Fraunhofer Institute for Open Communication Systems

Competence Center
Modelling and Testing

An Overview on TTCN-3

Ina Schieferdecker
Technical University Berlin/Fraunhofer FOKUS
Tel.: +49 30 3463 7241, Email: schieferdecker@fokus.fraunhofer.de

Outline

- Overview
- Main Concepts
- TTCN-3 in a Nutshell
- TTCN-3 based test systems
- An Example: IMS Benchmarking
- Summary

Outline

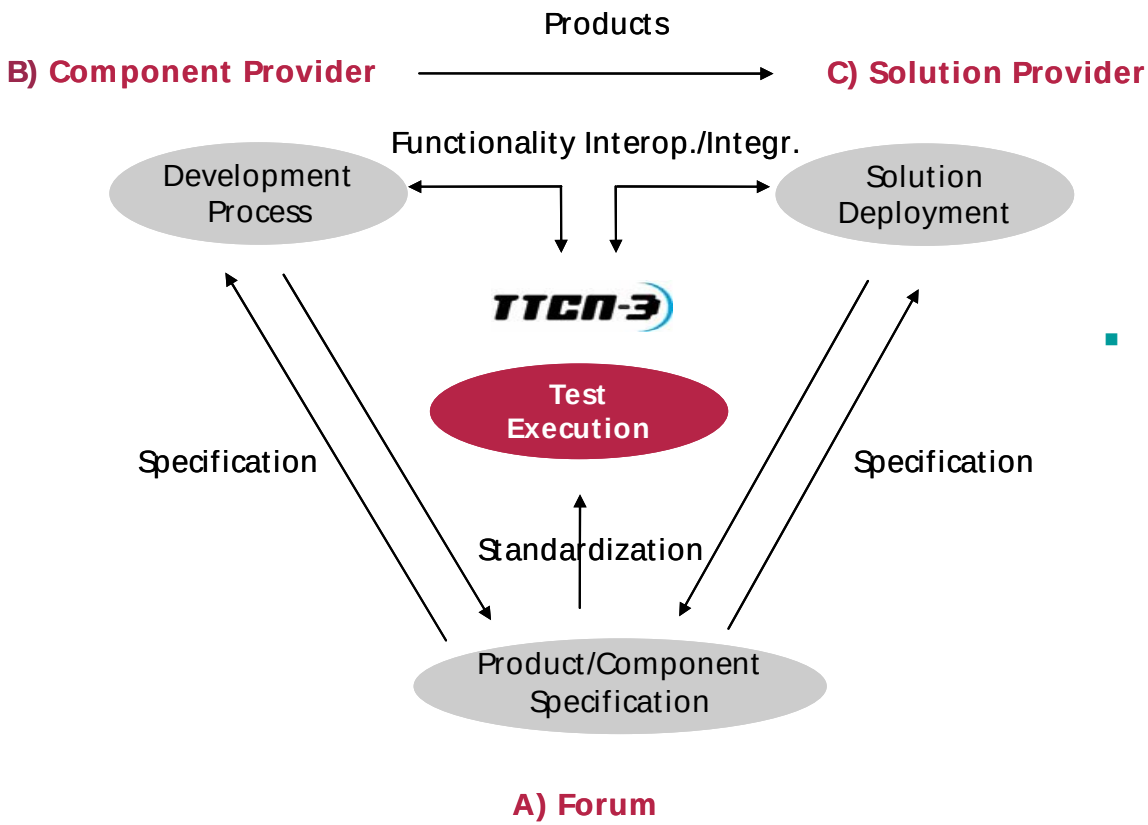
- Overview
- Main Concepts
- TTCN-3 in a Nutshell
- TTCN-3 based test systems
- An Example: IMS Benchmarking
- Summary

- The Testing and Test Control Notation
- A standardized alternative to proprietary test systems
  - Developed by a large group of testing experts
  - Used by a growing community
  - Proven by tools
  - Maintained at ETSI
- A test specification and implementation language
- A multipart standard covering
  - textual TTCN-3 core
  - graphical TTCN-3
  - execution interfaces TRI and TCI
  - language mappings to TTCN-3, e.g. for IDL

- Areas of Testing
  - Regression Testing
  - Conformance and Functionality Testing
  - Interoperability and Integration Testing
  - Load/ Stress Testing
- Applications
  - Mobile communications (GSM, GPRS, UMTS, TETRA)
  - Wireless LANs and MANs (Hiperlan, Hiperaccess), cordless phones (DECT)
  - Broadband technologies (B-ISDN, ATM)
  - Internet protocols (IPv6, SIP, Voice over IP)
  - Middleware platforms (CORBA, CCM, EJB, Web services)
  - Smart Card Testing, MOST, CAN, Powertrain

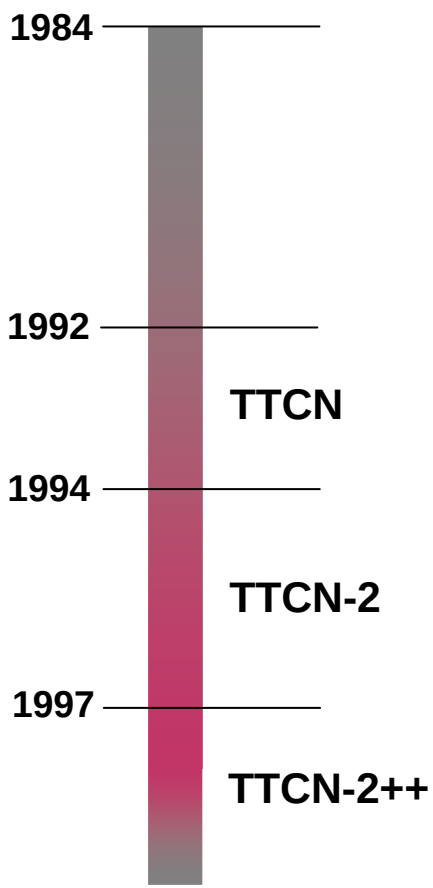
Placement of TTCN-3

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



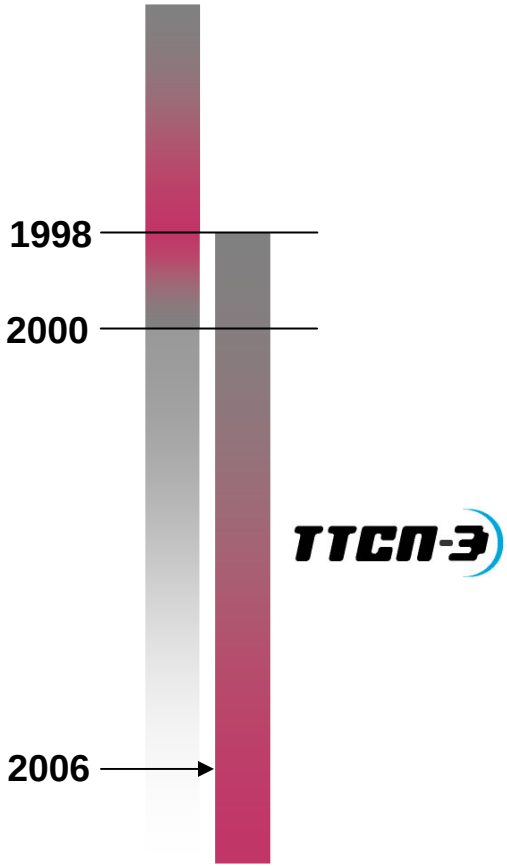
- The testing middleware
  - unifying the documentation and definition of tests
  - unifying the tests in IT, Internet- and Telco-based systems (supporting their convergence)
  - unifying the test infrastructure

History (1)



- TTCN (1992)
  - Published as an ISO standard
  - Tree and Tabular Combined Notation
  - Used for protocol testing (GSM, N-ISDN, B-ISDN)
- TTCN-2/2++ (1997)
  - Written by TC MTS
  - Published by ISO
  - Concurrent tests
  - Modularization
  - Manipulate external data
  - Rather for conformance testing

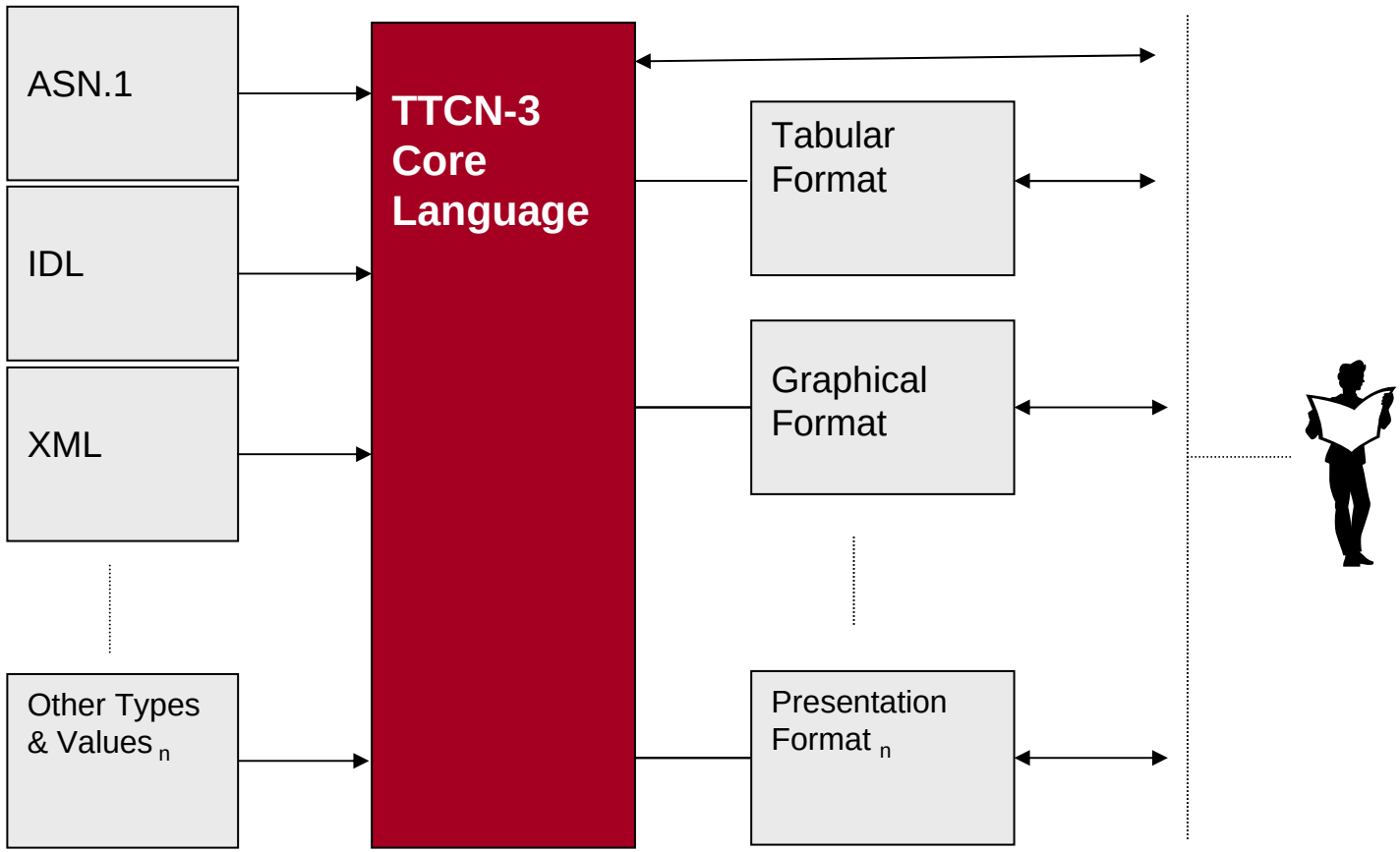
History (2)



- TTCN-3 (2000)
  - Testing and Test Control Notation
  - Written by TC MTS
  - Published by ETSI and ITU
  - Proper language
    (well defined syntax and semantics)
  - Enhanced communication, configuration and control
  - Standard test specification
    (SIP, SCTP, HiperLan, HiperAccess, IPv6 etc.)
- TTCN-3 (2006): version 3

→ Ongoing maintenance for change requests and extension proposals

TTCN-3 Definition



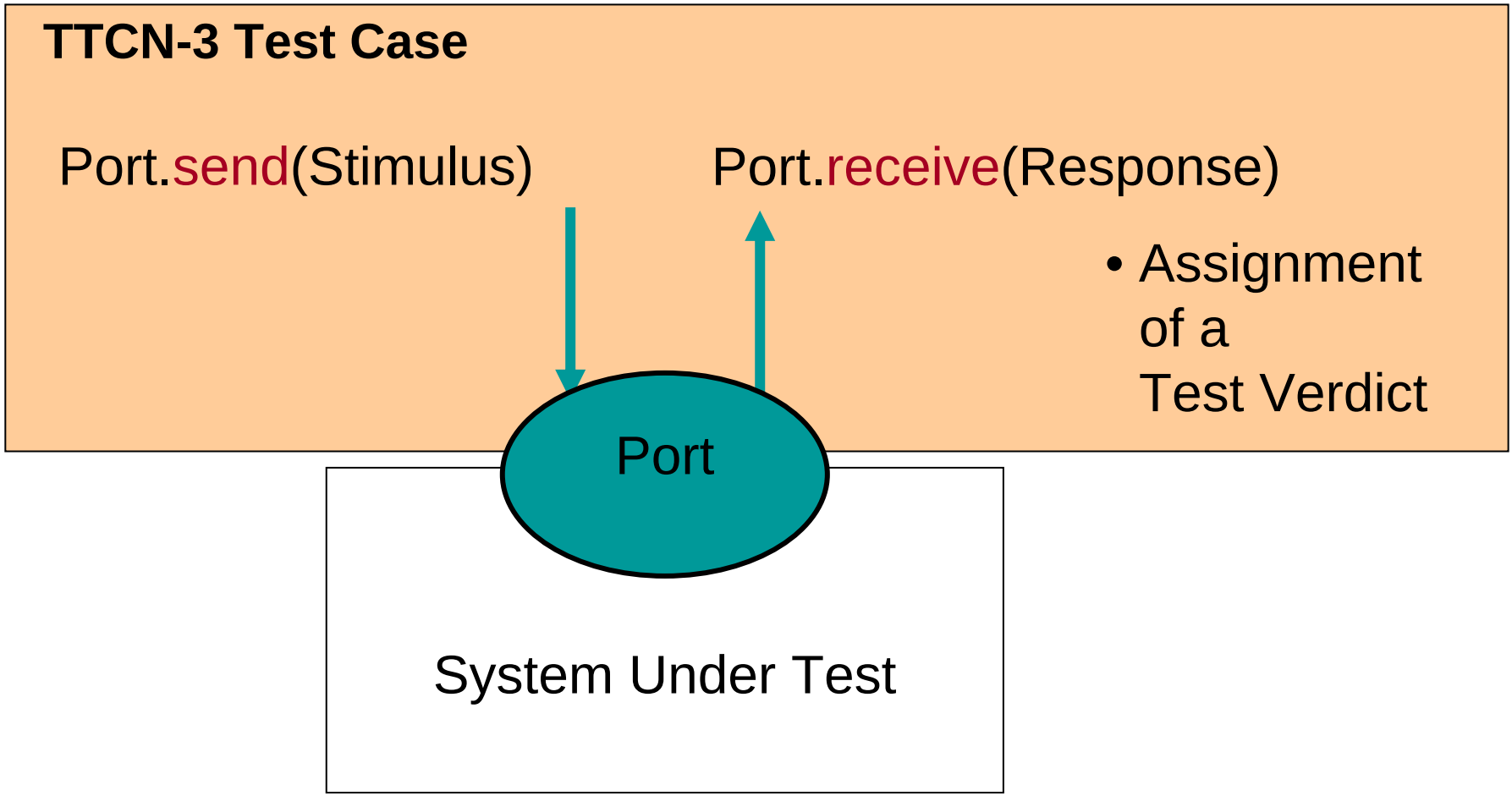
TTCN-3 Standards

- ETSI ES 201 873-1 TTCN-3 Core Language (CL)
- ETSI ES 201 873-2 TTCN-3 Tabular Presentation Format (TFT)
- ETSI ES 201 873-3 TTCN-3 Graphical Presentation Format (GFT)
- ETSI ES 201 873-4 TTCN-3 Semantics
- ETSI ES 201 873-5 TTCN-3 Runtime Interfaces (TRI)
- ETSI ES 201 873-6 TTCN-3 Control Interfaces (TCI)
- *ETSI ES 201 873-7 ASN.1 to TTCN-3 Mapping*
- ETSI ES 201 873-8 IDL to TTCN-3 Mapping
- *ETSI ES 201 873-9 XML Schema to TTCN-3 Mapping*
- *ETSI ES 201 873-10 TTCN-3 Documentation*

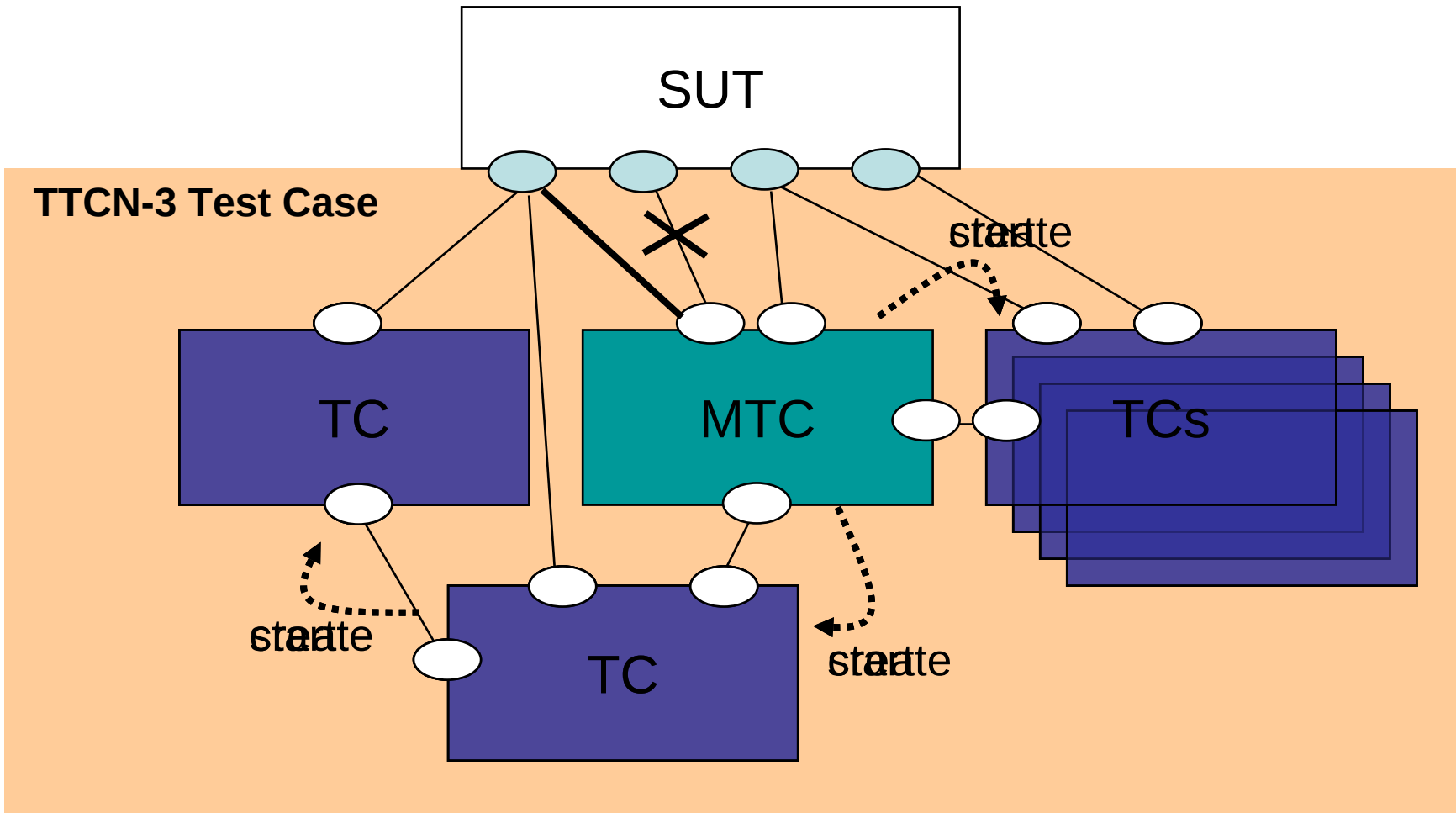
Outline

- Overview
- Main Concepts
- TTCN-3 in a Nutshell
- TTCN-3 based test systems
- An Example: IMS Benchmarking
- Summary

TTCN-3 – Based Black-Box Testing

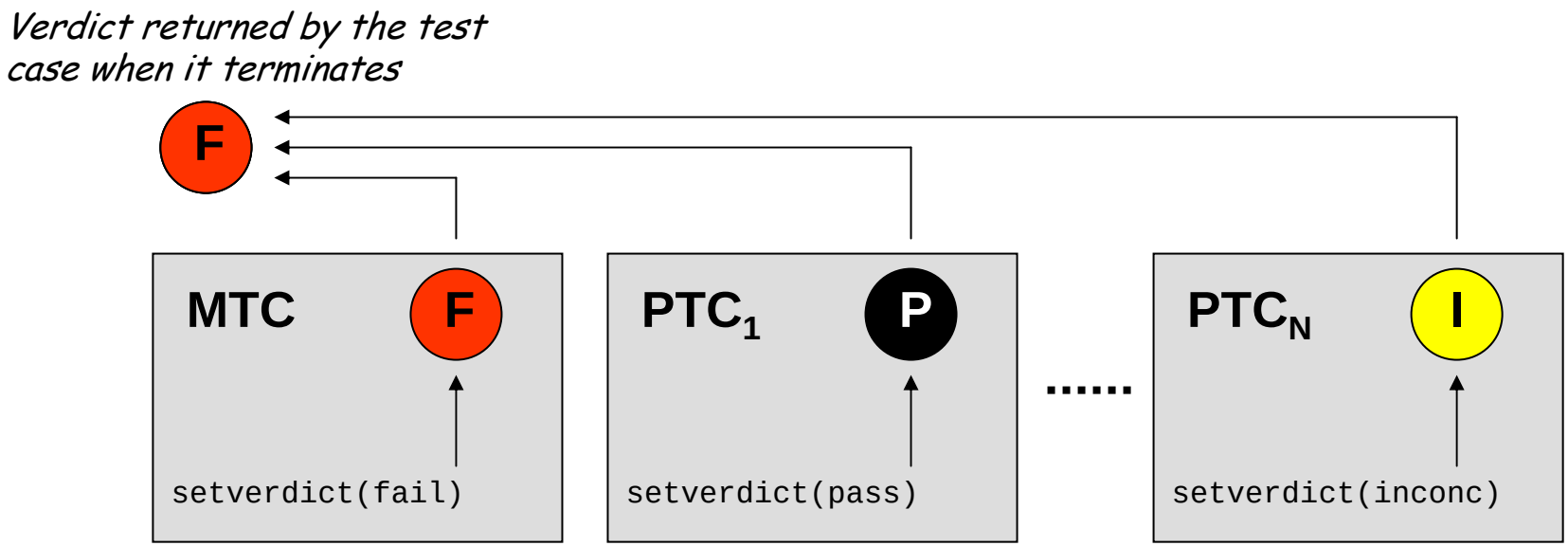


TTCN-3 – Test Configuration

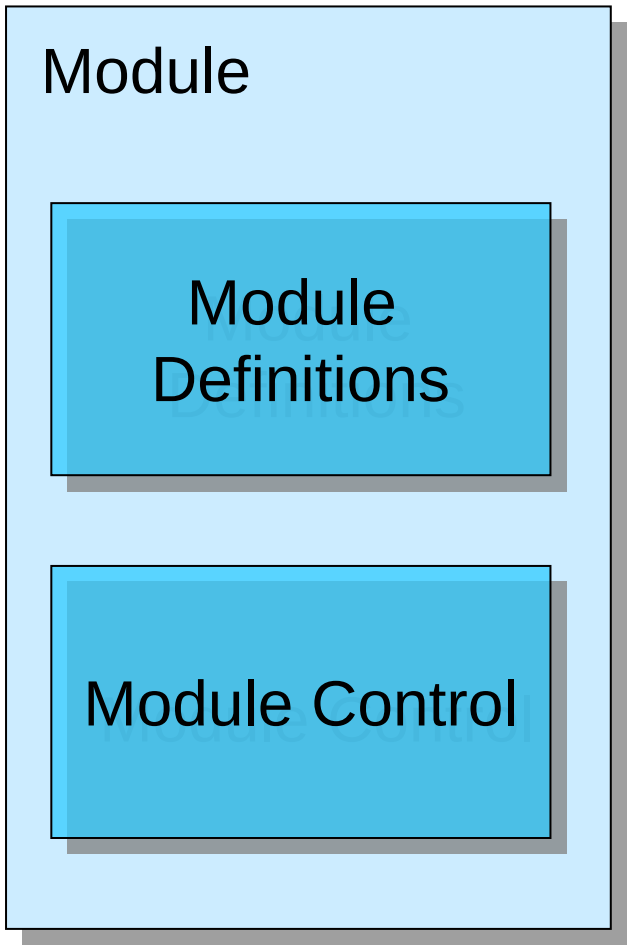


TTCN-3 – Test Verdicts

- Test verdicts: none < pass < inconc < fail < error
- Each test component has its own local verdict, which can be set (setverdict) and read (getverdict).
- A test case returns a global verdict



TTCN-3 Module

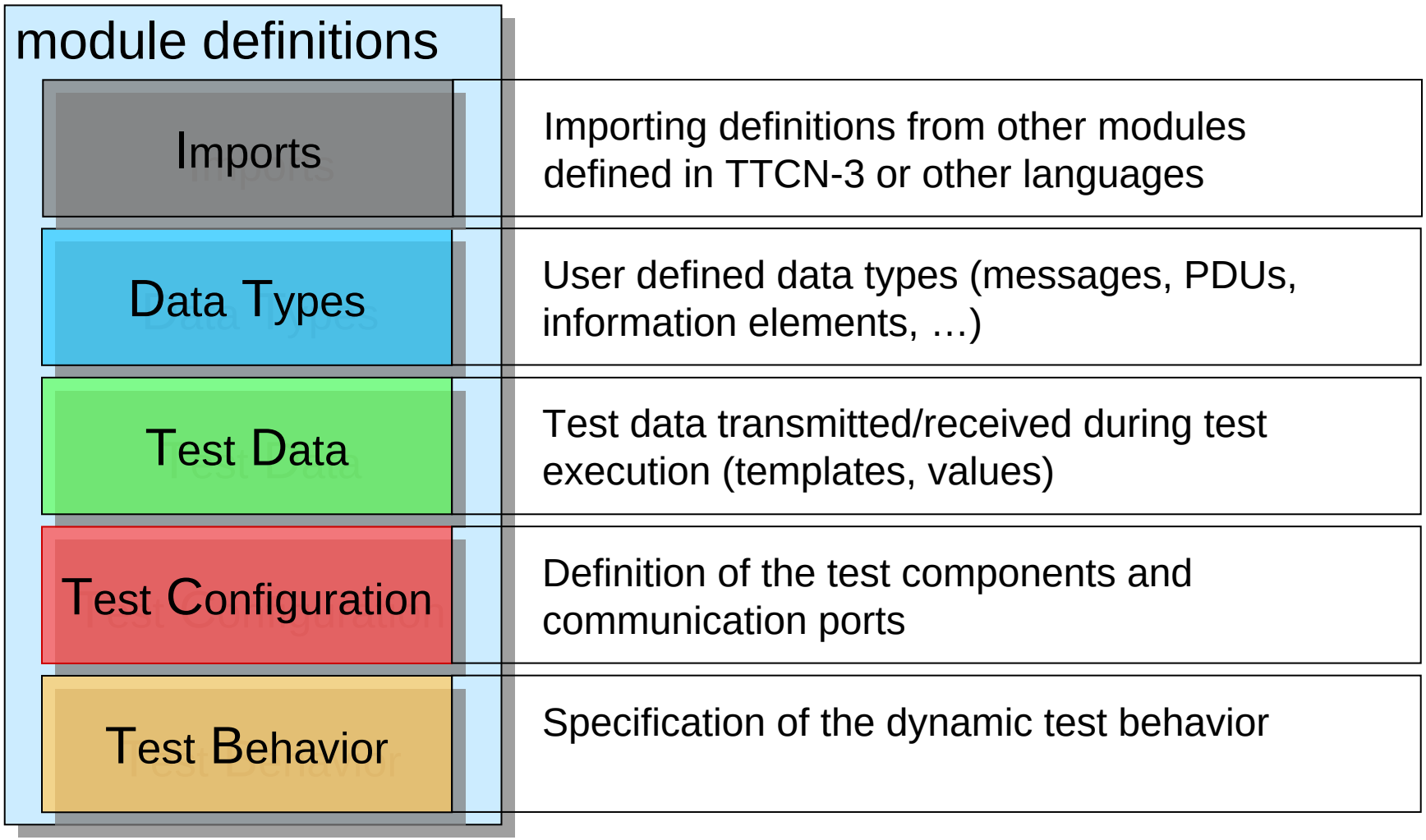


- The top level entity of TTCN-3 is module.
- A module can import definitions from other modules.
- A module contains a definition part and a control part.

```
module MyModule {
   // definition part

   control {
   // test execution logic
   }
}
```

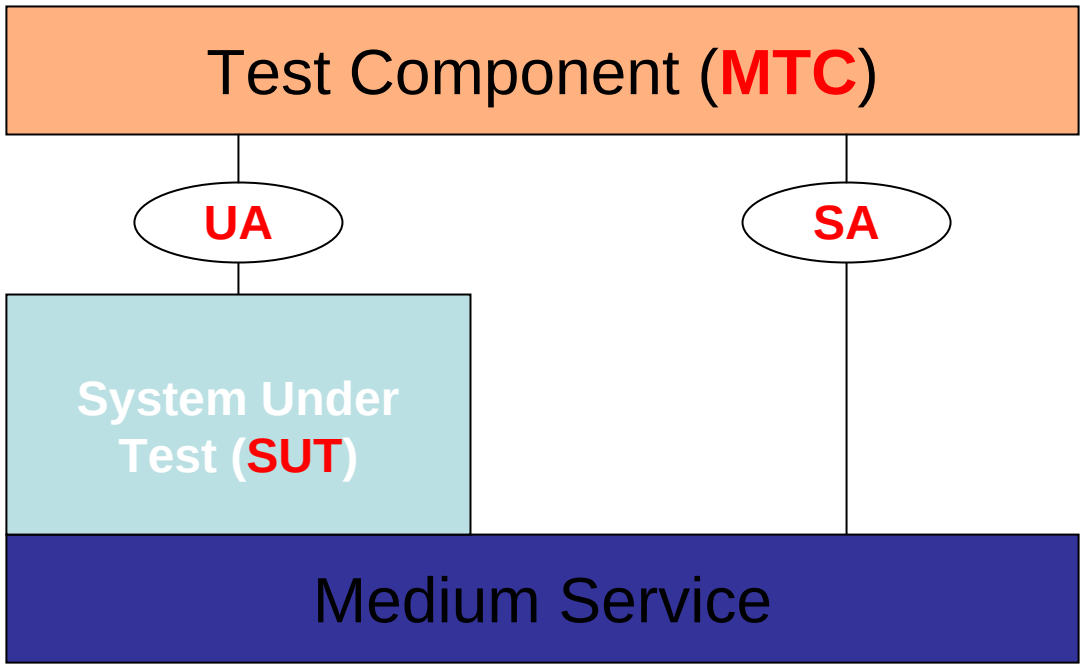
Major elements of TTCN-3



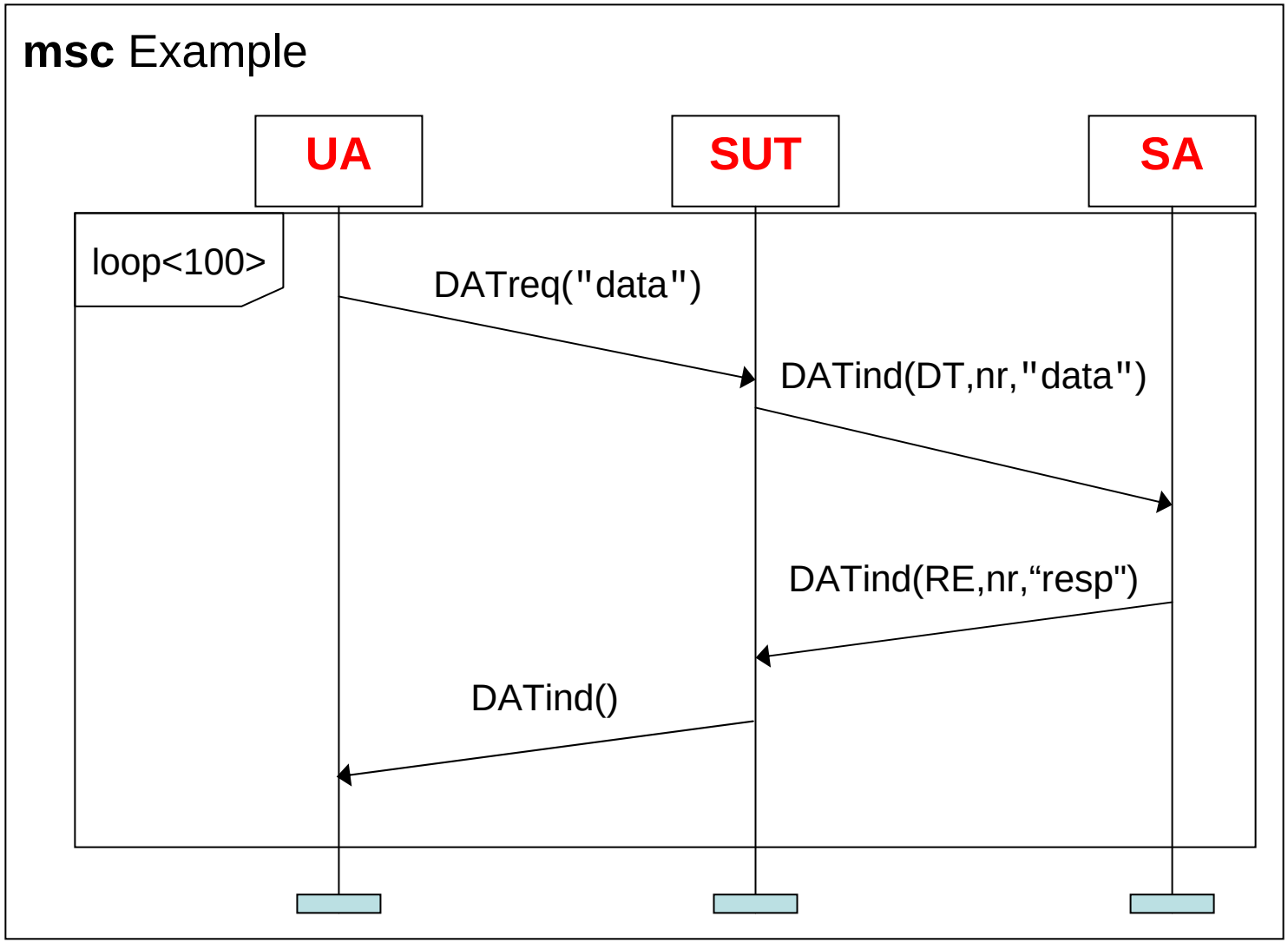
Outline

- Overview
- Main Concepts
- TTCN-3 in a Nutshell
- TTCN-3 based test systems
- An Example: IMS Benchmarking
- Summary

Example: Test Configuration



Example: Test Behavior

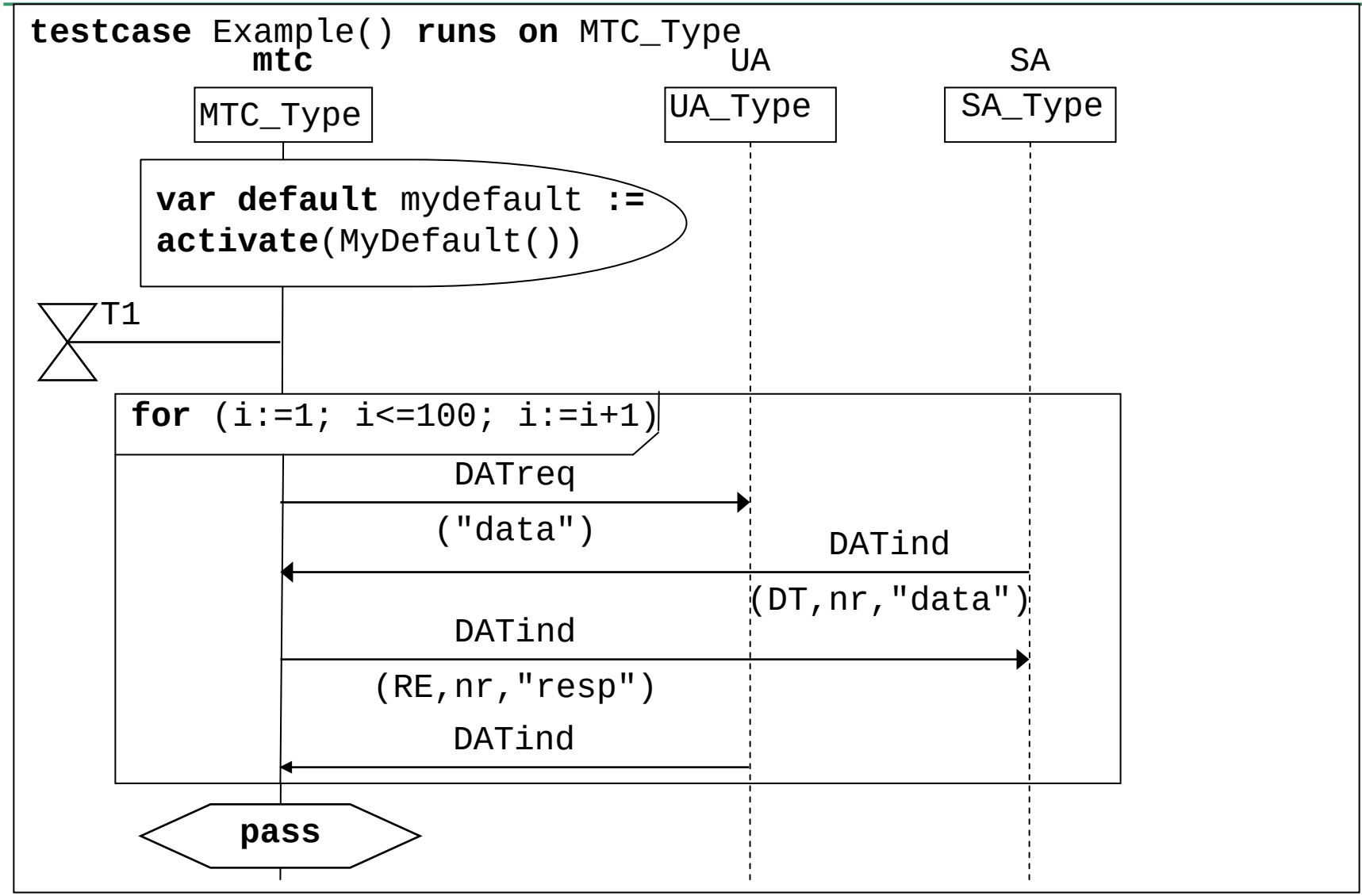


TTCN-3 Test Case Example

```
testcase Example( )        runs on MTC_Type {

        var default mydefault := activate (DefaultDef());
        T1.start;
        for (integer i:=1; i<=100; i:=i+1) {
                UA.send(DATreq:{"data"});
                SA.receive(DATind:{DT, nr, "data"});
                SA.send(DATind:{RE,nr, “resp”});
                UA.receive(DATind :{});
        }
        setverdict(pass);
        T1.stop;
}
```

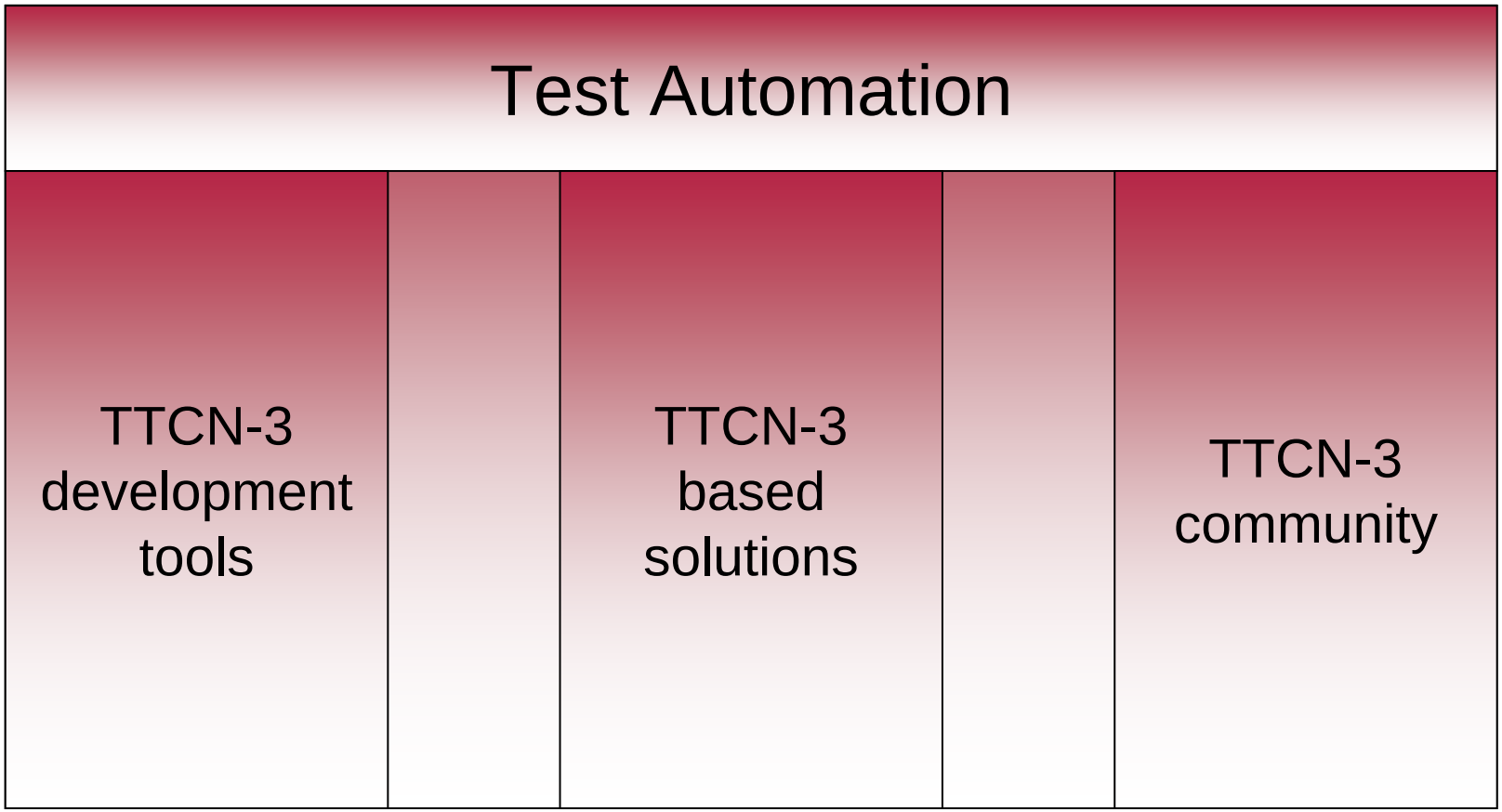
The same graphically



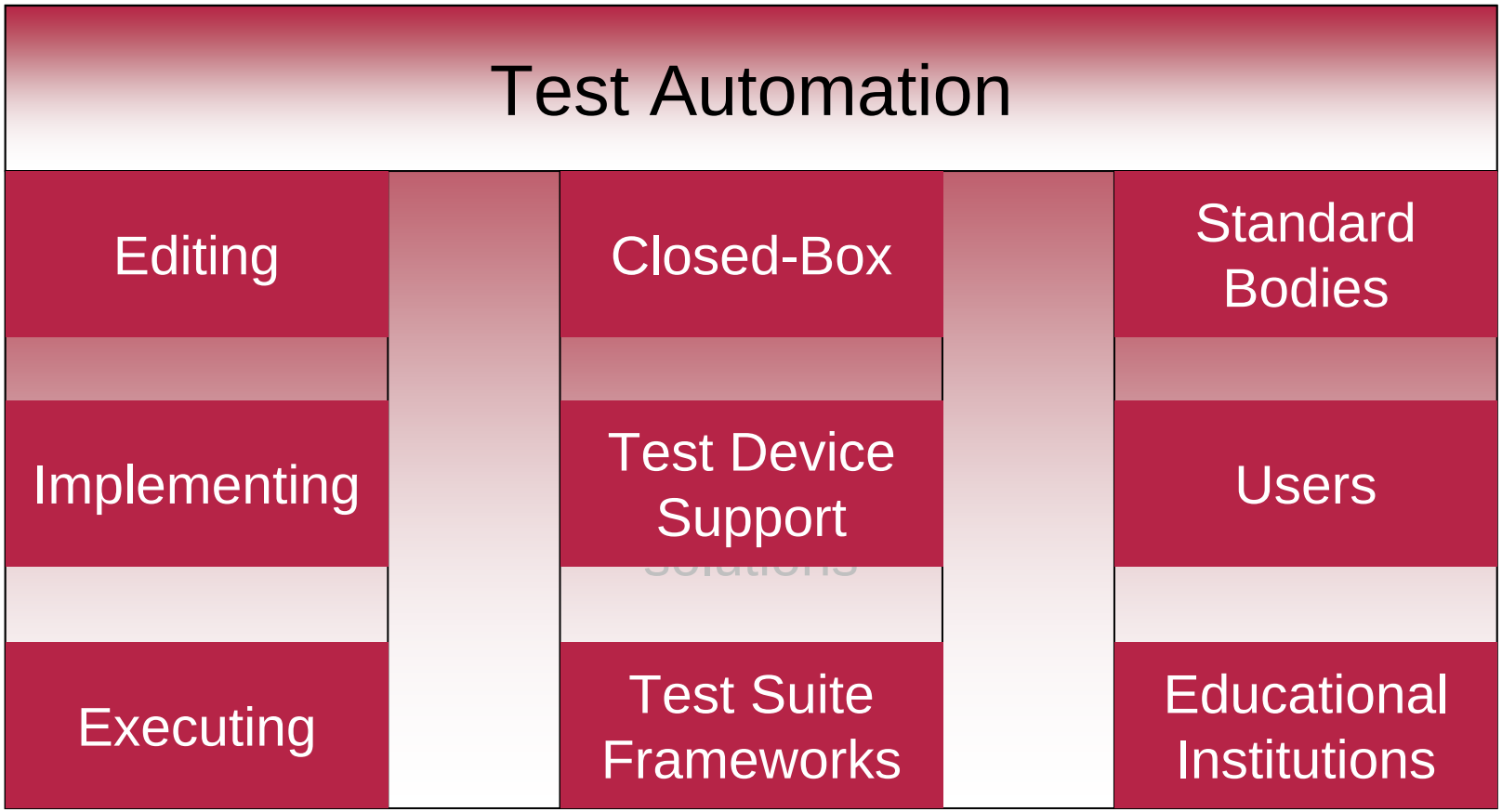
Outline

- Overview
- Main Concepts
- TTCN-3 in a Nutshell
- TTCN-3 based test systems
- An Example: IMS Benchmarking
- Summary

Aspects of TTCN-3 Tooling

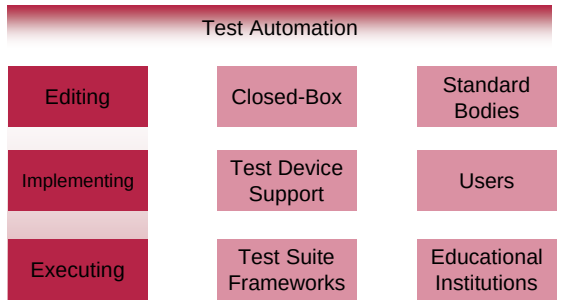


Aspects of TTCN-3 Tooling



TTCN-3 Development Tools

The Foundation



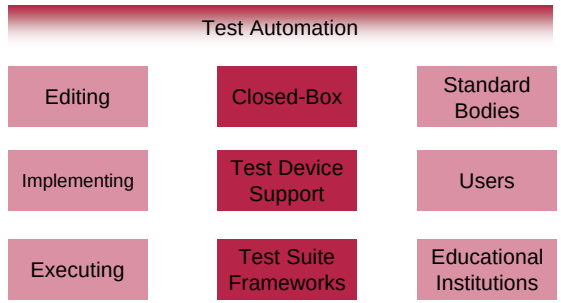
- Editing
  - Textual
  - Graphical
  - Tabular
- Implementing
  - Compilers / Interpreters
  - Standardized Implementation Interfaces (TRI / TCI)
  - Multiple Platform Support (Java / C / C++)
- Executing
  - Interactive: Graphical user interfaces
  - Fully automated: Command line user interfaces
  - Distributed: Distributed execution environments

- Recently, test generation tools towards TTCN-3

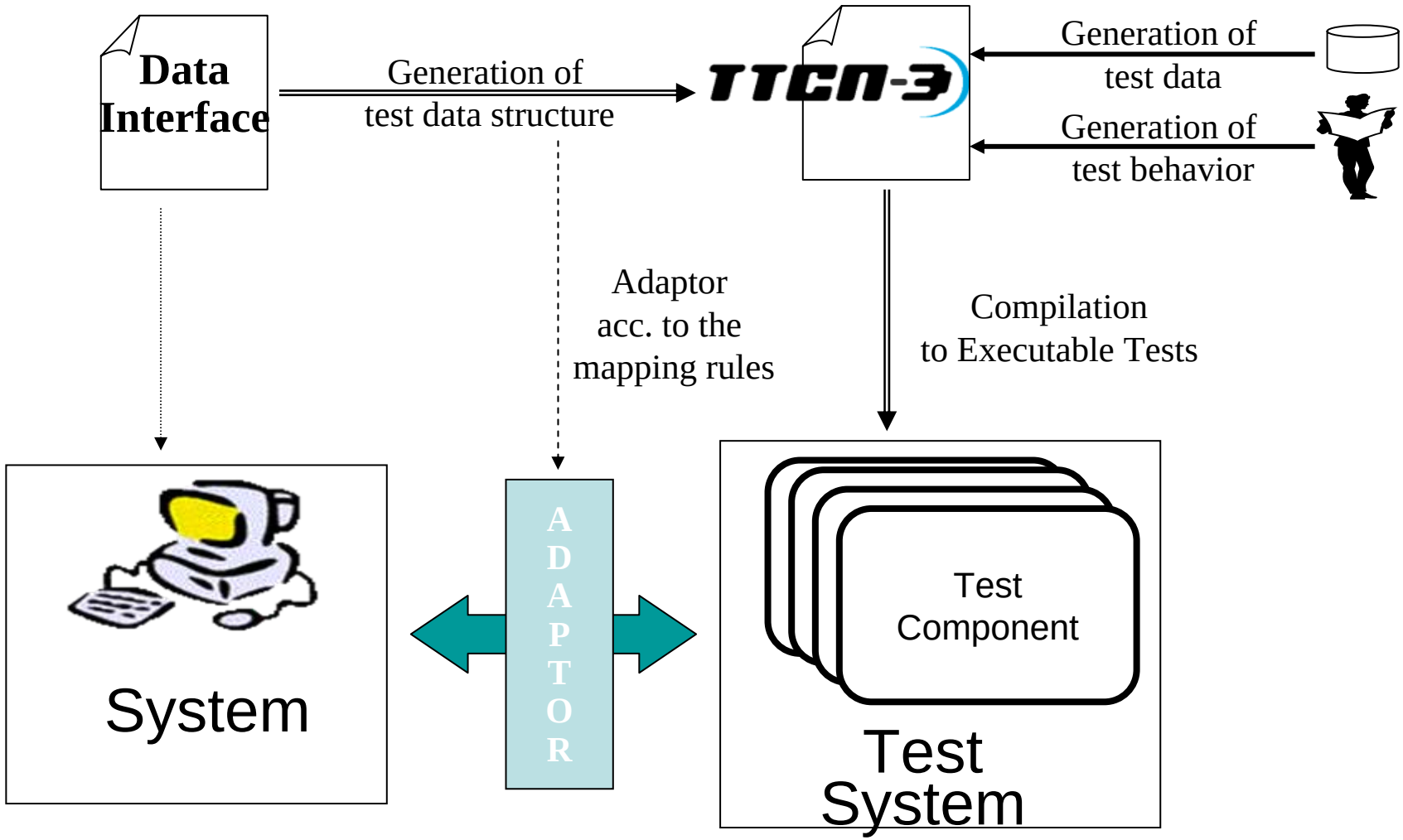
TTCN-3 Solutions

The Nuts and Bolts

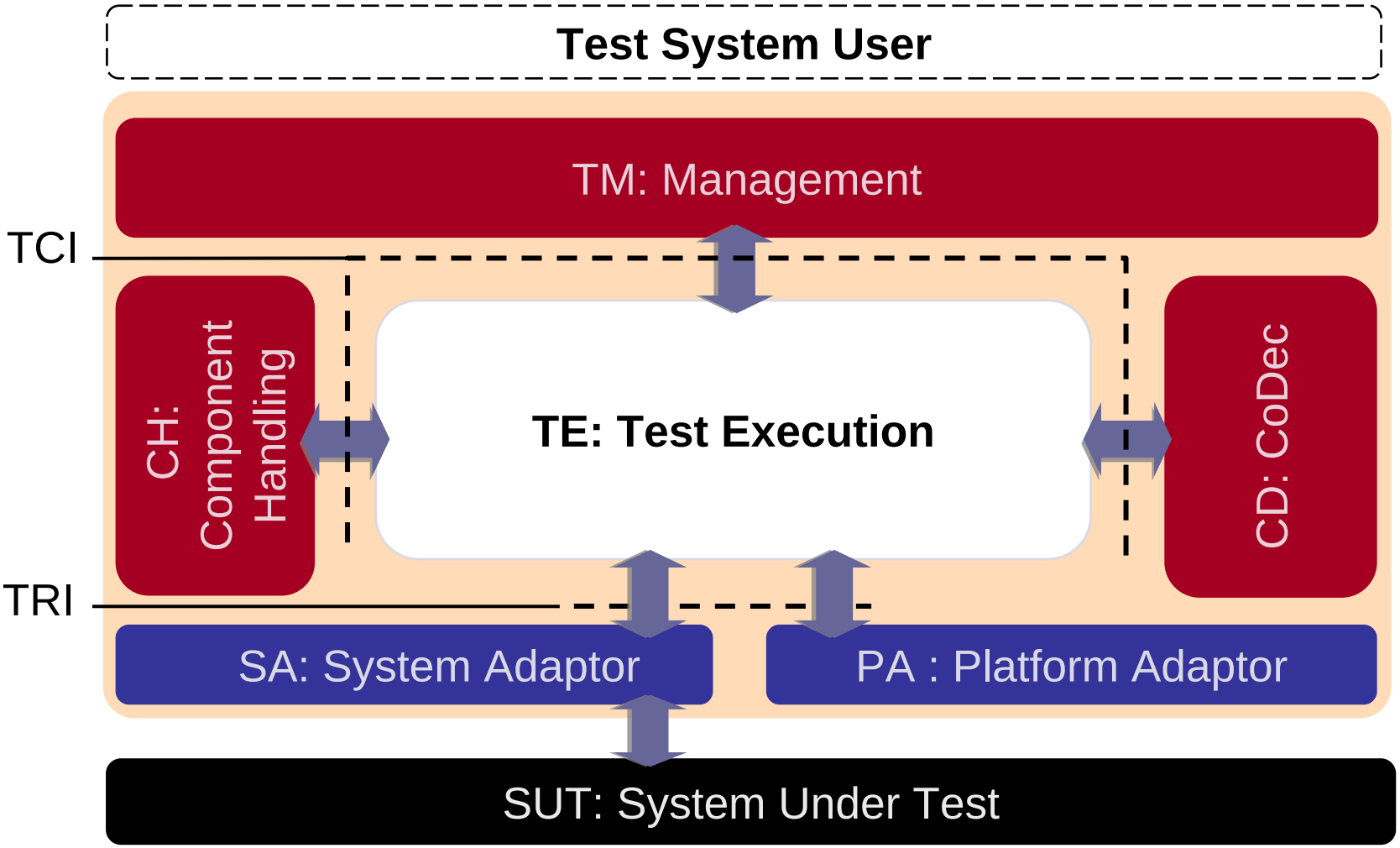
- Closed-Box Solutions
  - Ready-to-Run
  - Optimized application
    - Conformance test scenario
- Test Device Support
  - Test scripting language
  - Multiple interface support
    - User defined test scenarios
- Test Suite Frameworks
  - Ready-to-Run
  - Modifiable and extensible
    - Combining compliance and development tests



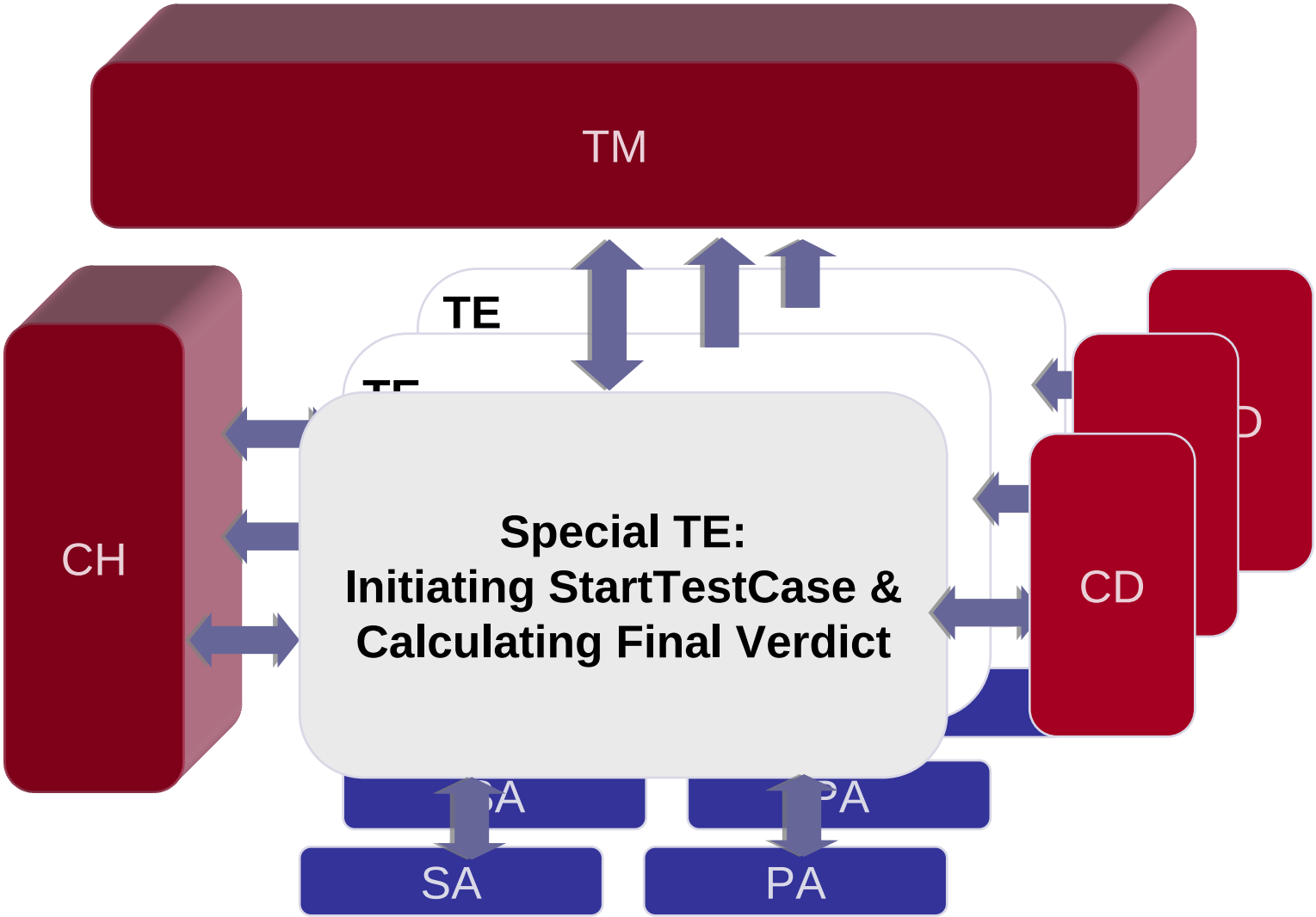
Overall Picture



The Execution Interfaces

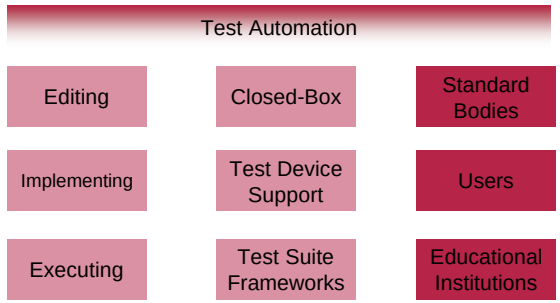


Local and distributed test setups



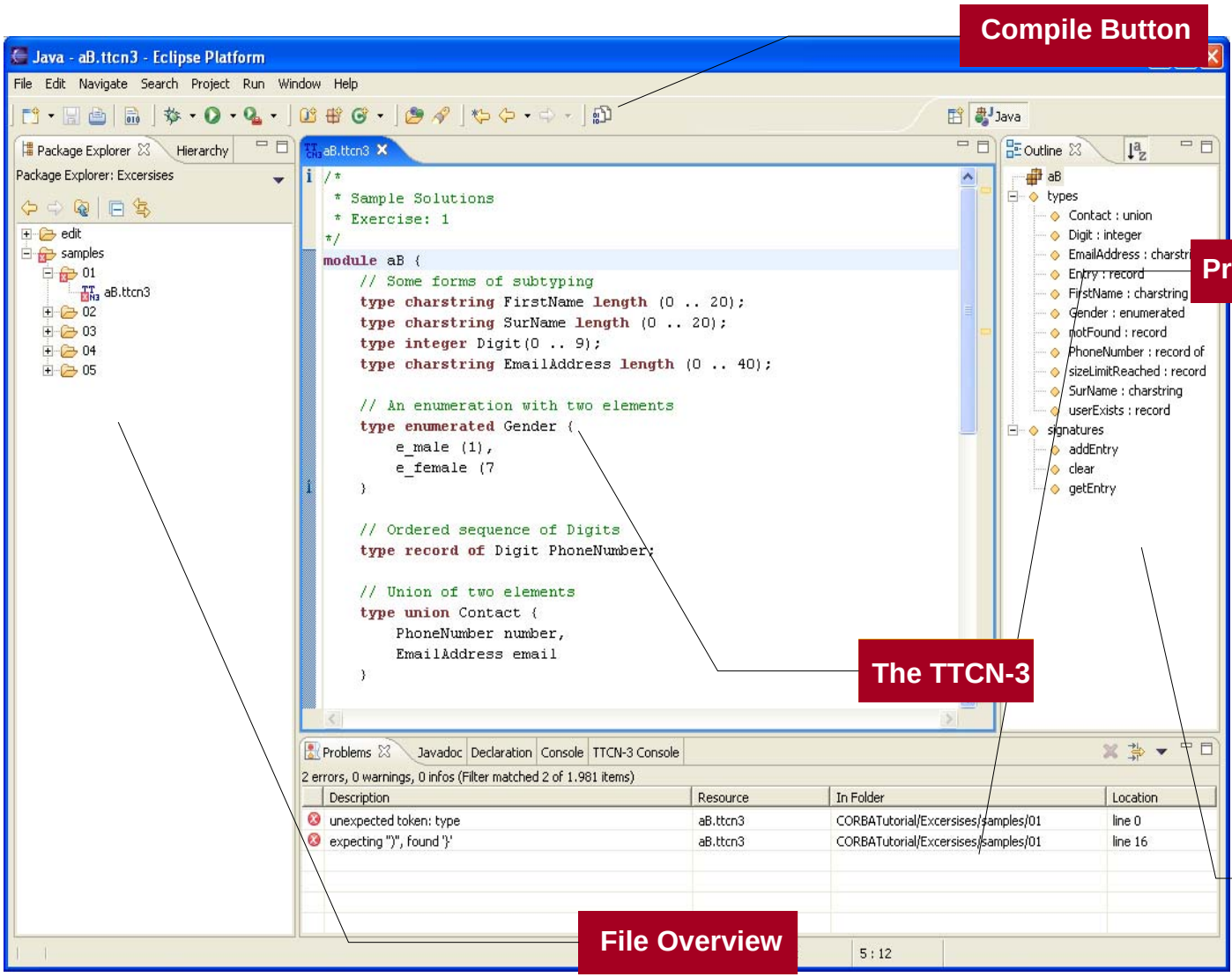
TTCN-3 Community

Resources and Users

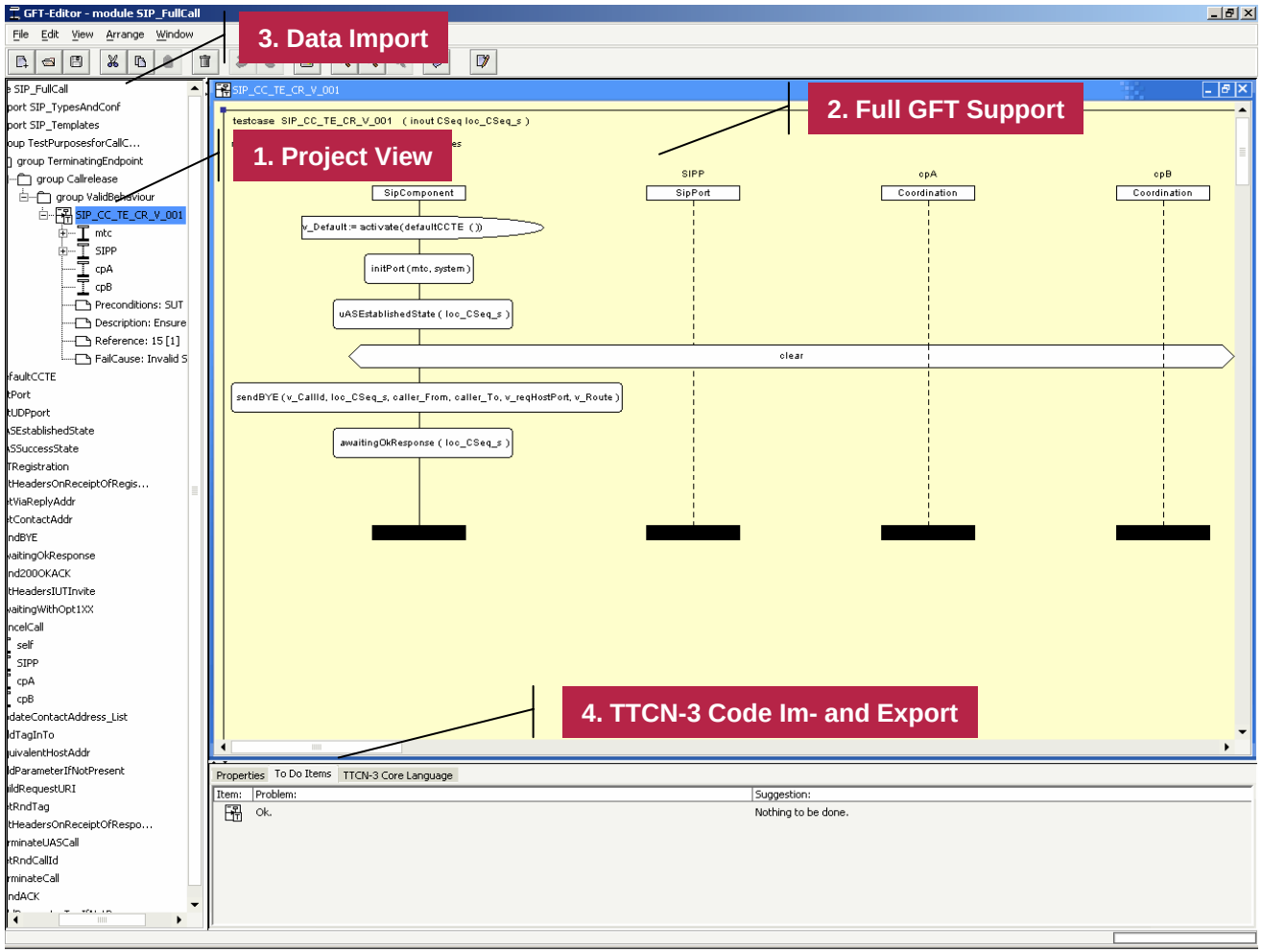


- Standard Bodies
  - ETSI, ITU, WiMAX, 3GPP, others
    - *Standard bodies produce TTCN-3 test suites*
  - TTCN-3 Web Site/Forum at ETSI (www.ttcn-3.org)
- Educational Institutions
  - Universities, Research Institutes
  - European Research Projects
    - *Free academic licenses available*
- Users
  - Different Domains: Telco, IT, Automotive, Embedded Systems
  - Education Tracks available
    - *TTCN-3 Users Conference*
    - *TTCN-3 Certificate*

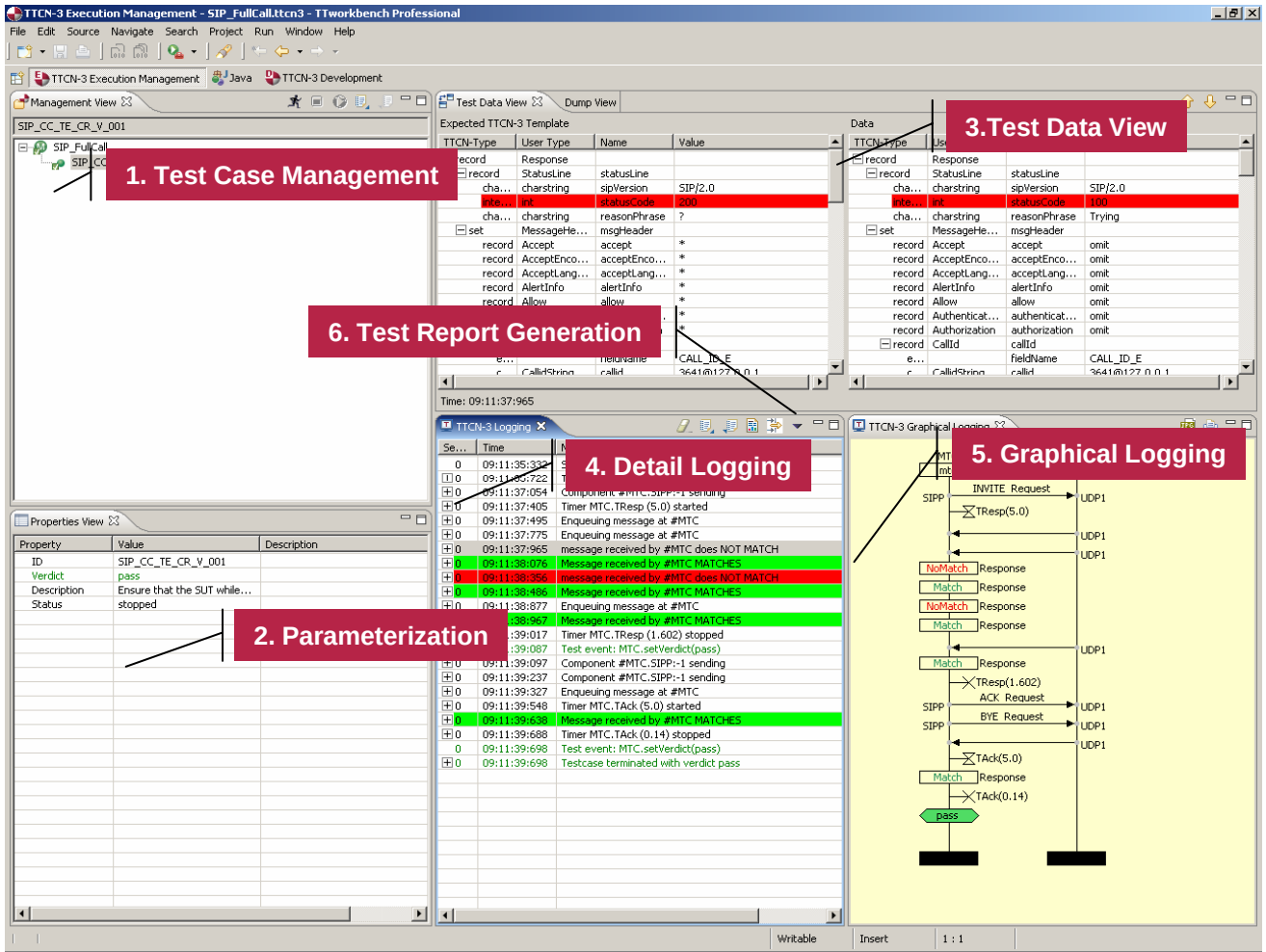
An Example: TTworkbench – textual test design



TTworkbench - graphical test design



TTworkbench – TTCN-3 Execution

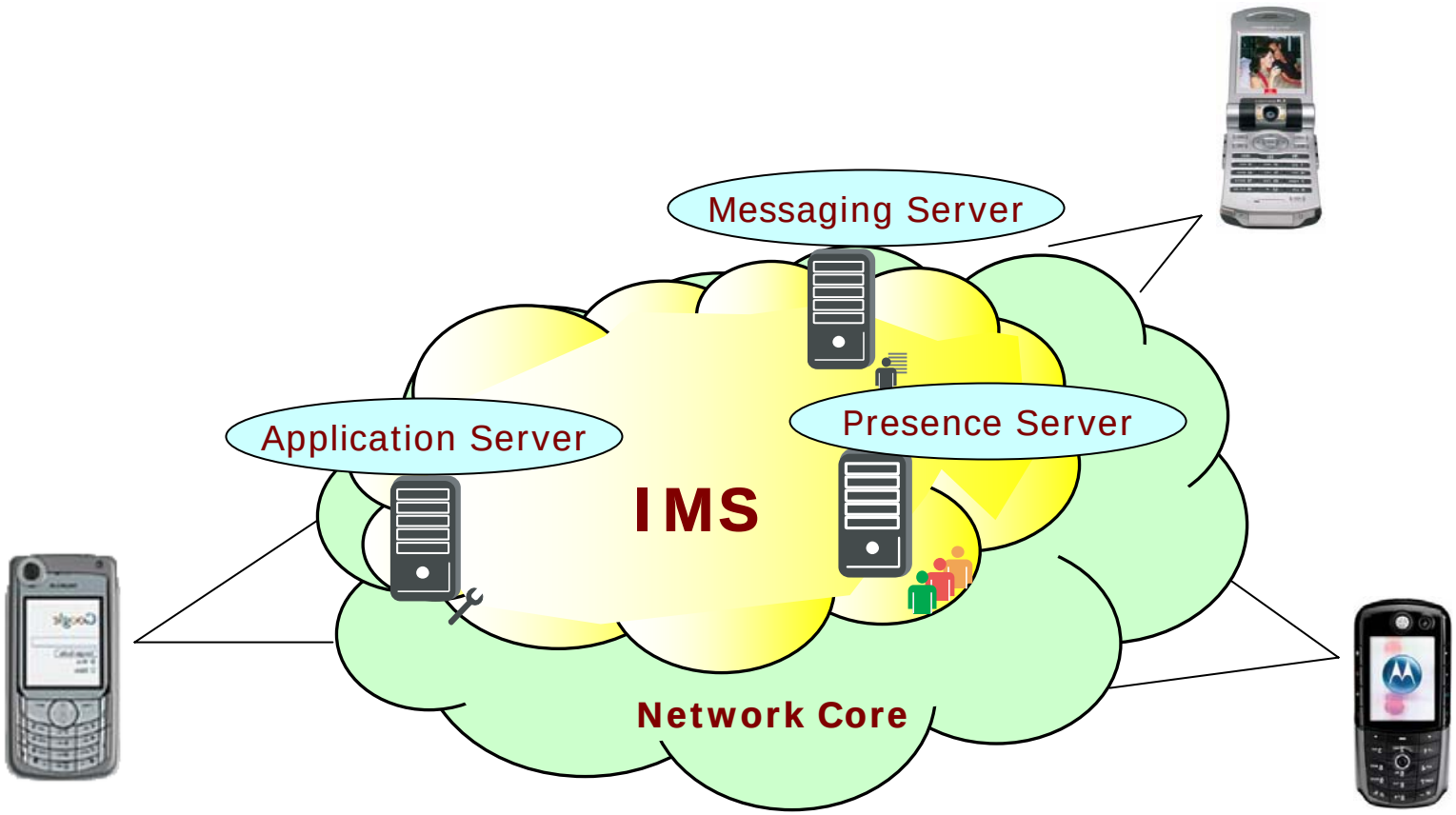


Outline

- Overview
- Main Concepts
- TTCN-3 in a Nutshell
- TTCN-3 based test systems
- An Example: IMS Benchmarking
- Summary

IMS in a Nutshell

- IMS = IP Multimedia Subsystem



IMS Testing

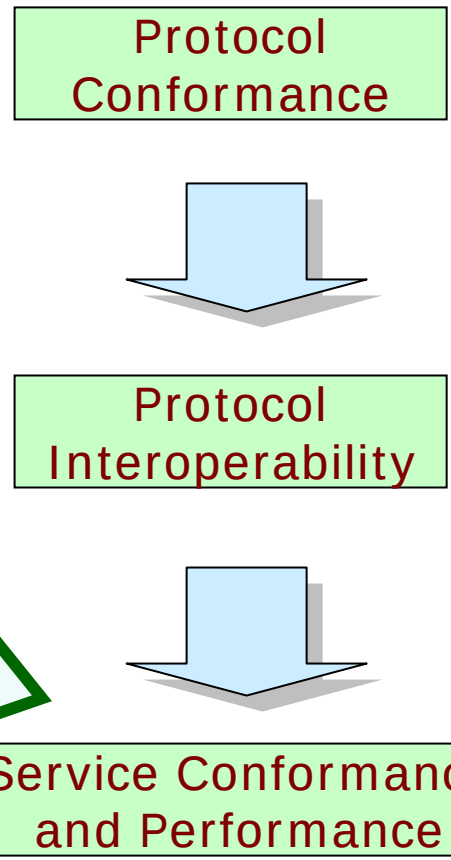
- The importance of testing
  - ... to valid
    - P
  - ... to
    comp
  - ... to v
    under

➢ Service-oriented testing

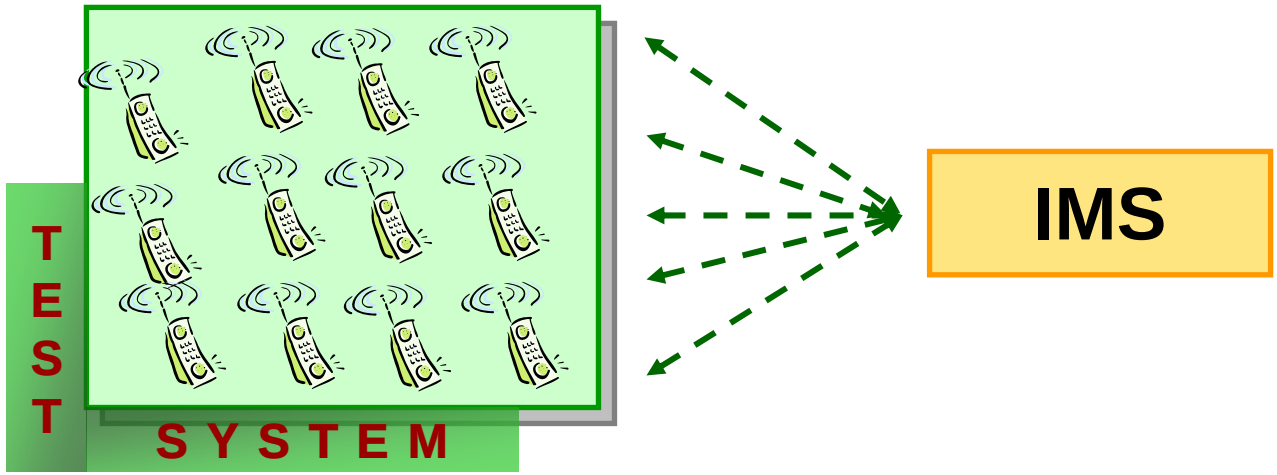
➢ Combines research and industrial interests

➢ Metrics for the correctness, reliability and scalability of IMS solution

➢ Objective performance comparison for network/service providers

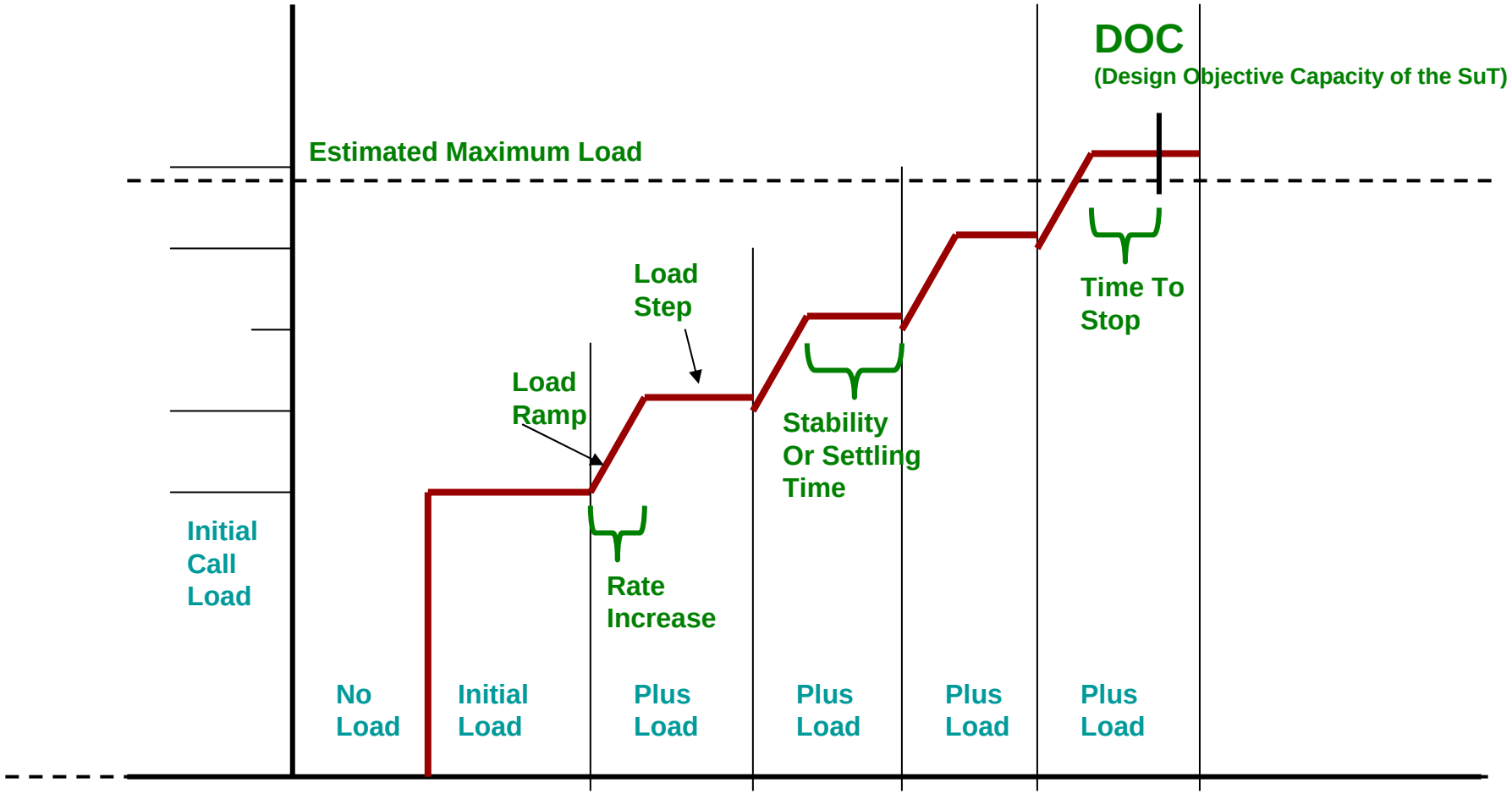


IMS Performance Testing



- Benchmarking
  - for comparison
- Load/stress
  - how system performs under load conditions
- Capacity testing
  - max load the system can handle before failing
- Scalability testing
  - to plan capacity improvements

Benchmark Procedure



IMS Test Bodies

- ETSI
  - Methodology for IMS network integration testing
  - SIP testing
- SIG
  - IMS benchmarking methodology
- TISPAN
  - Standardisation of converged networks
  - IMS benchmark

FOKUS Open Source IMS

- a Home Subscriber Server
- 3GPP compliant IMS Call Session Control Functions (CSCFs)
- a SIP2IMS gateway

FOKUS Test System

- **Scenario Description →** TTCN-3
  - Standardized implementation-independent test notation

- **Execution Platform → TTworkbench Enterprise**

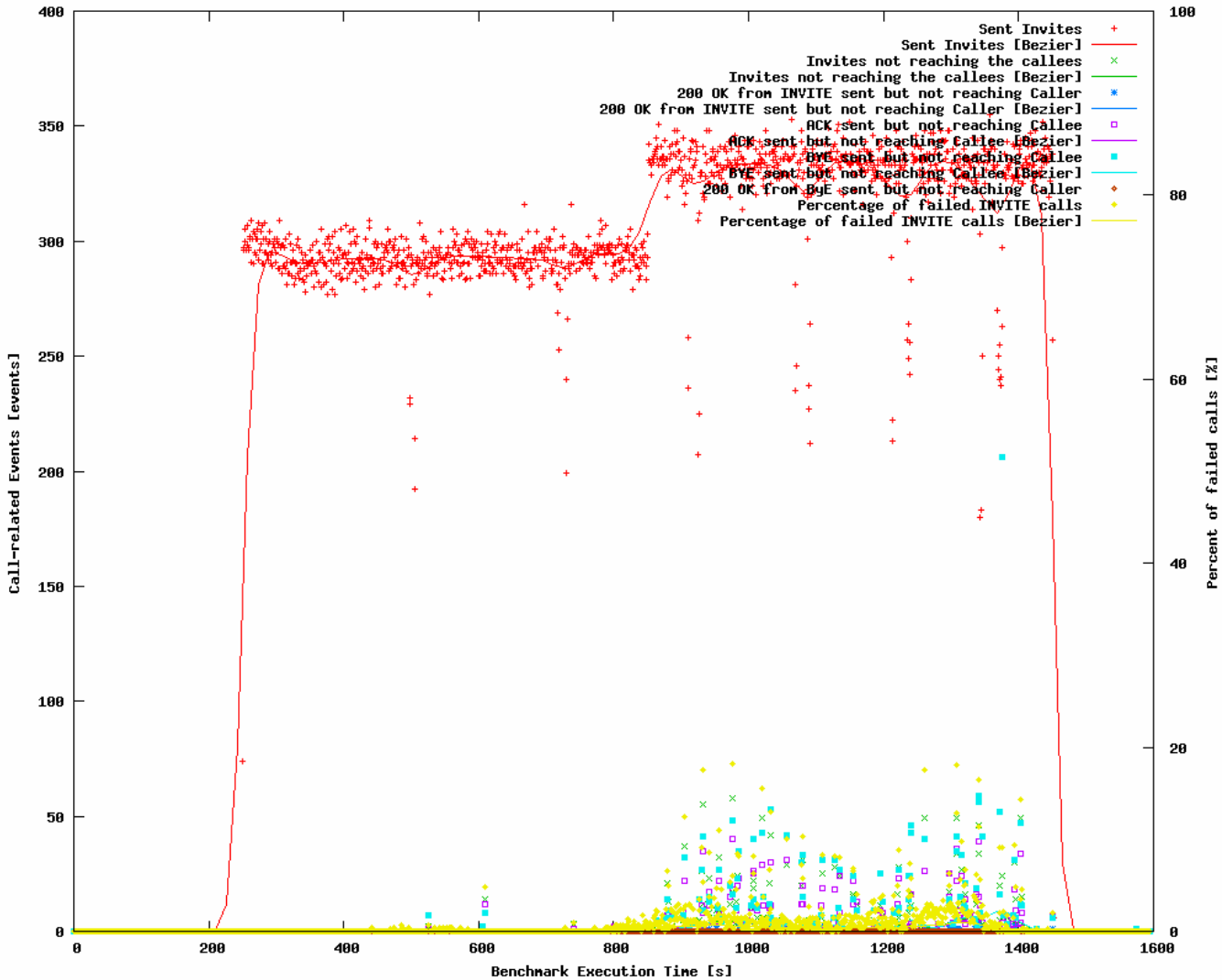
  - Distributed Test Execution Platform
  - Deploys, creates and coordinates distributed parallel test components emulating user equipment on several hosts
  - Synchronized traffic load, measurement and logging of results

- **Visualization → TraVis**
  - Merge CSV files logged separately by Test Daemons
  - Various graphs & statistics

First Benchmark Examples

scenario / server	5.1.2.1 Scenario 1.1 Successful Initial Registration (SAPS)	5.2.2.4 Scenario 2.4- Succesful Call (SAPS)	5.3.2.1 Scenario 3.1 Successful Message Exchange (SAPS)
kennicot	80	200	500
DTI	140	310	690
damascus	110	390	900

Example: Visualization of Fail Rate



Outline

- Overview
- Main Concepts
- TTCN-3 in a Nutshell
- TTCN-3 based test systems
- An Example: IMS Benchmarking
- Summary

TTCN-3

- Is
  - a test specification and implementation technique
  - open to various domains
  - open to various development and test processes
- For conformance, interoperability and performance testing!
- TTCN-3 is widely supported by tools

➢ TTCN-3 is the choice for technical testing and automated test execution

➢ It supports the development of telecommunication, Internet and IT standards via well-defined test suites

TTCN-3 is ...

- adopted by ITU-T

- taken for numerous ETSI test suites
  - SIP
  - IPv6
  - SIP/ISUP
  - Hiperlan/Hiperman
- taken for tests of other consortia like AutoSar, MOST Forum, WiMax Forum

Gains from Using TTCN-3 Tools

What Users Say

- Users of TTCN-3 report that ...
  - productivity,
  - system quality and
  - test reuse

... are doubled

- SUT coverage is substantially increased
- Testers can concentrate on the test logic
  - i.e. what to test
- The test execution is fully automated
  - i.e. how to test technically

At the End: Standardized Test Specifications

- Well-defined test notation for many testing applications
- Universally understood syntax and operational semantics
- Off-the-shelf tools
- Cheaper education and training costs
- Standardization, exchange and reuse of test suites
- Easier maintenance of test suites

- Transparency for the test process
- Increase of the objectiveness of tests
- Comparability of test results

Thank You!

Any Questions?

Please be invited to the
4th TTCN-3 User Conference
@ Ericsson, Sweden, May 2007