

# Contents

## Part I Fundamentals

<b>1</b>	<b>Introduction to Software Architecture</b>	3
1.1	The Concept of Software Architecture	3
1.2	Language for Modeling Software Architecture	5
1.2.1	Why Conceiving SysADL	6
1.2.2	Introducing SysML for SysADL	7
1.2.3	SysADL as a Specialization of SysML for Architecture Modeling	8
1.3	Designing Software Architecture with SysADL	9
1.3.1	Describing Software Architectures	10
1.3.2	Designing Quality-Based Software Architectures	10
1.3.3	Designing Style-Based Software Architectures	10
1.3.4	Textually Representing Software Architectures	10
1.4	Running Case Study to Illustrate Software Architecture	11
1.5	Summary	11
	Further Reading	12
	References	12
<b>2</b>	<b>Viewpoints for Describing Software Architectures</b>	13
2.1	The Definition of Software Architecture	13
2.2	Software Architecture Description	14
2.3	Concepts for Describing Software Architecture	17
2.4	Architectural Viewpoints and Views	21
2.4.1	Architectural Viewpoints	21
2.4.2	Architectural Views	23
2.5	Summary	24
	Further Reading	25
	Reference	25

<b>3</b>	<b>Eliciting Requirements of Software Architectures</b>	27
3.1	Introduction	27
3.2	The Concept of Requirement	28
3.3	Requirement Constructs	28
3.4	Dependencies Between Requirements	30
3.5	Requirements Diagram	32
3.6	Applying Requirement Constructs	33
3.7	Summary	36
	Further Reading	36
<b>4</b>	<b>Specifying the Structure of Software Architectures</b>	37
4.1	Introduction	37
4.2	Structural Viewpoint and Views	38
4.2.1	Structural Viewpoint	38
4.2.2	Structural Views	39
4.3	Structural Constructs	40
4.3.1	Component	40
4.3.2	Ports	41
4.3.3	Value Types	45
4.3.4	Components with Ports Typed by Value Types	46
4.3.5	Connector	48
4.3.6	Configuration	51
4.3.7	Composite Components	52
4.4	Diagrams for Structural Views	54
4.4.1	Block Definition Diagrams	54
4.4.2	Internal Block Diagrams	55
4.5	Describing the Architecture from the Structural Viewpoint	56
4.6	Summary	63
	Further Reading	64
<b>5</b>	<b>Specifying Behavior of Software Architectures</b>	65
5.1	Introduction	65
5.2	Behavioral Viewpoint and Views	66
5.2.1	Behavioral Viewpoint	66
5.2.2	Behavioral Views	67
5.3	Behavioral Constructs	67
5.3.1	Activity	67
5.3.2	Action	71
5.3.3	Equations in the Action Definition	73
5.3.4	Relating Definition of Activities and Actions	73
5.3.5	Relating Components and Connectors with Activities and Actions	74
5.4	Diagrams for Behavioral Views	74
5.4.1	Block Definition Diagrams	74
5.4.2	Activity Diagrams	75
5.4.3	Parametric Diagrams	80

5.5	Relating Structural and Behavioral Viewpoints. . . . .	80
5.6	Describing the Architecture from the Behavioral Viewpoint. . . .	81
5.7	Summary . . . . .	88
	Further Reading . . . . .	88
<b>6</b>	<b>Specifying Executable Software Architectures. . . . .</b>	<b>89</b>
6.1	Introduction . . . . .	89
6.2	Executable Viewpoint and Views . . . . .	90
6.2.1	Executable Viewpoint . . . . .	90
6.2.2	Executable Views . . . . .	91
6.3	Executable Constructs. . . . .	91
6.3.1	Executable. . . . .	91
6.3.2	Action Language . . . . .	92
6.4	Summary . . . . .	96
	Further Reading . . . . .	97
	Reference . . . . .	97
<b>7</b>	<b>Executing Software Architectures . . . . .</b>	<b>99</b>
7.1	Introduction . . . . .	99
7.2	Executing an Architecture. . . . .	100
7.2.1	Executing Components . . . . .	100
7.2.2	Executing Connectors and Delegations . . . . .	103
7.2.3	Executing Configurations. . . . .	104
7.3	Executing Activities . . . . .	105
7.3.1	The Semantics of Activity Elements . . . . .	105
7.3.2	Executing an Activity . . . . .	107
7.4	Executing the RTC System Example . . . . .	110
7.5	Summary . . . . .	118
	Further Reading . . . . .	119

**Part II Quality-Based Architectures**

<b>8</b>	<b>Introduction to Quality-Based Architectures. . . . .</b>	<b>123</b>
8.1	What Is a Quality . . . . .	123
8.2	What Is Quality-Based Architectures . . . . .	124
8.3	Analysing Quality-Based Architectures. . . . .	124
8.4	Quality Attributes: Modifiability, Scalability, and Fault Tolerance . . . . .	125
8.5	Summary . . . . .	126
	Further Reading . . . . .	126
<b>9</b>	<b>Designing Modifiability in Software Architectures . . . . .</b>	<b>127</b>
9.1	Introduction . . . . .	127
9.2	Expressing Modifiability Using Software Architecture Concepts. . . . .	128
9.2.1	Modifiability Causes and Effects . . . . .	128

9.2.2	Modifiability Quality Attributes . . . . .	129
9.2.3	A Classification of Modifiability Effects . . . . .	129
9.2.4	Examples of the Add Primitive . . . . .	130
9.3	Modifiability Tactics . . . . .	131
9.3.1	Using Modifiability Tactics . . . . .	131
9.4	Analysing Modifiability in the RTC System . . . . .	131
9.4.1	RTC System Requirements . . . . .	131
9.4.2	RTC System—Causes . . . . .	132
9.4.3	Analysing the Ripple Effect in ARCH1 . . . . .	132
9.4.4	Design a New Architecture: ARCH2 . . . . .	136
9.4.5	Analysing the Ripple Effects in ARCH2 . . . . .	139
9.4.6	Comparing Modifiability in ARCH1 and ARCH2 . . . . .	140
9.5	Summary . . . . .	140
	Further Reading . . . . .	141
	Reference . . . . .	141
<b>10</b>	<b>Designing Scalability in Software Architectures . . . . .</b>	<b>143</b>
10.1	Introduction . . . . .	143
10.2	Scalability Causes and Effects . . . . .	144
10.3	Scalability Quality Attribute . . . . .	144
10.4	Scalability Tactics . . . . .	145
10.5	Applying the Scalability Tactics . . . . .	145
10.5.1	The Component Definitions of ARCH2 and ARCH3 . . . . .	145
10.5.2	The Configuration of ARCH2 and ARCH3 . . . . .	145
10.5.3	The Configuration of RoomTemperatureControllerCP . . . . .	146
10.5.4	The Definition of CompositeMonitorCFD . . . . .	147
10.5.5	The AllTemperaturesCN Connector in ARCH3 . . . . .	149
10.6	Scalability Analysis . . . . .	151
10.6.1	RTC System Requirements . . . . .	151
10.6.2	RTC System—Causes . . . . .	152
10.6.3	Analyzing the Ripple Effect . . . . .	152
10.7	Summary . . . . .	153
	Further Reading . . . . .	154
<b>11</b>	<b>Designing Fault Tolerance in Software Architectures . . . . .</b>	<b>155</b>
11.1	Introduction . . . . .	155
11.2	Fault Tolerance Causes and Effects . . . . .	156
11.3	Fault Tolerance Quality Attributes . . . . .	157
11.4	Fault Tolerance Tactics . . . . .	158
11.5	Applying Fault Tolerance Tactics . . . . .	158
11.5.1	The Configuration of ARCH3 and ARCH4 . . . . .	159
11.5.2	The HeartbeaterCP Component . . . . .	160

11.6	Fault Tolerance Analysis . . . . .	163
11.6.1	RTC System Requirements . . . . .	163
11.6.2	RTC System—Causes . . . . .	163
11.6.3	Analyzing the Ripple Effect. . . . .	164
11.7	Summary . . . . .	164
	Further Reading . . . . .	164

**Part III Style-Based Architectures**

<b>12</b>	<b>Introduction to Style-Based Architectures . . . . .</b>	<b>167</b>
12.1	What Is an Architectural Style . . . . .	167
12.2	What Is a Style-Based Architecture . . . . .	168
12.3	Architectural Styles. . . . .	168
12.4	Summary . . . . .	169
	Further Reading . . . . .	170
<b>13</b>	<b>Pipe-Filter Architectural Style . . . . .</b>	<b>171</b>
13.1	Conceptual Overview . . . . .	171
13.2	Pipe-Filter Structural Viewpoint . . . . .	173
13.3	Pipe-Filter Behavioral Viewpoint . . . . .	174
13.4	The Pipeline Substyle. . . . .	175
13.5	Summary . . . . .	177
	Further Reading . . . . .	177
<b>14</b>	<b>Client Server Architectural Style . . . . .</b>	<b>179</b>
14.1	Conceptual Overview . . . . .	179
14.2	An Example of Client–Server in RTC System . . . . .	180
14.3	Client–Server Structural Viewpoint. . . . .	181
14.4	Client–Server Behavioral Viewpoint. . . . .	184
14.5	Summary . . . . .	187
	Further Reading . . . . .	187
<b>15</b>	<b>Feedback Control Loop Architectural Style . . . . .</b>	<b>189</b>
15.1	Conceptual Overview . . . . .	189
15.2	Feedback Control Loop Structural Viewpoint. . . . .	190
15.3	Feedback Control Loop Behavioral Viewpoint. . . . .	193
15.4	Summary . . . . .	194
	Further Reading . . . . .	195
<b>16</b>	<b>Blackboard Architectural Style . . . . .</b>	<b>197</b>
16.1	Conceptual Overview . . . . .	197
16.2	Blackboard Structural Viewpoint . . . . .	198
16.3	Blackboard Behavioral Viewpoint . . . . .	199
16.4	Tuple Space . . . . .	203
16.5	An Example of Blackboard in RTC System. . . . .	206
16.6	Summary . . . . .	209
	Further Reading . . . . .	210

## **Part IV Textual Description of Architectures**

<b>17</b>	<b>Textually Representing Software Architectures</b>	<b>213</b>
17.1	Introduction	213
17.2	Textual Notation	214
17.2.1	Properties and Data	214
17.2.2	Components and Ports	217
17.2.3	Connectors	218
17.2.4	Compositions and Architecture	220
17.2.5	Activities	223
17.2.6	Executable Advanced Examples	225
17.2.7	Protocols	228
17.2.8	Actions	228
17.2.9	Constraints	230
17.2.10	Executables	231
17.2.11	Executable Advanced Examples	232
17.3	Summing up	234
17.4	Summary	234
	Further Reading	234
	<b>Glossary</b>	<b>235</b>

Software Architecture in Action

Designing and Executing Architectural Models with  
SysADL Grounded on the OMG SysML Standard

Oquendo, F.; Leite, J.; Batista, T.

2016, XVII, 236 p. 249 illus., 46 illus. in color., Softcover

ISBN: 978-3-319-44337-9