test parameter definition)
- standardized TC/TE parameter mapping
- standardized TE calling mechanism
- standardized verdict and error handling



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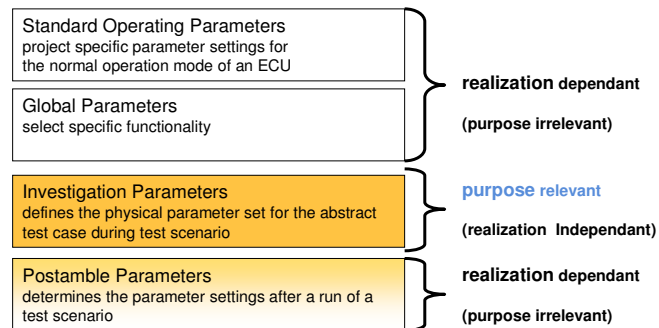
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## TTCN-3 Framework

- **Test Case (TC) Framework ensures**

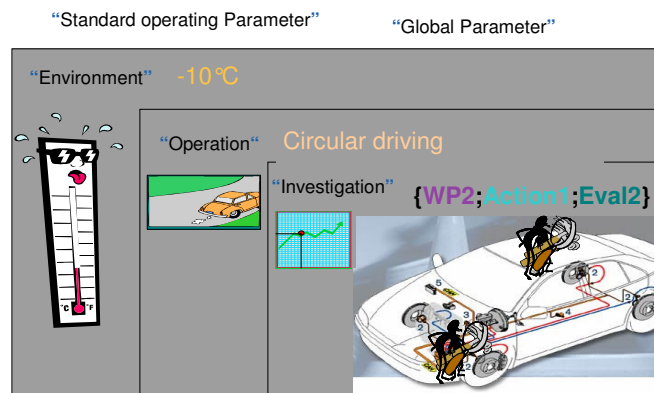
- Parameter classification of Modulepar parameters to support the parameter value assignment



## TTCN-3 Framework

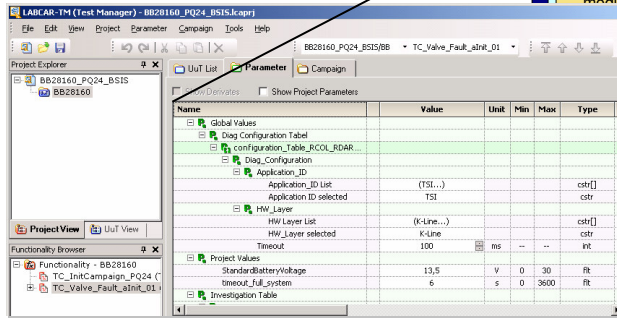
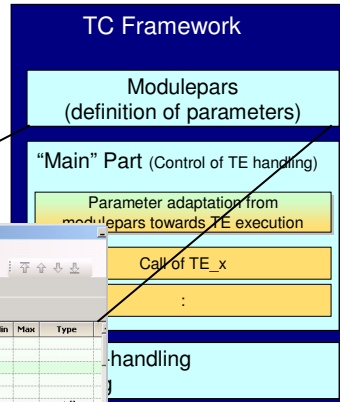
- **Test case (TC) Framework ensures**

- standardized modulepars parameter types



## TTCN-3 Framework

- **Test Case (TC) Framework ensures**
  - standardized modulepars (Parameter definition)



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## TTCN-3 Framework

- **Test case (TC) Framework ensures**
  - Parameter example

```
const Type_SUT_RflT C_UBatt_StandardOperating_RflT := (
    val      := 13.5, // default value
    lbl     := "Batteryvoltage", // ASAP-Path, if SUT access required
    unit    := "V", // unit in volt
    val_min := 0, // min value
    val_max := 24.0, // max value
    comment := "Standard Battery supply voltage", // comment for LCA-Tool user
    name    := "StandardBatteryVoltage" // LCA-Tool GUI displayed name
)
```

```
type record Type_STOPPA_RUR {
    charstring name,
    charstring functionality,
    charstring comment,
    Type_SUT_RflT Ubatt_operating_RflT
} // END Type_STOPPA_RUR
```

```
const Type_STOPPA_RUR C_MP_STOPPA_RUR := {
    name           := "STOPPA",
    functionality  := "",
    comment        := "Project specific settings",
    Ubatt_operating_RflT := C_UBatt_StandardOperating_RflT
} // End C_MP_STOPPA_RUR
```

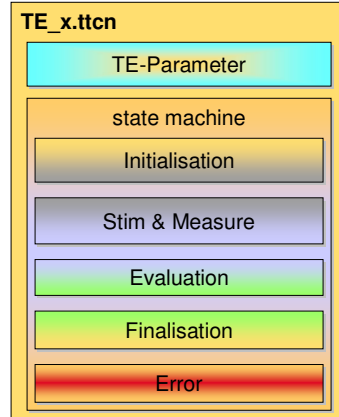
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## TTCN-3 Framework

- **Test Entity (TE) Framework ensures**

- standardized structure to code a TTCN test entity (TestCase)
- standardized TTCN module usage
- standardized parameter definition
- standardized error handling
- standardized 4-Step-Method
  - Initialisation
  - Stimulation & Measurement
  - Evaluation (verdict identification)
  - Finalisation

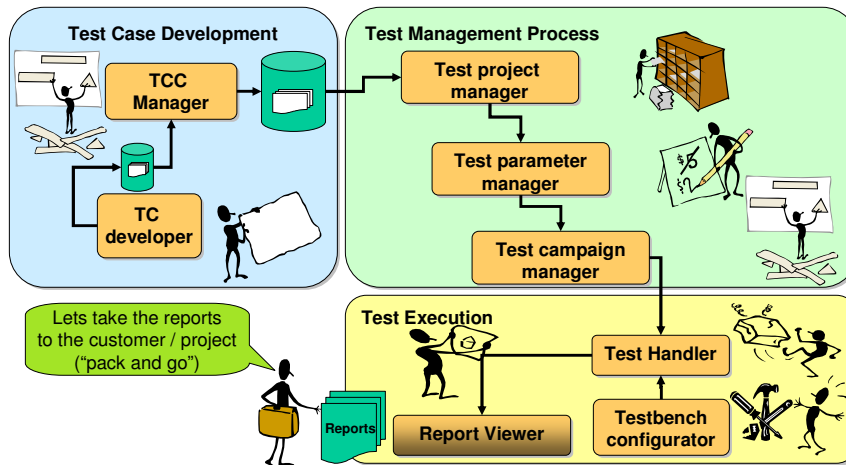


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## Testing Workflow



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## LABCAR-AUTOMATION (ETAS Product)

### Key Features

- LABCAR-AUTOMATION enables automotive companies to develop, manage and execute **systematic and efficient automated tests** for ECU software.
- Its modular and open architecture provides **test bench and test language independence**.
- Customers benefit from **reuse of test cases and test projects** for different test bench setups.
- Customers benefit from integrated process-safe test management and parameterization services for **handling ECU variants**.

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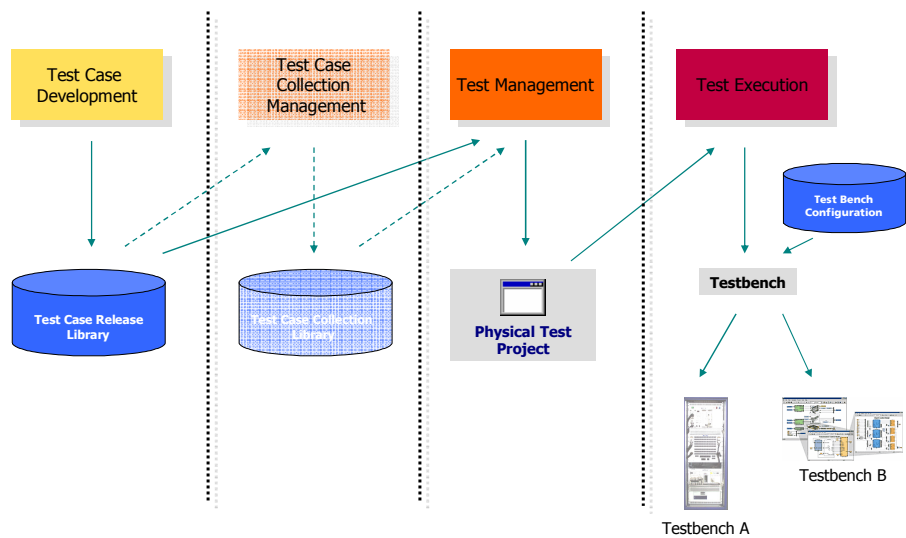
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## LABCAR-AUTOMATION

### From Test Case Development to Test Execution



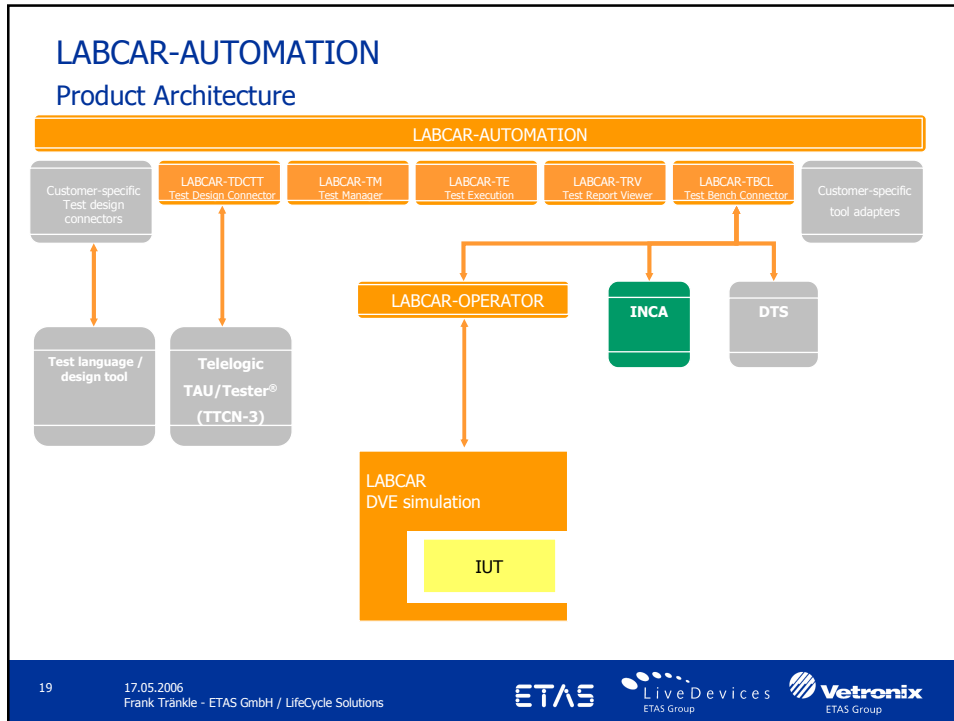
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- ## Extensions to Standard TTCN-3 for Automotive Proposal for future standardization efforts
- **Predefined Framework**
    - 4-Step-Method
  - **External Function Library Mechanism**
  - **Libraries**
    - Basic mathematical functions
    - String operations
    - Functions for signal analysis
    - .....
  - **Standardized parameter types for modulpar**
    - Physical unit, max/min value support
    - Comments
  - **Improved error handling concept**
    - Exception handling
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Thank you for your attention!

Your questions are welcome!