

---

# Contents

## Part I Operational Applications and Requirements

<b>1</b>	<b>Operational Applications in the Power Delivery System</b> . . . . .	3
<b>2</b>	<b>IEC 61850 Communication Model</b> . . . . .	7
<b>3</b>	<b>Substation-to-Substation Applications</b> . . . . .	11
3.1	Line Protection Applications . . . . .	11
3.1.1	State Comparison Protection Schemes . . . . .	14
3.1.2	Analogue Comparison Protection Schemes . . . . .	18
3.1.3	Protection Relay Communication in the IEC 61850 . . . . .	21
3.2	System Protection Schemes . . . . .	22
3.2.1	SPS Applications . . . . .	23
3.2.2	SPS Architecture . . . . .	24
3.2.3	Wide Area Protection & Control (WAP&C) . . . . .	25
<b>4</b>	<b>Field Device to Central Platform Applications</b> . . . . .	29
4.1	Power System SCADA . . . . .	30
4.2	Synchrophasor-Based Wide Area Monitoring System . . . . .	31
4.3	Other IP-Based Monitoring Applications in the Substation . . . . .	34
<b>5</b>	<b>Inter-platform Applications</b> . . . . .	37
<b>6</b>	<b>Office-to-Field Applications</b> . . . . .	39
6.1	Remote Access from Office to Grid Device and Information . . . . .	41
6.2	Field Worker Access to Central Platforms and Applications . . . . .	41
<b>7</b>	<b>Smart Distribution Applications</b> . . . . .	45
 <b>Part II Provisioning of Utility-Grade Communication Services</b>		
<b>8</b>	<b>Service Provisioning, Quality of Service, and SLA</b> . . . . .	49

<b>9</b>	<b>Service Specification Attributes . . . . .</b>	<b>53</b>
9.1	Operational Coverage and Topology . . . . .	53
9.2	Throughput . . . . .	54
9.3	Time Constraints. . . . .	55
9.4	Service Integrity and Data Loss . . . . .	59
9.5	Availability and Dependability . . . . .	62
9.6	Communication Security . . . . .	64
9.7	Future Proofing, Legacy Support, Vendor Independence . . . . .	65
9.8	Electromagnetic and Environmental Constraints . . . . .	66
9.9	Service Survivability, Resilience and Disaster Readiness . . . . .	67
9.10	Cost Considerations. . . . .	68
<b>10</b>	<b>Building and Adjusting Service Level Agreements . . . . .</b>	<b>75</b>
<b>11</b>	<b>Service Provisioning Models—Impact on the Delivery Process . . . . .</b>	<b>81</b>
<b>Part III Delivery of Communication Services in the Utility Environment</b>		
<b>12</b>	<b>Introduction on Service Delivery . . . . .</b>	<b>89</b>
<b>13</b>	<b>Communication Service Delivery Architecture . . . . .</b>	<b>91</b>
<b>14</b>	<b>Service Interfacing at the Access Point. . . . .</b>	<b>95</b>
14.1	Legacy Interfacing. . . . .	95
14.2	Ethernet Access . . . . .	96
<b>15</b>	<b>Synchronization at User-to-Network Interface . . . . .</b>	<b>99</b>
<b>16</b>	<b>Circuit and Packet Conversions at the Service Access Point . . . . .</b>	<b>103</b>
16.1	Packet Over TDM. . . . .	103
16.2	Circuit Emulation Over Packet . . . . .	104
<b>17</b>	<b>Modeling the Service Delivery Process . . . . .</b>	<b>109</b>
<b>18</b>	<b>Managing the Delivered Communication Service . . . . .</b>	<b>115</b>
<b>19</b>	<b>Meeting Service Quality at a Packet-Switched Access Point . . . . .</b>	<b>119</b>
<b>20</b>	<b>Integrating Service Delivery for IT and OT Communications . . . . .</b>	<b>129</b>
<b>Part IV Deploying Reliable and Secure Network Infrastructures</b>		
<b>21</b>	<b>Deploying Reliable and Secure Network Infrastructures . . . . .</b>	<b>137</b>
<b>22</b>	<b>An Overview on Network Technologies . . . . .</b>	<b>139</b>
22.1	Multiplexing and Switching Fundamentals . . . . .	139
22.2	Optical Communication . . . . .	140
22.3	Wavelength Division Multiplexing (C- and D-WDM) . . . . .	141
22.4	Time Division Multiplexing (PDH and SDH) . . . . .	142
22.5	Optical Transport Networks (OTN) . . . . .	145

22.6	Ethernet Transport . . . . .	146
22.7	Multi-protocol Label Switching (MPLS) . . . . .	147
22.8	MPLS-TP or IP-MPLS in Operational Context . . . . .	150
22.9	Radio Communication . . . . .	151
22.10	Power Line Carrier . . . . .	153
<b>23</b>	<b>Hierarchical and Overlay Architectures . . . . .</b>	<b>155</b>
<b>24</b>	<b>Revisiting the Process Model—Upstream Management . . . . .</b>	<b>161</b>
24.1	Policy Definition and Business Planning . . . . .	163
24.2	Strategic Deployment and Tactical Adjustments . . . . .	165
24.3	Business Development, Service Offer, and Service Migrations . . . . .	169
<b>25</b>	<b>Telecom Network Asset Ownership . . . . .</b>	<b>171</b>
25.1	Fiber and RF Infrastructure . . . . .	172
25.2	Transport Network Assets . . . . .	175
25.3	Application Service Networks and Platforms . . . . .	176
<b>26</b>	<b>Planning Network Transformations and Migrations . . . . .</b>	<b>177</b>
<b>27</b>	<b>Cyber-Secure and Disaster-Resistant Communications . . . . .</b>	<b>183</b>
27.1	Risk and Impact Assessment . . . . .	184
27.2	Designing for Cyber-Security . . . . .	185
27.3	Designing for Disaster-Resistance . . . . .	190
 <b>Part V Maintaining Network Operation</b>		
<b>28</b>	<b>Maintaining Network Operation—Introduction . . . . .</b>	<b>195</b>
<b>29</b>	<b>Reasons for a Formal Approach to O&amp;M . . . . .</b>	<b>197</b>
<b>30</b>	<b>O&amp;M Scope, Process, and Organization . . . . .</b>	<b>201</b>
30.1	User-Provider Relationship . . . . .	202
30.2	Network Perimeter for O&M . . . . .	203
30.3	Scope of O&M Activities. . . . .	204
30.4	Evolution of O&M Scopes and Processes. . . . .	205
30.5	Transforming the O&M . . . . .	206
30.6	Operation and Maintenance Organization . . . . .	208
30.7	Network Operation Center Activities . . . . .	210
<b>31</b>	<b>Managing Faults and Anomalies . . . . .</b>	<b>213</b>
31.1	Fault Detection . . . . .	213
31.2	Fault Localization and Problem Management . . . . .	217
31.3	Fault Notification and Reporting . . . . .	217
31.4	Fault Diagnostics . . . . .	218
31.5	Fault Recovery and Reporting. . . . .	218

---

<b>32 Incident Management and Work Assignment</b> . . . . .	219
<b>33 Configuration and Change Management</b> . . . . .	221
33.1 Configuration Database—Network and Service Inventory. . . . .	221
33.2 User Order Handling and Service Activation . . . . .	224
33.3 Configuration and Change Management, Capacity Management. . . . .	224
33.4 O&M Tools and IT Platform Management . . . . .	226
33.5 Asset Lifecycle and Spare Management . . . . .	226
<b>34 Quality and Performance Monitoring</b> . . . . .	229
34.1 TDM Transmission Performance Monitoring . . . . .	230
34.2 Packet-Switched Network Performance Monitoring . . . . .	230
<b>35 Telecom O&amp;M Communications and Field Worker Support</b> . . . . .	233
35.1 Telecom O&M Communications . . . . .	233
35.2 Connecting to Field Device and Management Platforms. . . . .	234
35.3 Human-to-Human O&M Communications . . . . .	235
35.4 External O&M Interventions. . . . .	236
35.5 Field Worker Access to Operational Sites and Assets. . . . .	237
35.6 Disaster-Mode Operation . . . . .	240
<b>Appendix 1: Termination Networks and Service Access</b> . . . . .	243
<b>Appendix 2: ITIL Management Framework</b> . . . . .	253
<b>Appendix 3: Some Relevant Standards</b> . . . . .	259
<b>Appendix 4: CIGRE Technical Brochure Contributors</b> . . . . .	263
<b>Bibliography</b> . . . . .	265
<b>Index</b> . . . . .	267



<http://www.springer.com/978-3-319-40282-6>

Utility Communication Networks and Services

Specification, Deployment and Operation

Samitier, C. (Ed.)

2017, XXIX, 269 p. 75 illus., 56 illus. in color., Hardcover

ISBN: 978-3-319-40282-6