

Contents

About the Authors	xiii
Foreword	xv
Acknowledgements	xvii
List of Figures	xix
List of Tables	xxi
Abbreviations and Acronyms	xxvii
1 Introduction	1
1.1 TTCN-3 as a Language	2
1.1.1 TTCN-3 Presentation Formats	2
1.2 The Development of TTCN-3	4
1.2.1 Future Development	5
1.3 Summary	5
2 TTCN-3 by Example	7
2.1 TTCN-3 Test Suite	7
2.1.1 Problem Domain	7
2.1.2 Test Purpose	9
2.1.3 TTCN-3 Modules	10
2.1.4 Data Types and Messages	10
2.1.5 Components and Ports	13
2.1.6 A First Test Case	14
2.1.7 Handling Erroneous Situations	15
2.1.8 Default Behaviour	16
2.1.9 Concurrent TTCN-3	17
2.1.10 Procedure-based Communication	19

2.2	TTCN-3 Test Systems	22
2.2.1	High-level View of a Test System	23
2.3	Summary	24
3	Basic TTCN-3	25
3.1	Basic Constructs	25
3.1.1	Identifiers	25
3.1.2	Modules	26
3.1.3	Scope	26
3.1.4	Constants	27
3.1.5	Variables	27
3.1.6	Comments	28
3.1.7	Basic Data Types	28
3.1.8	Subtypes	29
3.1.9	Functions	30
3.2	Basic Statements	32
3.2.1	Operators, Expressions and Assignments	32
3.2.2	The Conditional Statement	33
3.2.3	Loops	34
3.2.4	Labels and Goto	34
3.2.5	The log Statement	36
3.2.6	The Control Part	36
3.3	Summary	38
4	Non-concurrent TTCN-3	39
4.1	Ports	40
4.2	Components	41
4.3	Test Cases	42
4.3.1	Main Test Component	43
4.3.2	Test Case Verdict	43
4.3.3	Test Case Invocation	44
4.3.4	Test Case Parameters	45
4.3.5	Test Case Behaviour	46
4.3.6	Test Case Termination	47
4.4	Templates	47
4.5	Message-based Communication	48
4.5.1	Send	49
4.5.2	Receive	49
4.5.3	Check	51
4.5.4	Receive on Several Ports	52
4.6	Timers	53
4.7	Alt Statement	55
4.7.1	Boolean Guards	56
4.7.2	Repeat Statement	58
4.7.3	Alt Statements vs. Stand-alone Blocking Statements	59
4.8	Altsteps	60

4.9	Default Altsteps	62
4.10	Functions	65
4.10.1	Restrictions on the Runs on Clause	66
4.11	Summary	68
5	Concurrent TTCN-3	69
5.1	Concurrent Test Case Example	70
5.2	Test Components	70
5.2.1	Main Test Component and Test System Interface	71
5.2.2	Parallel Test Components	72
5.2.3	Component References	73
5.2.4	Starting Behaviour	75
5.2.5	Stopping Parallel Test Components	76
5.2.6	Await Termination of Test Components	77
5.2.7	Check Execution of Test Components	78
5.2.8	Verdict Computation	78
5.3	Mappings and Connections	79
5.3.1	Mappings	79
5.3.2	Connections	80
5.3.3	Many-to-one Mappings and Connections	81
5.4	Miscellaneous Port Operations	83
5.5	SUT Addresses	83
5.6	Summary	85
6	Procedure-based Communication	87
6.1	Procedure-Versus Message-based Communication	87
6.2	An Example – the Directory Service	88
6.3	Procedure-based Communication in TTCN-3	89
6.3.1	Non-blocking Signatures	91
6.4	Communication Operations	91
6.5	Procedure-based Communication on the Client Side	92
6.5.1	The <code>call</code> Statement	92
6.5.2	The <code>getreply</code> Operation	93
6.5.3	The <code>catch</code> Operation	95
6.5.4	On Defaults, Deadlocks, and Timed Invocations	97
6.5.5	Non-blocking Use of the <code>call</code> Operation	98
6.6	Procedure-based Communication on the Server Side	101
6.6.1	The <code>getcall</code> Operation	101
6.6.2	The <code>reply</code> Operation	102
6.6.3	The <code>raise</code> Operation	104
6.7	Addressing	104
6.8	Summary	107
7	Modular TTCN-3	109
7.1	Modules	110
7.1.1	Definition of a Module	110

7.1.2	Modularization of TTCN-3 Test Suites	111
7.2	Group Definitions	111
7.3	Importing	112
7.3.1	Visibility of TTCN-3 Definitions	113
7.3.2	About Transitivity of Imports and Cyclic Imports	113
7.3.3	Restricting the Import of TTCN-3 Definitions	114
7.3.4	Module Prefixing of Imported Definitions	116
7.3.5	Recursive Imports	117
7.3.6	Importing from Other Languages	118
7.4	Module Parameters	118
7.5	Attributes	119
7.5.1	Accessing Attribute Values	120
7.5.2	Scoping of Attributes	121
7.5.3	Assigning Attributes to Imported Definitions	122
7.5.4	Using Attributes to Define Encodings	123
7.6	Summary	123
8	TTCN-3 Data Types	125
8.1	The Session Initiation Protocol	126
8.2	Subtyping	127
8.2.1	Type Aliasing	128
8.2.2	Value List	129
8.2.3	Value Ranges	129
8.2.4	Character Set Restrictions for Strings	130
8.2.5	Length Restrictions for Strings and List Types	130
8.2.6	Subtyping of Subtypes	131
8.2.7	Type Conversion	132
8.3	TTCN-3 Built-in Types	132
8.3.1	The Boolean Type	132
8.3.2	The Integer Type	133
8.3.3	The Float Type	134
8.3.4	The Charstring and the Universal Charstring Type	135
8.3.5	The Verdicttype Type	137
8.3.6	The Binary String Types Bitstring, Hexstring, and Octetstring	137
8.3.7	The Objid Type	139
8.3.8	The Default Type	139
8.4	User-defined Types	139
8.4.1	The Enumerated Type	140
8.4.2	The Record Type	140
8.4.3	The Set Type	142
8.4.4	The Union Type	144
8.4.5	The List Types	146
8.5	Summary	150

9	Advanced Type Topics	153
9.1	Type Compatibility	153
9.1.1	Strict Type Compatibility	154
9.1.2	Type Compatibility for Structured Types	157
9.2	The Anytype Type	157
9.2.1	Using the anytype for Generic Protocol Definitions and Data Types	159
9.3	The Address Type	160
9.4	Recursive Type Definitions	162
9.5	Foreign Type Systems	164
9.5.1	Using ASN.1 Types in TTCN-3	165
9.5.2	Using IDL Types in TTCN-3	169
9.6	Summary	170
10	Templates	173
10.1	A First Look at TTCN-3 Templates	173
10.2	The TTCN-3 Match Operation	175
10.3	Template Definition for One Specific Value	176
10.4	Template Definitions with Matching Expressions	177
10.4.1	The 'any' Matching Expression	177
10.4.2	Value Lists	177
10.4.3	Complemented Value List	179
10.4.4	Value Ranges	179
10.4.5	More About Matching Expression for Structured Types	180
10.4.6	More About Matching Expressions for List-like Types	182
10.4.7	More About Matching Expressions for String Types	185
10.5	Template Definitions for Signatures	190
10.6	About Assignment, Access of Templates, and the Valueof Operation	190
10.7	Summary	192
11	Advanced Templates	193
11.1	Template Definitions for Complex Type Structures	193
11.2	Template References	195
11.3	Template Parameterization	196
11.3.1	Value Parameters	196
11.3.2	Template Parameters	197
11.3.3	About the Use of Template Parameterization	197
11.4	Selective Modification of Other Templates	197
11.5	Explicit Versus Implicit Template Definitions	199
11.6	Structuring of Template Definitions for Complex Types	199
11.7	Summary	200

12	TTCN-3 Test Systems in Practice	201
12.1	The Anatomy of a TTCN-3 Test System	201
12.1.1	The TTCN-3 Executable	202
12.2	Test System Execution of a Simple Test Case	203
12.2.1	Test System and Test Case Initialization	203
12.2.2	Preparation of Communication Channels Towards the SUT	203
12.2.3	Handling of Communication Towards the SUT	205
12.2.4	Starting of TTCN-3 Timers	206
12.2.5	Handling Incoming Communication from the SUT	207
12.2.6	Handling Timeouts and Stopping of Timers	207
12.2.7	Teardown of Communication Channels Towards the SUT	208
12.3	More About The SUT Adapter	209
12.3.1	Execution Threads in the SA	209
12.3.2	Management of TRI Information	209
12.3.3	Procedure-based Communication with the SUT	210
12.3.4	Dynamic SUT Adapter Configuration	210
12.3.5	Distributed SUT Adapter Implementations	210
12.4	More About The Platform Adapter	211
12.4.1	TRI Timing Operations	211
12.4.2	Non-real-time Implementation	212
12.4.3	External Functions	212
12.5	More About External Codecs	213
12.5.1	Access to the TTCN-3 Values	213
12.5.2	Encoder Implementation	213
12.5.3	Decoder Implementation	214
12.5.4	Advanced Aspects of Codec Implementations	215
12.6	Conclusion	216
13	Advice and Examples	217
13.1	TTCN-3 Style Guide	217
13.1.1	Motivation	217
13.1.2	Examples	218
13.2	Suggestions for Modularization	220
13.3	Template Specification for Complex Message Definitions	223
13.3.1	Example Implementation of a SIP Message Interchange	223
13.3.2	A SIP Type Definition	223
13.3.3	Specification of the Expected SIP Request	224
13.3.4	Specification of the 200 OK Response	227
13.3.5	About the Benefits of Smart Template Definitions	229
13.4	Useful Behaviour	229
13.4.1	Convert Conditions to Verdicts	229

13.4.2	Unexpected Messages	230
13.4.3	Waiting	231
13.4.4	Successful Altstep	232
13.4.5	Additional String Conversion Functions	233
13.4.6	Binary Addition	234
13.5	Synchronizing Parallel Test Components	235
13.5.1	Common Definitions	237
13.5.2	Parallel Test Components	239
13.5.3	Main Test Component	240
14	Closing Thoughts and Future Directions	245
	References	247
	Index	249

