

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 Bühlner 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