AN INTRODUCTION TO TTCN-3

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TestingStage, Kiev, April 14, 2018

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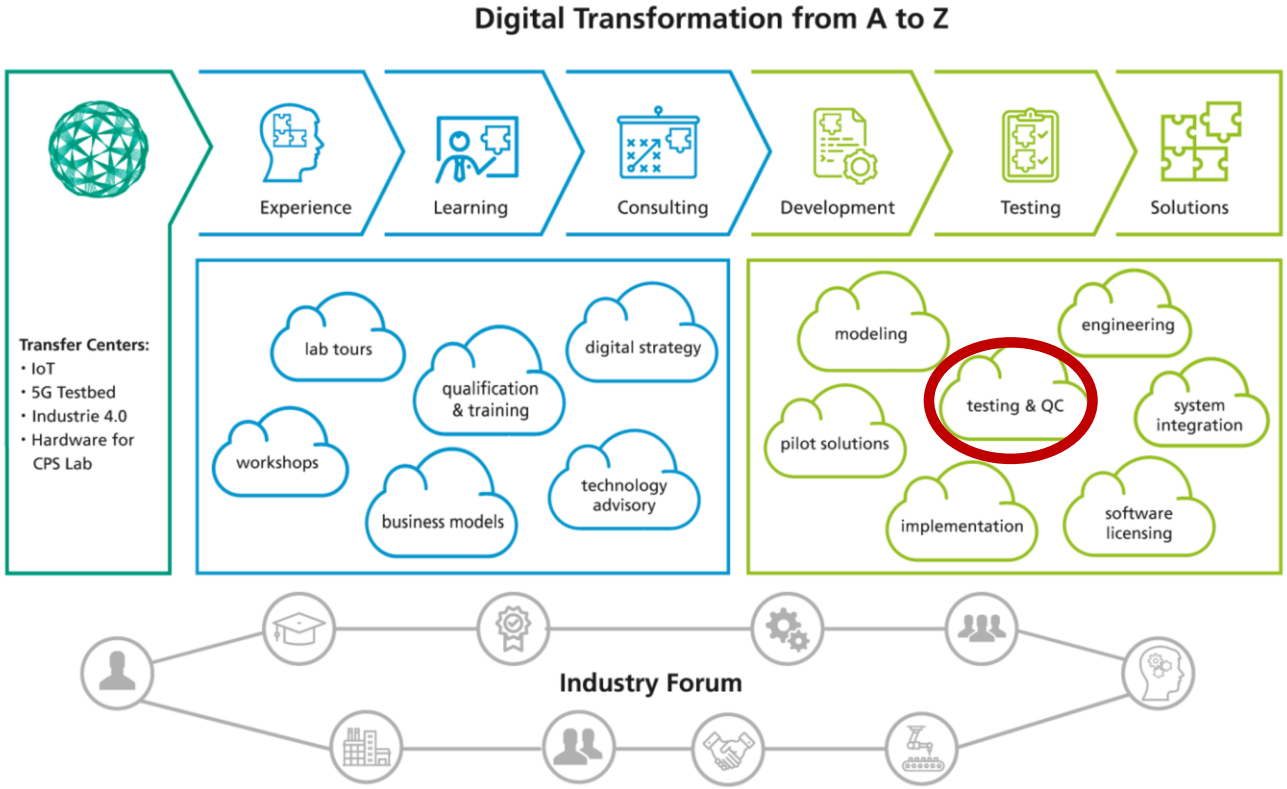
Engineering a Connected World

BERLIN CENTER FOR DIGITAL TRANSFORMATION



AGENDA

- Introduction
- Language concepts
- Application domains
- Summary and outlook

INTRODUCTION

TESTING TODAY

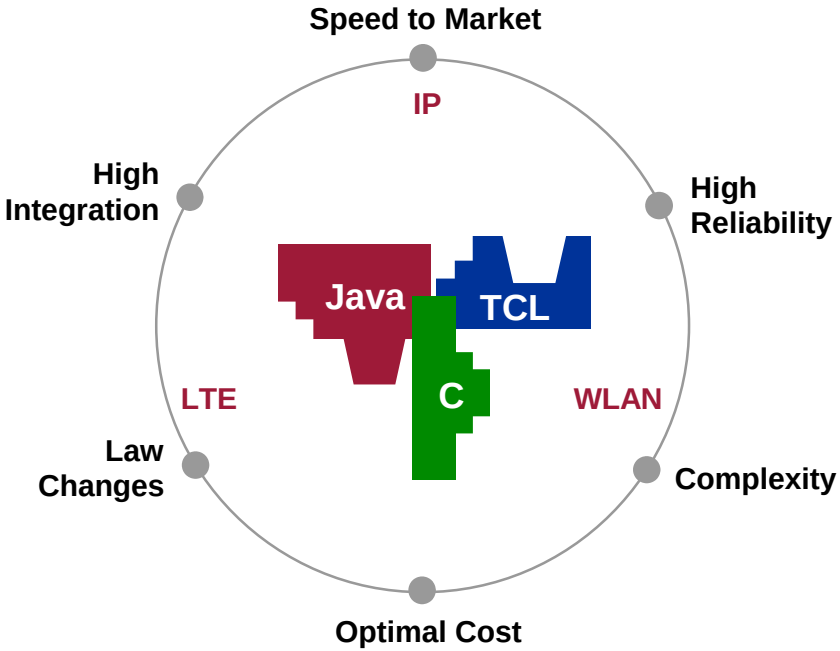
Is

- Important for QA
- Expensive (costs!)
- Time critical

But

- Only rarely practiced
- Unsystematic
- Performed by hand
- Error-prone
- Uncool („*If you are a bad programmer you might be a tester*.“)
- Destructive

WHY USING TTCN-3



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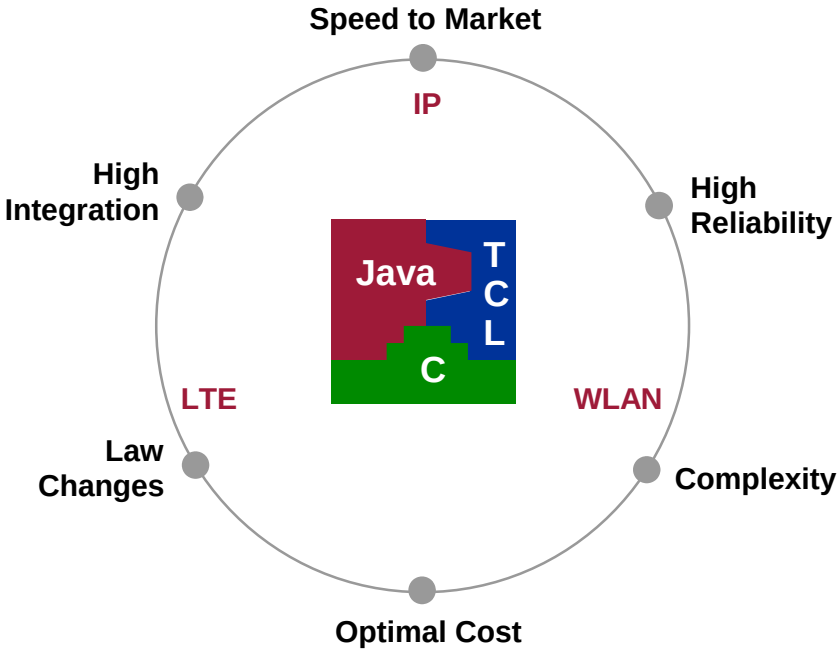

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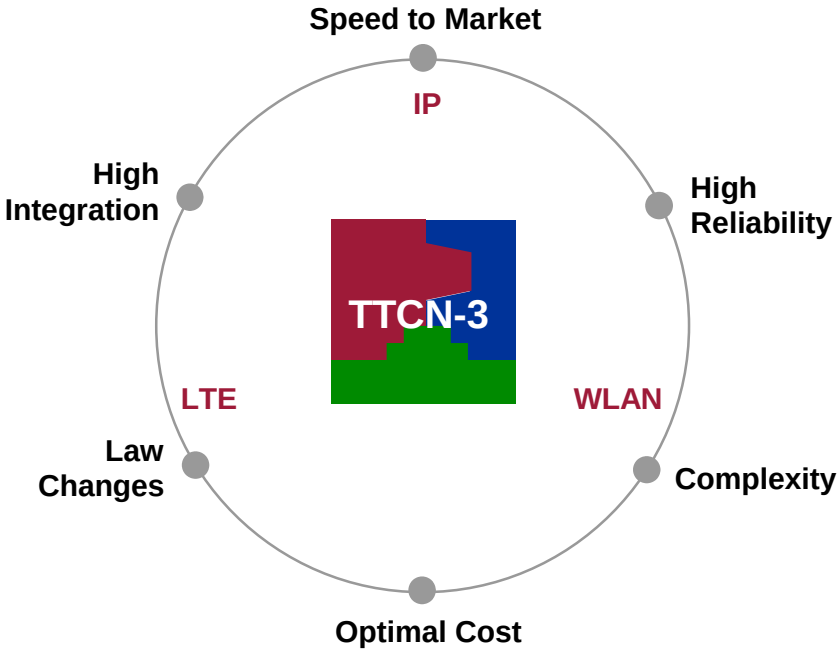

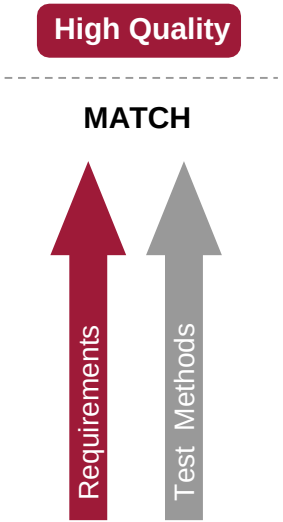

THE INTERNATIONAL TEST LANGUAGE

What do we use?

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CHALLENGE TEST AUTOMATION

- TTCN-3 is the **Testing and Test Control Notation**
- **Internationally standardized** testing language for formally defining test scenarios.
- Designed **purely for testing**

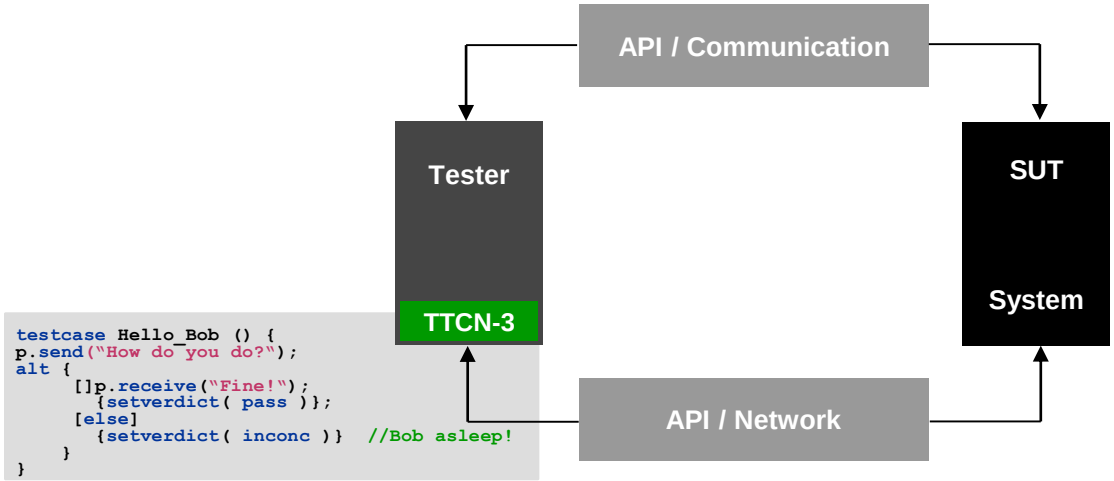
TESTING OF COMMUNICATION SCENARIOS

TESTING OF COMMUNICATION SCENARIOS


```
testcase Hello_Bob () {
      p.send("How do you do?");
      alt {
      []p.receive("Fine!");
            {setverdict( pass )};
      [else]
            {setverdict( inconc )} //Bob asleep!
      }
}
```

TESTING AND TEST CONTROL NOTATION (TTCN-3)

- **Distributed testing**
- **Automatic** execution (TTCN-3 -> Java/C++) and logging
- Import and use of **external data types** (ASN.1, IDL, XML, JSON)



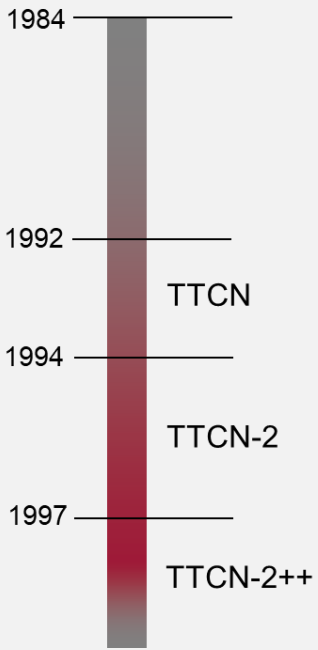
DESIGN PRINCIPLES OF TTCN-3

- **One test technology for different tests**
  - Distributed, platform-independent testing
  - Integrated graphical test development, documentation and analysis
  - Adaptable, open test environment

- **Areas of Testing**
  - *Conformance* and *functional* testing
  - *Interoperability* and *integration* testing
  - *Real-time*, *performance*, *load* and *stress* testing
  - *Security* testing
  - *Regression* testing

- Used for *system and product* **qualification and certification** (e.g. **handset** certification)

TTCN-3 HISTORY



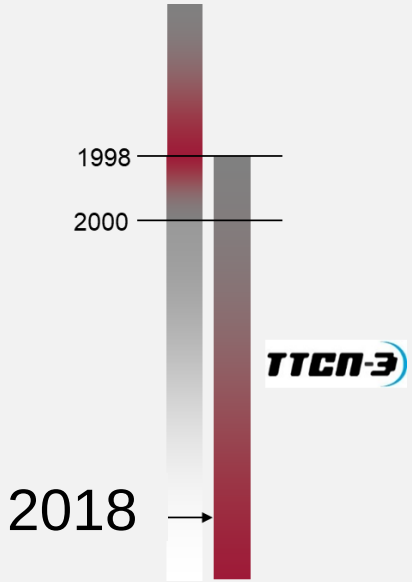
TTCN (1992)

- published as ISO standard
- **Tree and Tabular Combined Notation**
- used for protocol tests:
  GSM, N-ISDN, B-ISDN

TTCN-2/2++ (1997)

- enhancements by ETSI MTS
- module concept, concurrency
- used for conformance tests

TTCN-3 HISTORY (CONT.)

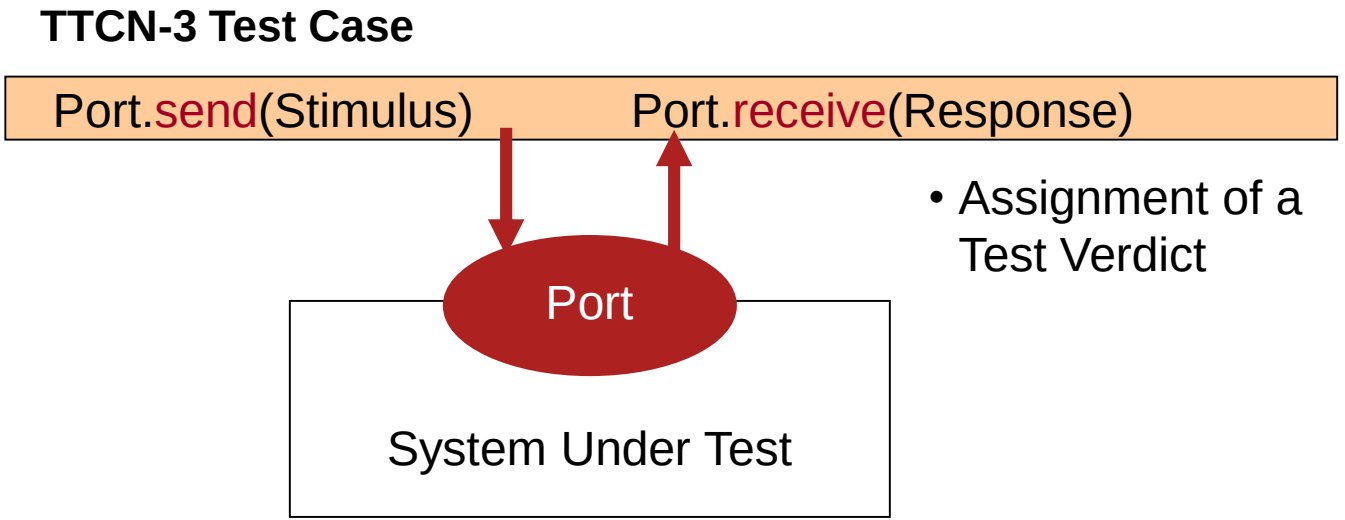


TTCN-3 (2000)

- Further development by ETSI MTS
- **Testing and Test Control Notation**
- Standardised test specifications:
  - SIP, SCTP, M3UA, IPv6
  - HiperLan, HiperAccess, WiMAX
  - 3GPP **UMTS, LTE**, **NB-IoT, 5G**
  - OMA
  - TETRA
  - MOST, AUTOSAR
  - EUROCONTROL
  - **oneM2M**

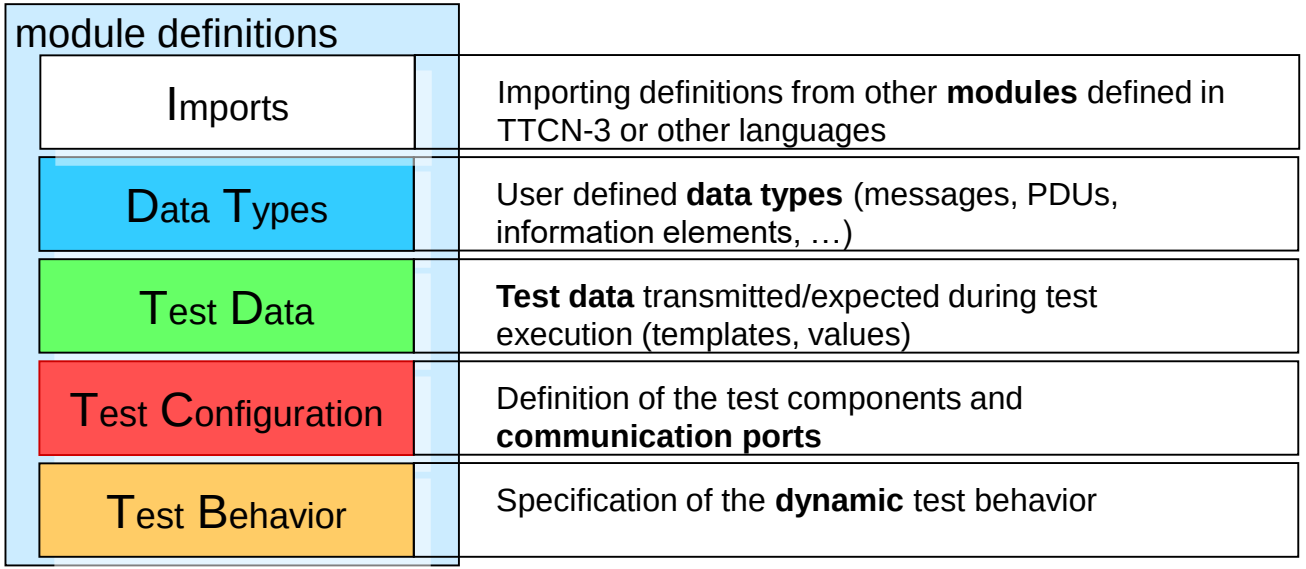
LANGUAGE CONCEPTS

TTCN-3 IS DESIGNED FOR DYNAMIC TESTING



- Assignment of a Test Verdict

MAJOR LANGUAGE ELEMENTS OF TTCN-3 NOTATION



IMPLEMENTATION

Type definitions: boolean, integer, float, bitstring, charstring, octectstring, hexstring, record, set, enumeration, union

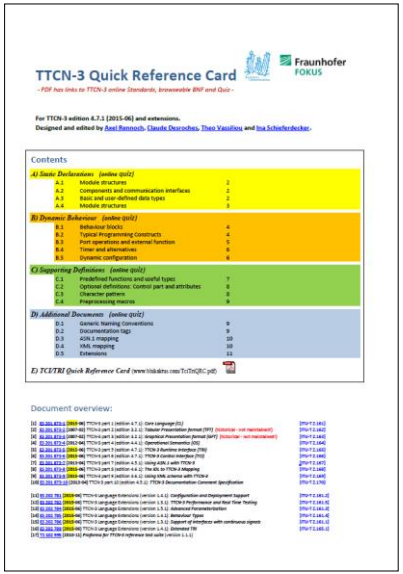
Programming constructs:

- *message:* send/receive
- *procedure:* call/getcall, reply/getreply, raise/catch
- if-then-else, loops: for, while, do-while, functions, alternatives
- component/port/timer control

Predefined functions:

type conversion, lengthof (string), sizeof (records), …

Overview: e.g. TTCN-3 Quick Reference Card


TTCN-3 Quick Reference Card

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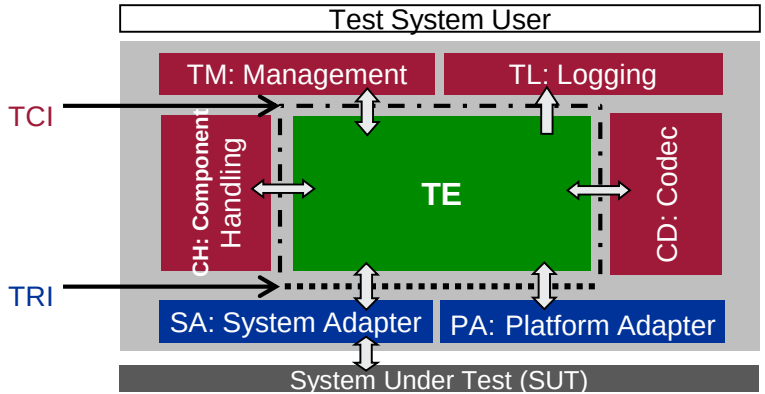
Contents

Document overview:

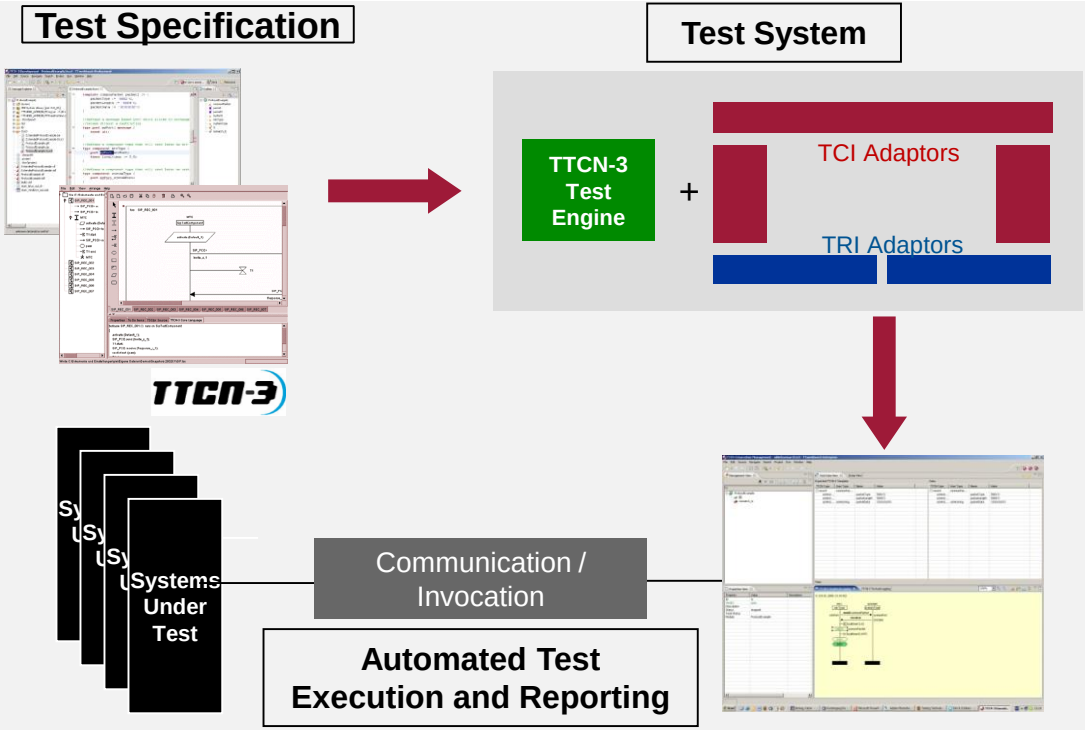
A TTCN-3 TEST SYSTEM



ETSI ES 201 873-1		TTCN-3 Core Language (CL)
ETSI ES 201 873-5		TTCN-3 Runtime Interface (TRI)
ETSI ES 201 873-6		TTCN-3 Control Interfaces (TCI)

TE	–	TTCN-3 Executable
TM	–	Test Management
TL	–	Test Logging
CD	–	Codec
CH	–	Component Handling
SA	–	System Adapter
PA	–	Platform Adapter
SUT	–	System Under Test

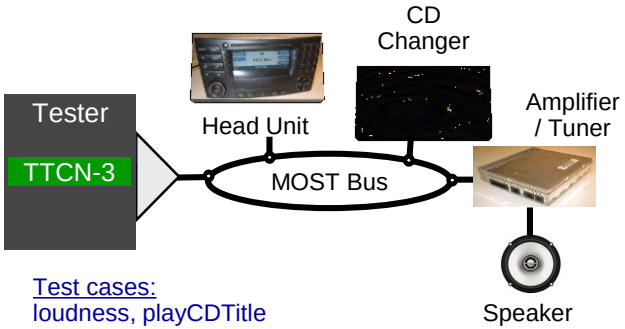
IMPLEMENTATION



TTCN-3 FOR MULTIPLE PURPOSES

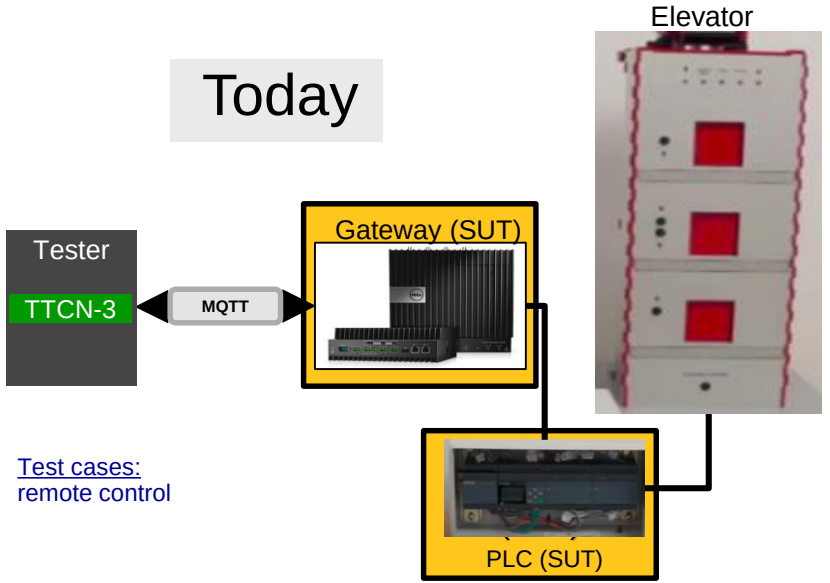
- Test technology address **various protocols** and **interfaces**
- Control of ***real*** and/or ***virtual*** **devices**
  (special hardware-interfaces, simulators)

Earlier days



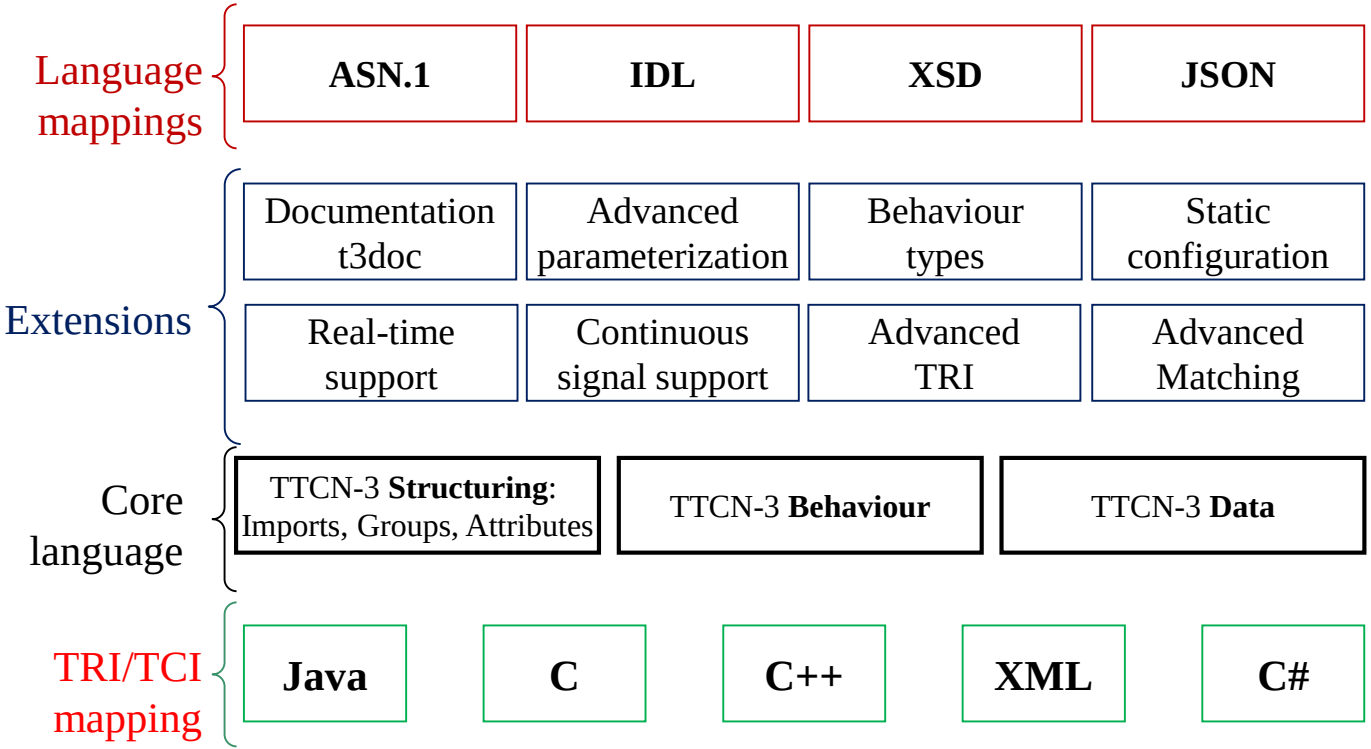
Test cases:
loudness, playCDTitle

Today



Test cases:
remote control

TTCN-3 STANDARDS OVERVIEW



COMMERCIAL TTCN-3 TOOLS (SOURCE: WWW.TTCN-3.ORG)

TTCN-3 Compilers and Interpreters

- **Exhaustif/TTCN**: compiler (C++) produced by Métodos y Tecnología (MTP), Spain.
- **OpenTTCN:** interpreter (C, Java, C# interfaces) produced by OpenTTCN Ltd, Finland.
- **MessageMagic:** compiler (C/C++, Java, C#) produced by ELVIOR, Estonia.
- **Real Time Developer Studio**: modelling tool including TTCN-3 compiler by PragmaDev, France.
- **TAU Tester:** compiler (C) by IBM.
- **TTCN-3 toolbox**: compiler (C) by Devoteam, Germany.
- **TTCN-3 Express**: compiler (C#) by Fraunhofer FIRST and Metarga GmbH, Germany.
- **TTworkbench**: compiler (C, Java) by Spirent, USA/Germany.

TTCN-3 Generators

- **Qtronic** by Conformiq OY, Finland. generate complete TTCN-3 test suites from e.g., UML, Java, or C# models.
- **MaTeLo** by All4Tec, France (TTCN-3 test suites from usage models specified using Markov chains).
- **MOTES** by ELVIOR, Estonia (from the state model of the SUT)

OPEN SOURCE TTCN-3 TOOLS (SOURCE: WWW.TTCN-3.ORG)

- **LoongTesting** testing platform including TTCN-3 **compiler** and **integrated development environment** by Information Processing Center of USTC, China.
- **BBT** TTCN-3 **Compiler**, by BroadBit, Hungary.
- **TRex:** by University of Göttingen to provide **IDE** functionality for TTCN-3 core notation, and to support assessment and automatic restructuring of TTCN-3 test suites. (open-source Eclipse plug-in).
- **T3doc** by Federico Engler and further developed by ETSI. for generating HTML **documentation** via tagged TTCN-3 comments.
- **Codec generator** by IRISA as part of T3DevKit. It automatically **generates a codec** based on TTCN-3 type module(s), C++ codec functions.
- **T3DevLib** by IRISA as part of T3DevKit. It allows the development or **integration of Codec, SUT and Platform Adapter** implementations written in C++.
- **NEW TITAN** by Ericsson: **https://projects.eclipse.org/projects/tools.titan !**

... and more academic prototype/research tools
(guideline checking, quality analysis, ...)

APPLICATION DOMAINS

What else?

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TTCN-3 DOMAINS: TELECOM

- ✓ **Industrial use**
  - Big companies with hundreds of TTCN-3 engineers: Ericsson, Nokia, Siemens, Motorola
  - large distribution among SME
- ✓ **Standardization bodies**
  - standardized test suites:
    ETSI / 3GPP (**LTE**!)/ OMA / TETRA / oneM2M / ***5G*** *(in preparation)*
  - IMS performance benchmark project:
    Intel, HP, BT, FOKUS and others
- ✓ **Test tool manufacturer**
  - Commercial Tektronix, Catapult, Nexus, R&S, Spirent, …

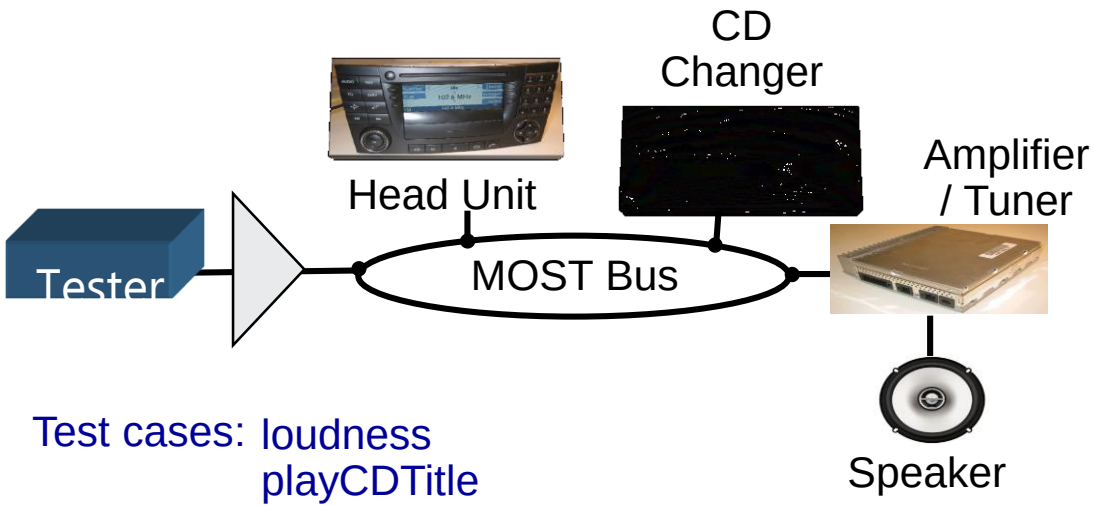
- ✓ **Certification programs** based on TTCN-3: e.g. WiMax forum, **oneM2M**

TTCN-3 DOMAINS: AUTOMOTIVE

- ✓ **Car communication systems**
  - – Daimler, Volkswagen, SiemensVDO
  - – edutainment bus system (test suite)
- ✓ **Standardization groups**
  - – AUTOSAR consortium
  - – MOST cooperation
- ✓ Car-to-car communication

Telematics Applications in the Cockpit

- Audio (CD / Radio), Video
- Telephone, SMS
- Navigation
- Speech recognition
- User interface for body electronic



Test cases: loudness
playCDTitle

TTCN-3 DOMAINS: MEDICINE

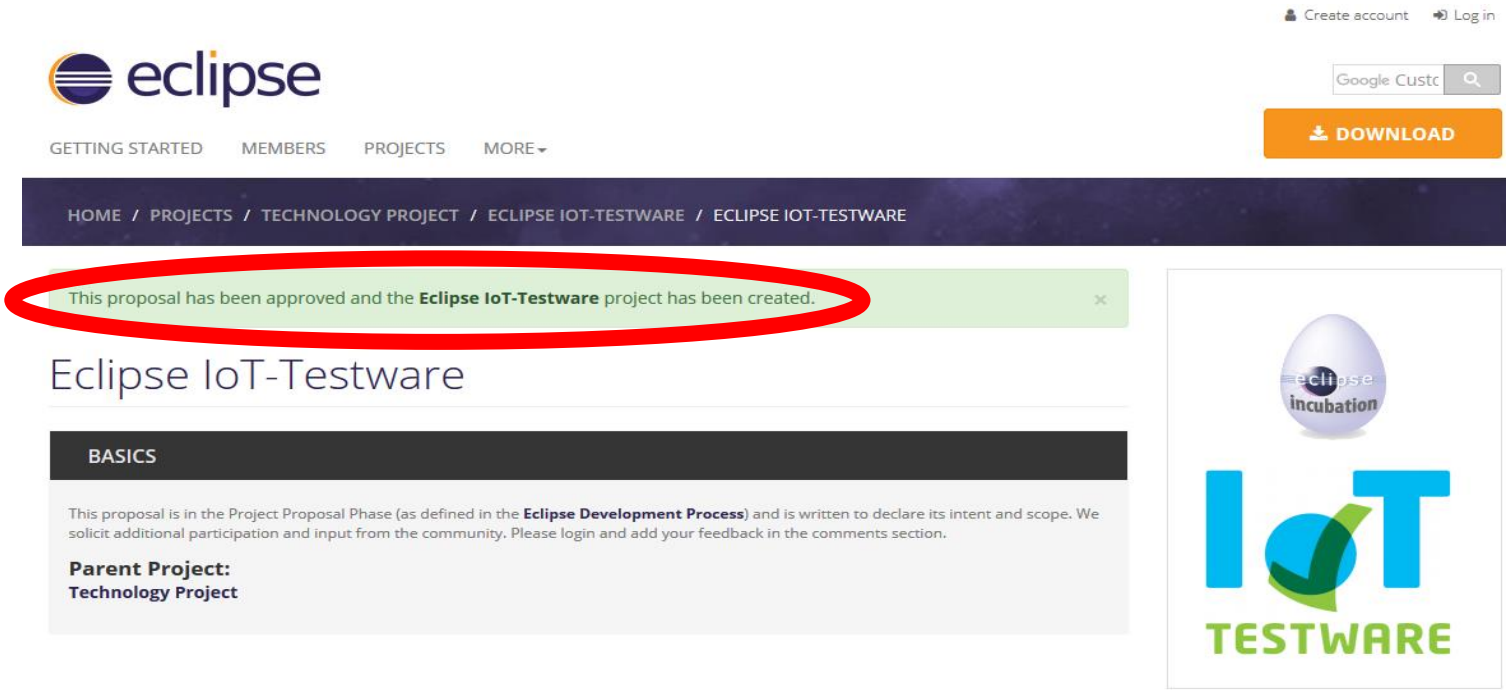
Medicine

- SiemensMED (image processing)
- HL7 eHealth protocols (Interoperability)

<u>Upcoming E-Health infrastructure for Germany</u>

- High security requirements
  (e.g. certificates, cryptography)
- Multiple heterogenous interfaces:
  - cardterminals, card simulations,
  - Webservices, OCSP server etc.

IOT-TESTWARE



THE TEST EXECUTION TOOL

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Eclipse Titan

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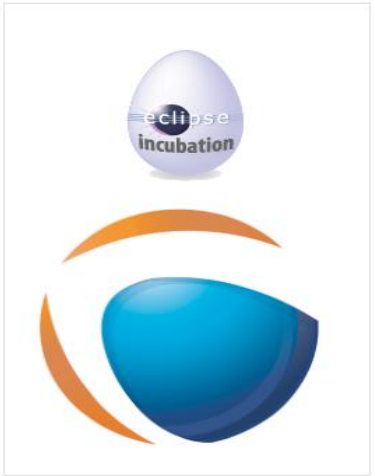
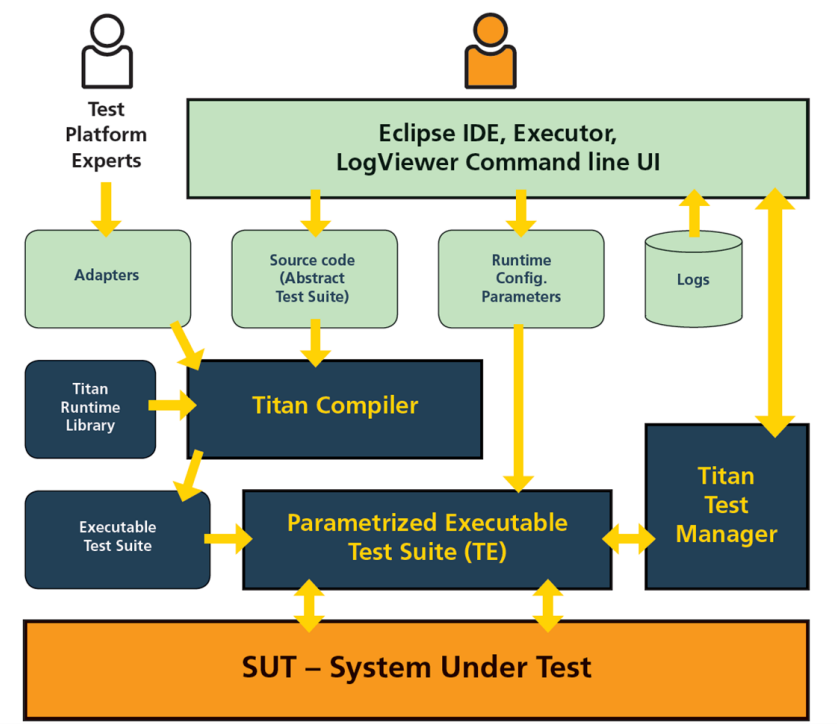
Titan is a TTCN-3 compilation and execution environment with an Eclipse-based IDE.
TTCN-3 is a modular language specifically designed for testing (the acronym itself stands for Test and Test Conformance Notation), standardized by ETSI (see **www.ttcn-3.org**) and endorsed by ITU.
The user of the tool can develop test cases, test execution logic and build the executable test suite for several platforms.
Titan consists of a core part, executing in a Unix/Linux-like environment and a set of Eclipse plug-ins.

Titan



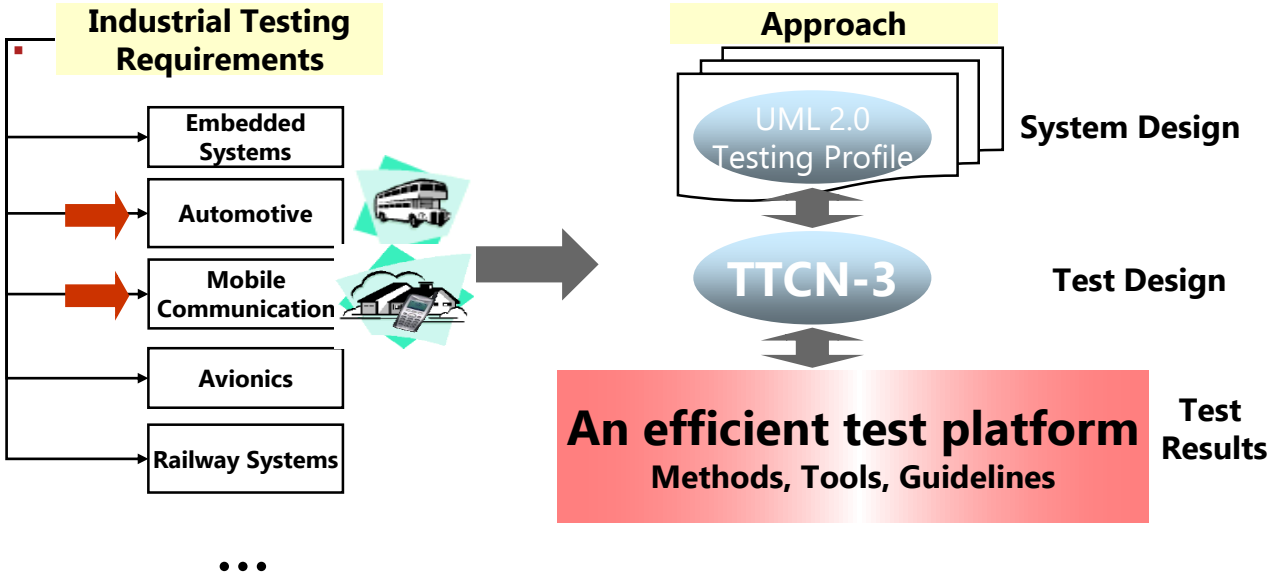
ECLIPSE TITAN PROJECT



TTCN-3 LINK TO MBT

Objective:

- To develop an efficient **test platform** fulfilling **industrial testing requirements**
- To **execute high-level test models**, e.g. UML testing profile



SUMMARY AND OUTLOOK

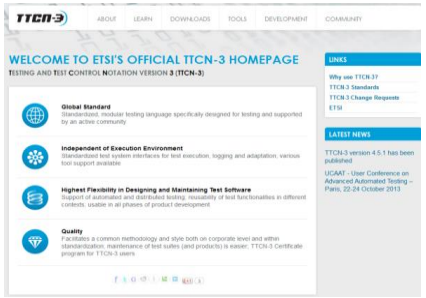
GOOD REASONS FOR STANDARDIZED TEST LANGUAGES

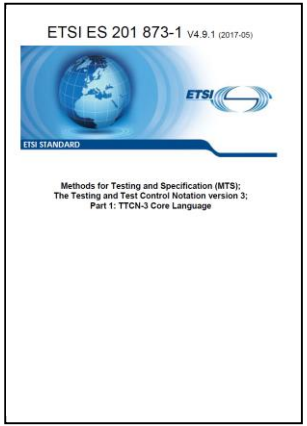
- They significantly increases your **system quality**.
- You can **focus on what** to test, not on how.
- They reduce costs and efforts in test system **maintenance**.
- They are **independent** of access technology, operating system and implementation domain.

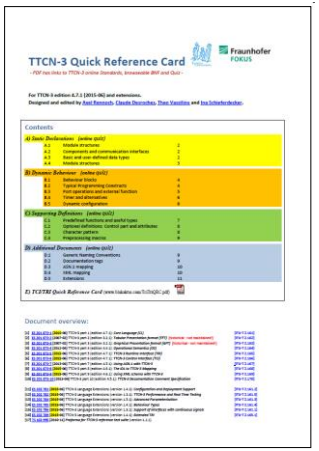
- They support **communication** between system development and test department.
- You can count on available, trained and **certified experts**

TTCN-3 SOURCES

- Online information
  → www.ttcn-3.org
- TTCN-3 User Conference
  → 2018 in Paris, France
- TTCN-3 Standards, Papers, Book
  → http://www.ttcn.de/
- Quick Reference
  → http://www.blukaktus.com/
- Exercises and Tooling
  → research licenses







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CONTACTS

Thank you for your attention!

https://www.fokus.fraunhofer.de/sqc

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