Int J Softw Tools Technol Transfer (2008) 10:281–283
DOI 10.1007/s10009-008-0071-4

INTRODUCTION

Introduction to the special section on advances in test automation: the evolution of TTCN-3

Ina Schieferdecker · Jens Grabowski

Published online: 4 April 2008

1 Introduction

The quality of software-based systems becomes increasingly important as the influence of software in almost every area of economy and society is growing. Today, software is used in safety- and security-critical domains for systems where reliability, robustness, trustworthiness, etc. are essential. Due to the variety of system quality aspects (as for example defined by ISO 9126 [2]), there are numerous techniques such as constructive, analytical, or process-oriented techniques that are used to assess and assure system quality as early and as continuously as possible in the system development and maintenance process. However, analytical methods and in particular dynamic testing approaches remain a central and often also an exclusive instrument to check the resulting quality of the overall system. For years, experts have been convinced that test design is the central element to successful and meaningful software testing. In the meantime, however, it has become apparent that testing requires all the typical elements of software engineering: tests are software-based systems that need to be engineered, designed, verified, validated, and executed like any other software-based system. Specialities of test systems involve the ability to control, stimulate, observe, and evaluate the system under test. Although standard development and programming techniques are mostly applicable, specific solutions for the development of test systems respecting their peculiarities seem reasonable. This motivated the development and standardisation of specialised test specification and test implementation languages.

Among the original reasons for developing the Tree and Tabular Combined Notation (TTCN) [3] was the precise definition of conformance for protocols of telecommunication components according to their specifications. Test specifications were regarded as means to objectively define test procedures and to evaluate, compare, and certify equipment on a sound and repeatable base. In the spirit of these developments, the automated execution of TTCN became likewise important.

Over the years, TTCN grew in its expressivity and usage. Various pilot projects demonstrated its successful applicability outside the telecommunication area. With the convergence of the information technology and telecommunication industries, the direct applicability of TTCN became also apparent to people without a background in the telecommunication domain. These trends and the characteristics of more recent IT and telecommunication technologies imposed new requirements on TTCN itself. The development of a new version of TTCN—TTCN-3, now standing for Testing and Test Control Notation version 3 [1]—is a result of these new requirements.

TTCN-3 has been developed by a group of testing experts at the European Telecommunication Standards Institute (ETSI). Launched in September 2000 as a new standardised test technology, it is since then continuously maintained and improved along the needs of its user community. The TTCN-3 community meets yearly at the TTCN-3 User Conference (T3UC) at different places in Europe. In 2007, the first T3UC Asia took place in Beijing.

I. Schieferdecker
Design and Testing of Communication-Based Systems, Secr. FR 5-14, Faculty IV—Electrical Engineering and Computer Science, Technical University Berlin, Franklinstr. 28-29, 10587 Berlin, Germany
e-mail: ina@cs.tu-berlin.de

J. Grabowski (✉)
Software Engineering for Distributed Systems Group, Institute of Computer Science, University of Göttingen, Lotzestrasse 16-18, 37083 Göttingen, Germany
e-mail: grabowski@informatik.uni-goettingen.de

This special section of the STTT journal is a collection of recent research and industrial applications of TTCN-3 in the telecommunication, information technology, and automotive domains in 2005 and 2006. All contributions are detailed elaborations of presentations given at T3UC.

The section is grouped into articles on test automation and development processes (see 1.1), on test development with TTCN-3 (see 1.2), and on TTCN-3 applications (see 1.3).

1.1 Test automation and development processes

This collection of contributions is about the proper placement of test-automation- and test-specification-based approaches in system development processes.

Martin Botteck and Thomas Deiß discuss in "*Introduction of TTCN-3 into the product development process*" issues that have prevented the widespread adoption of TTCN-3 within Nokia. The needs for tool interoperability as well as higher level test designs are outlined to make efficient use of modular and reusable TTCN-3 specifications.

The article "*Automating test automation*" by Andrej Pietschker discusses how TTCN-3 can be introduced despite of or as an added value to existing legacy test automation environments. The central concept is to use TTCN-3 as an integrator and driver for existing test solutions and to enable the development of future test solutions in a powerful TTCN-3 environment.

Markus Warken discusses in his contribution "*From testing to anti-product development*" a detailed development process for the test system—the so-called anti-product. Roles and development steps for a test-specification-based process are derived.

1.2 Test development with TTCN-3

These contributions discuss aspects of developing TTCN-3 test specifications such as test quality aspects, test libraries, code generation of system adapters, and the derivation of TTCN-3 tests from former TTCN specifications.

Helmut Neukirchen, Benjamin Zeiss, and Jens Grabowski define in "*An approach to quality engineering of TTCN-3 test specifications*" a test quality model and discuss the use of test metrics, test code smells, and refactorings to improve test quality.

In "*Test suite development with TTCN-3 libraries*", Stephan Schulz presents a library driven approach for TTCN-3 test suite development and demonstrates its application in the context of the test framework for the Internet Protocol version 6 (IPv6).

Ariel Sabiguero, Anthony Baire, and César Viho discuss support for developing encoding/decoding functions for TTCN-3 test systems by means of a codec generator in "*Automatic CoDec generation to reduce test engineering cost*". The generator has been developed for IPv6 but is of wider applicability.

Finally, Thomas Deiß discusses in "*Refactoring and Converting a TTCN-2 Test Suite*" the conversion of former TTCN test suites into TTCN-3 for the sake of a common test technology base for, e.g., interworking test solutions. Selected issues in the conversion process are explained and proposals for an optimised conversion are made.

1.3 TTCN-3 applications

This collection of contributions is about applying TTCN-3 for functional and performance testing of telecommunication networks, for testing Web applications and for testing embedded systems in the automotive domain.

Axel Rennoch, Michael Gläser, Sebastian Müller, and Peter Schmitting discuss the development of a TTCN-3 test suite for interworking tests between Voice over IP (using the signalling protocol SIP) and traditional ISDN networks in "*Standardization of network integration tests using TTCN-3*".

In "*An IMS performance benchmark implementation based on TTCN-3 language*", George Din describes a performance benchmarking methodology, its realisation with TTCN-3 and the application for a set of IMS servers. IMS is the IP Multimedia Subsystem for the realisation of advanced audio, video and Web services.

Bernard Stepien, Liam Peyton, and Pulei Xiong report about the development of a TTCN-3-based test framework for Web applications in "*Framework testing of Web applications using TTCN-3*". They demonstrate how test specifications can be used to define tests on different levels of abstraction to make them robust with respect to changes in presentation and implementation details.

In "*Testing hybrid control systems with TTCN-3—an overview on Continuous TTCN-3*", Ina Schieferdecker and Jürgen Grossmann present an extension of TTCN-3 that covers streams and hybrid automata for continuous and hybrid embedded systems as they are used, e.g., in the automotive domain.

This special section reflects the T3UC programme of the years 2005 and 2006 by providing a mixture of selected industrial and academic contributions. We hope that this collection appeals to people who are interested in the current capabilities of TTCN-3, reports about successful applications of TTCN-3, and directions of future TTCN-3 developments. We are thankful to all authors and reviewers of this special section who worked hard to provide high-quality articles on TTCN-3, the STTT team for keeping the online paper submission system running smoothly, and the editors-in-chief

for their encouragement to realise this special section of the STTT Journal.

References

1. ETSI Standard ES 201 873-1 V3.2.1 (2007–02): The Testing and Test Control Notation version 3; Part 1: TTCN-3 core language. European Telecommunications Standards Institute (ETSI), Sophia-Antipolis, France (2007)
2. ISO/IEC Standard No. 9126: Software engineering—product quality; Parts 1–4. International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC), Geneva, Switzerland (2001–2004)
3. ISO/IEC Standard No. 9646, Part 3: Information technology—open systems interconnection—conformance testing methodology and framework—Part 3: The Tree and Tabular Combined Notation (TTCN). International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC), Geneva, Switzerland (1998)