

Content

Acknowledgements.....	V
Preface.....	VIII
Preface.....	IX
Foreword.....	XI
1 Introduction	1
1.1 History of OPC.....	1
1.2 OPC – an overview.....	8
1.3 Comparison and assessment of technologies.....	12
1.4 Structure and tasks of the OPC Foundation.....	16
1.5 OPC is standard IEC 62541.....	22
1.6 Collaboration with other organizations.....	25
2 Fundamentals	27
2.1 Introduction.....	27
2.2 Classic OPC Specifications.....	29
2.2.1 OPC Overview and OPC Common Definitions and Interfaces ..	29
2.2.2 OPC Data Access Specification.....	34
2.2.3 OPC XML-DA Specification.....	52
2.2.4 OPC Data eXchange Specification.....	55
2.2.5 OPC Historical Data Access Specification.....	57
2.2.6 OPC Alarms and Events Specification.....	65
2.2.7 OPC Command Execution Specification.....	77
2.2.8 OPC Complex Data Specification.....	78
2.2.9 OPC Batch Specification.....	80
2.3 OPC Unified Architecture.....	86
2.3.1 Introduction.....	86
2.3.1.1 Never touch a running system – why a new OPC?	86
2.3.1.2 Ten reasons for OPC UA.....	87
2.3.1.3 Origin, development and objectives of OPC UA.....	92
2.3.1.4 New possibilities with OPC UA.....	93
2.3.1.5 Overview.....	94
2.3.2 UA specifications.....	94
2.3.3 Main technological features.....	99

2.3.4	UA Address Space.....	104
2.3.4.1	Classic OPC Address Space.....	104
2.3.4.2	OPC UA Address Space.....	105
2.3.4.3	Nodes and References.....	105
2.3.4.4	Node Classes.....	105
2.3.4.5	Variables.....	106
2.3.4.6	Objects.....	107
2.3.4.7	Methods.....	107
2.3.4.8	Views.....	108
2.3.4.9	Type Definitions.....	108
2.3.4.10	Reference Types.....	109
2.3.4.11	Standard Nodes in the UA Address Space.....	110
2.3.5	Information model.....	111
2.3.5.1	Concept.....	111
2.3.5.2	ObjectTypes.....	114
2.3.5.3	VariableTypes.....	115
2.3.5.4	DataTypes.....	119
2.3.5.5	ReferenceTypes.....	123
2.3.5.6	State machines.....	126
2.3.5.7	Process example.....	127
2.3.6	Services.....	131
2.3.6.1	Introduction.....	131
2.3.6.2	Comparison to Classic OPC:.....	140
2.3.6.3	Use Cases.....	143
2.3.6.4	Technical details.....	144
2.3.7	Specific Type Access.....	147
2.3.7.1	Data Access.....	149
2.3.7.2	Historical Access.....	157
2.3.7.3	Alarms and Conditions.....	167
2.3.7.4	Programs.....	176
2.3.8	Utility Specification Parts.....	184
2.3.8.1	Aggregates.....	184
2.3.8.2	OPC UA Discovery.....	190
2.3.9	Redundancy.....	196
2.3.9.1	Comparison to Classic OPC.....	196
2.3.9.2	Use cases.....	196
2.3.9.3	Technical details.....	198
2.3.9.4	Server redundancy.....	198
2.3.9.5	Transparent redundancy.....	198
2.3.9.6	Non-transparent redundancy.....	198
2.3.10	Security.....	201
2.3.10.1	Introduction.....	201
2.3.10.2	Comparison to Classic OPC.....	205
2.3.10.3	OPC UA Security.....	206
2.3.10.4	Use cases.....	208

2.3.10.5	Technical details	211
2.3.10.6	Certificates and Certificate handling	215
2.3.11	Transports	216
2.3.11.1	Introduction	216
2.3.11.2	Concepts	216
2.3.11.3	Overview	217
2.3.11.4	Technical details	219
2.3.12	Profiles	223
2.3.12.1	Comparison to Classic OPC	224
2.3.12.2	Part 7 – Definitions	224
2.3.12.3	Server Profiles	225
2.3.12.4	Client Profiles	226
2.3.12.5	Transport Profiles	227
2.3.12.6	Security Profiles	227
2.3.12.7	Part 7 – Profiles specifics	228
2.3.12.8	Use cases	228
2.4	Companion Standards	230
2.4.1	OPC UA Collaborations	230
2.4.2	Companion Standard FDI – Device Integration with OPC UA	231
2.4.2.1	What does “device integration” actually mean?	231
2.4.2.2	FDT and EDDL	231
2.4.2.3	Field Device Integration	232
2.4.2.4	FDI concept and architecture	233
2.4.2.5	Why OPC UA?	234
2.4.2.6	Summary	235
2.4.3	Analyzer Device Integration – ADI	236
2.4.3.1	Introduction	236
2.4.3.2	Vision	236
2.4.3.3	Team	238
2.4.3.4	Solution	238
2.4.3.5	OPC COM vs OPC UA and Analyzers	241
2.4.4	OpenO&M	242
2.4.4.1	Operations & Maintenance Industry Challenges	242
2.4.4.2	Use case: Operations & Maintenance – How to select priorities	244
2.4.4.3	The MIMOSA Organization	245
2.4.4.4	MIMOSA and OPC UA	246
2.4.5	PLCopen: definition of an IEC 61131-3 OPC UA information model	248
2.4.5.1	PLCopen and IEC 61131-3	248
2.4.5.2	PLCopen and OPC Foundation: joint working group	249
2.4.5.3	Application	250
2.4.5.4	Outlook	251

- 2.5 OPC Compliance Testing..... 251
 - 2.5.1 Overview 251
 - 2.5.2 Online Catalog 252
 - 2.5.3 Self Certification (Classic OPC) 253
 - 2.5.3.1 Server Compliance Test Tools 254
 - 2.5.3.2 Client Compliance Test Tools – OPC Analyzer 258
 - 2.5.3.3 Interoperability Workshop..... 259
 - 2.5.4 Self Certification (OPC UA) 259
 - 2.5.4.1 OPC UA CTT – Server 260
 - 2.5.4.2 OPC UA CTT – Client 261
 - 2.5.5 Third Party Certification..... 262
 - 2.5.5.1 Test Lab Functionality 263
 - 2.5.5.2 Server..... 264
 - 2.5.5.3 Client 265
 - 2.5.6 OPC Certification..... 265

- 3 Implementation..... 267**
 - 3.1 Introduction..... 267
 - 3.2 Base technologies and architecture concepts 268
 - 3.2.1 Distributed Component Object Model (DCOM) 268
 - 3.2.2 XML, HTTP and SOAP..... 274
 - 3.2.3 Web Services, WSDL and WS*..... 277
 - 3.2.4 SOA 279
 - 3.3 Implementation of OPC components 280
 - 3.3.1 DCOM based implementation of OPC 281
 - 3.3.2 Web Services based implementation of OPC 285
 - 3.3.3 Implementation of Classic OPC components by means of toolkits 287
 - 3.4 Implementation of OPC UA components 293
 - 3.4.1 Basics of OPC UA implementation 294
 - 3.4.2 OPC UA implementation based on the OPC UA Stack 296
 - 3.4.2.1 OPC UA Stack – Overview..... 296
 - 3.4.2.2 Java UA Stack 304
 - 3.4.2.3 OPC UA development with Java 308
 - 3.4.2.4 Design and modeling of the Address Space 312
 - 3.4.3 Implementing OPC UA by means of Toolkits 319
 - 3.4.3.1 OPC Toolkits 319
 - 3.4.3.2 Make or Buy 321
 - 3.4.3.3 OPC UA Toolkit example..... 322
 - 3.4.3.4 Implementing UA Servers 324
 - 3.4.3.5 Implementing UA Clients..... 326
 - 3.4.3.6 Implementing embedded OPC UA components 327
 - 3.4.3.7 Implementing hybrid OPC components 329
 - 3.5 Summary 330

4	Application	333
4.1	Introduction	333
4.2	Classic OPC product samples	337
4.2.1	LonWorks® OPC Server – Connecting two open standards	337
4.2.2	SIMATIC WinCC flexible and SIMATIC WinCC – Visualization software with OPC communication	341
4.2.3	MCD and OPC – two plus points for automotive manufacturing	345
4.2.4	Industrial & Financial Systems (IFS) uses OPC to interact with automation equipment	354
4.2.5	Increased productivity and reduced costs through OPC at Bühler AG	358
4.3	Aspects of Use of Classic OPC Products	362
4.3.1	Introduction	362
4.3.2	DCOM configuration	364
4.3.3	OPC communication without DCOM – OPC Tunneling	376
4.3.4	OPC communication and OPC Security	377
4.3.5	OPC Gateways	378
4.3.6	Optimizing OPC communications with many clients	381
4.3.7	Dealing with differences between multivendor OPC Servers	382
4.3.8	Archiving OPC Data to a database	383
4.3.9	Summary	383
4.4	OPC UA Product Samples	384
4.4.1	SAP and OPC UA	384
4.4.2	ICONICS GENESIS64 Version 10 – Visualization with OPC UA	390
4.4.3	OPC UA server and OPC UA client in an embedded controller	394
4.4.4	UA Address Space Model Designer	398
4.5	Performance	404
4.5.1	Performance assessments of Classic OPC applications	405
4.5.2	Performance assessments of Classic OPC in real-world applications	413
4.5.3	Performance assessments of OPC XML DA	416
4.5.4	Performance assessments of OPC Unified Architecture	419
5	Summary and Outlook	427
	Literature	433
	Index	435