TTCN-3 Tutorial

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What is TTCN-3?

- Testing and Test Control Notation Version 3
- Internationally standardized testing language
  - Product of the ETSI Technical Committee MTS (Methods for Testing and Specification)
- A programming language that has been used for more than 15 years in standardization as well as industry
  - Specifically designed for black box testing and certification
  - Constantly developed and maintained at ETSI by a team of leading testing experts from industry, institutes, and academia
- A testing technology that applies to a variety of application domains and types of testing
  - Knowledge of TTCN-3 is valuable both for employees as well as employers due to its wide applicability
  - Offers potential for reducing training and test maintenance costs significantly
  - Proven to work in very large and complex industrial tests, e.g., 3G network elements
What makes TTCN-3 different …

- From conventional programming or scripting languages?
  - Rich type system including native list types and support for subtyping
  - Embodies powerful build-in matching mechanism
  - Snapshot semantics, i.e., well defined handling of port and timeout queues during their access
  - Concept of verdicts and a verdict resolution mechanism
  - Support for specification of concurrent test behaviour
  - Support for timers
  - Allows test configuration at run-time
  - Tests focus only on implementation to be tested

- From a test tool or vendor proprietary testing language?
  - Not tied to a particular application or its interface(s)
  - Not tied to any specific test execution environment, compiler or operation system
  - TTCN-3 as such is not executable and requires a compiler/interpreter, adapter as well as codec implementations
TTCN-3 Benefits

- TTCN-3 is easy to learn
  - Look and feel of a regular programming language
- Unambiguous specification and execution of tests
  - Well defined syntax, static - and operational semantics
  - Enables completely automated test execution
- Off-the-shelf tools and test systems are readily available
  - Five different commercial TTCN-3 tools on the market
- Open source community now taking shape
  - Tools as well as test suites and useful modules
- Can be used to specify tests for standardization as well as proprietary product features
- Flexible testing technology
  - Virtually no limits to adapt a test system to your needs
  - Scalable – allows test systems to grow over time
TTCN-3 Success stories

- **At ETSI**
  - Used for development of any new conformance and interoperability test suite, e.g., SIP, IPv6, WiMax, 3GPP IMS, ...

- **In industry**
  - Applied in a variety of application domains, e.g., telecom, automotive, financial, ... (see www.tt-medal.org)
  - Ericsson reported 1,500 active licenses at TTCN-3 User Conference 2007
  - Motorola reports doubling of testing productivity
  - Huawei introduced TTCN-3 in 2005, 200 000 test cases written

- **In academia and research institutes**
  - Bluetooth roaming algorithms, web services & project mgmt system, IMS benchmark, RIPng, GRID application testing, ...

- **Beyond Europe**
  - Strong community in China
Expansion of TTCN-3 Use

- Test Type
- Test Domain

- Distributed
- Telecom
- Internet
- Transport
- Module
- Unit
- Layer
- Integration
- Laboratory

World Class Standards
Main Capabilities of TTCN-3

- Dynamic concurrent testing configurations
- Various communication mechanisms (synch and asynch)
- Data and signature templates with powerful matching mechanisms (including regular expressions)
- Attributes for encoding, display or user-defined information
- Test suite parameterization
- Control of Test Case execution and selection mechanisms
- Control of complex test configurations
- Assignment and handling of test verdicts
- Harmonized with ASN.1 (XML and IDL coming)
- Different presentation formats
- Well-defined syntax, static - and operational semantics
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World Class Standards

The Core Language and Other Presentation Formats

- Core format is text based (most popular)
- TTCN-3 can be edited or viewed in other formats
  - Tabular format (for TTCN-2 people)
  - Graphical format (good for visual overview)
  - Other standardized formats in the future?
  - Proprietary formats possible

TTCN-3 Core Language

Text format

Tabular Format

Graphical Format

Presentation Format

Presentation Format
testcase TC_resolveEtsiWww() runs on DnsClient
{
    timer t_ack;
    serverPort.send(m_dnsQuestion("www.etsi.org"));
    t_ack.start(1.0);
    alt {
        alt {
            serverPort.receive(mw_dnsAnswer("172.26.1.17")) {
                setverdict (pass);
            }
        }
        serverPort.receive { // any other message
            setverdict(fail);
        }
        t_ack.timeout {
            setverdict(inconc);
        }
    }
    t_ack.stop;
}
Use of TTCN-3 With Other Languages

- TTCN can be integrated with types systems of other languages
- Fully harmonized with ASN.1 (1997)
- Harmonized with other languages
  - IDL, XML, C/C++
TTCN-3 Key Concepts

- Black-Box Testing
- Test Configuration
- Test Components
- Communication Ports
- Test Verdicts
All test behavior is executed on one (main) test component
A test involves execution of many parallel test components

Dynamic instantiation of components and communication links
Building blocks of a TTCN-3 Test Suite

Data types which specify
- Structure of messages or calls and their information elements (fields, parameters)
- Internal data structures (e.g., for computation)
- Possibly encoding or display information

Built-in basic types
- integer, boolean, float,
- bitstring, hexstring, octetstring,
- charstring, universal charstring

... and structured types
- record, record of, set, set of
- union, enumerated

... and special types such as
- component, port, verdicttype, default, etc
Building blocks of a TTCN-3 Test Suite

- **Actual test data (values) used during testing**
  - Constants or Templates for specific message or call parameter values
  - Matching expressions for allowing multiple message or call parameter values
    - value range, value list, wildcards, presence, length, size, permutation
    - regular expressions
  - Using also template decomposition, parameterization and modification

- **Test Suite**
  - **Test Data Types**
  - **Actual Test Data**
Building blocks of a TTCN-3 Test Suite

**Static aspects**
- Test component and port types

**Dynamic aspects**
- Dynamic instantiation and management of test components
- Mappings of test components to abstract test system interfaces
- Connections between test component interfaces
- Management of test components
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Building blocks of a TTCN-3 Test Suite

- **Test Suite**
  - Test Data Types
  - Actual Test Data
  - Test Configuration
  - Test Behaviour

**Test cases**
- specify sending/receiving messages, computation (e.g., checksums), and verdict assignment
- can be decomposed with functions and altsteps
- can (re)use default behaviour
- can use timers and timeouts

**Test execution control (optional)**
- order, repetition, conditions, etc
module EtsiDnsTests
{
   // Test definition part
   modulepar boolean mp_example;

   testcase TC_resolveEtsiWww()
   runs on DnsClient
   {
      // .. as in previous slide
   }

   // Test execution part
   control {
      if (mp_example) {
         execute(TC_resolveEtsiWww());
      }
   }
}
Where can I learn more?

- Visit ETSI’s official TTCN-3 web site ([www.ttcn-3.org](http://www.ttcn-3.org))
  - Public TTCN-3 test suites, useful TTCN-3 modules
  - Links to commercial as well as open source tools
- Read well written TTCN-3 standard suite
- Join the ETSI mailing list ([list.etsi.org/TTCN3.html](http://list.etsi.org/TTCN3.html))
- Take a course (see [www.tt-medal.org](http://www.tt-medal.org))
- Read publications
  - Proceedings of Conference for Testing of Communicating Systems (TESTCOM)
  - Presentations of yearly TTCN-3 User Conferences in Europe or Asia (see [www.ttcn-3.org](http://www.ttcn-3.org))
- Register for the next TTCN-3 user conference!
Thank You!