Service-Oriented Architecture

A Field Guide to Integrating XML and Web Services

Thomas Erl
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>XIX</td>
</tr>
<tr>
<td>Chapter 1</td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Why this guide is important</td>
<td>2</td>
</tr>
<tr>
<td>1.1.1 The hammer and XML</td>
<td>2</td>
</tr>
<tr>
<td>1.1.2 XML and Web services</td>
<td>3</td>
</tr>
<tr>
<td>1.1.3 Web services and Service-Oriented Architecture</td>
<td>3</td>
</tr>
<tr>
<td>1.1.4 Service-Oriented Architecture and the hammer</td>
<td>3</td>
</tr>
<tr>
<td>1.1.5 The hammer and you</td>
<td>4</td>
</tr>
<tr>
<td>1.2 The XML &amp; Web Services Integration Framework (XWIF)</td>
<td>4</td>
</tr>
<tr>
<td>1.3 How this guide is organized</td>
<td>5</td>
</tr>
<tr>
<td>1.3.1 Part I: The technical landscape</td>
<td>6</td>
</tr>
<tr>
<td>1.3.2 Part II: Integrating technology</td>
<td>7</td>
</tr>
<tr>
<td>1.3.3 Part III: Integrating applications</td>
<td>9</td>
</tr>
<tr>
<td>1.3.4 Part IV: Integrating the enterprise</td>
<td>12</td>
</tr>
<tr>
<td>1.3.5 The extended enterprise</td>
<td>13</td>
</tr>
<tr>
<td>1.4 <a href="http://www.serviceoriented.ws">www.serviceoriented.ws</a></td>
<td>13</td>
</tr>
<tr>
<td>1.5 Contact the author</td>
<td>13</td>
</tr>
</tbody>
</table>
Contents

Part I

The technical landscape

Chapter 2
Introduction to XML technologies

2.1 Extensible Markup Language (XML) ...................................................... 18
  2.1.1 Concepts .......................................................................................... 20
  2.1.2 Schemas .......................................................................................... 21
  2.1.3 Programming models ....................................................................... 22
  2.1.4 Syntax .............................................................................................. 23
2.2 Document Type Definitions (DTD) .................................................... 24
  2.2.1 Concepts .......................................................................................... 25
  2.2.2 Syntax .............................................................................................. 25
2.3 XML Schema Definition Language (XSD) ....................................... 28
  2.3.1 Concepts .......................................................................................... 28
  2.3.2 Syntax .............................................................................................. 28
2.4 Extensible Stylesheet Language Transformations (XSLT) ............... 33
  2.4.1 Concepts .......................................................................................... 34
  2.4.2 Syntax .............................................................................................. 35
2.5 XML Query Language (XQuery) ....................................................... 38
  2.5.1 Concepts .......................................................................................... 38
  2.5.2 Syntax .............................................................................................. 41
2.6 XML Path Language (XPath) ............................................................ 43
  2.6.1 Concepts .......................................................................................... 43
  2.6.2 Syntax .............................................................................................. 44

Chapter 3
Introduction to Web services technologies

3.1 Web services and the service-oriented architecture (SOA) .......... 48
  3.1.1 Understanding services ................................................................... 48
  3.1.2 XML Web services ......................................................................... 49
  3.1.3 Service-oriented architecture (SOA) .............................................. 50
  3.1.4 Common principles of service-orientation .................................... 53
  3.1.5 Web service roles ......................................................................... 55
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.6 Web service interaction</td>
<td>57</td>
</tr>
<tr>
<td>3.1.7 Service models</td>
<td>61</td>
</tr>
<tr>
<td>3.1.8 Web service description structure</td>
<td>64</td>
</tr>
<tr>
<td>3.1.9 Introduction to first-generation Web services</td>
<td>66</td>
</tr>
<tr>
<td>3.2 Web Services Description Language (WSDL)</td>
<td>67</td>
</tr>
<tr>
<td>3.2.1 Abstract interface definition</td>
<td>68</td>
</tr>
<tr>
<td>3.2.2 Concrete (implementation) definition</td>
<td>70</td>
</tr>
<tr>
<td>3.2.3 Supplementary constructs</td>
<td>71</td>
</tr>
<tr>
<td>3.3 Simple Object Access Protocol (SOAP)</td>
<td>72</td>
</tr>
<tr>
<td>3.3.1 SOAP messaging framework</td>
<td>74</td>
</tr>
<tr>
<td>3.3.2 SOAP message structure</td>
<td>77</td>
</tr>
<tr>
<td>3.4 Universal Description, Discovery, and Integration (UDDI)</td>
<td>81</td>
</tr>
<tr>
<td>4.1 Second-generation Web services and the service-oriented enterprise (SOE)</td>
<td>90</td>
</tr>
<tr>
<td>4.1.1 Problems solved by second-generation specifications</td>
<td>92</td>
</tr>
<tr>
<td>4.1.2 The second-generation landscape</td>
<td>94</td>
</tr>
<tr>
<td>4.2 WS-Coordination and WS-Transaction</td>
<td>96</td>
</tr>
<tr>
<td>4.2.1 Concepts</td>
<td>96</td>
</tr>
<tr>
<td>4.2.2 Syntax</td>
<td>99</td>
</tr>
<tr>
<td>4.3 Business Process Execution Language for Web Services (BPEL4WS)</td>
<td>100</td>
</tr>
<tr>
<td>4.3.1 Recent business process specifications</td>
<td>100</td>
</tr>
<tr>
<td>4.3.2 Concepts</td>
<td>100</td>
</tr>
<tr>
<td>4.3.3 Syntax</td>
<td>106</td>
</tr>
<tr>
<td>4.4 WS-Security and the Web services security specifications</td>
<td>109</td>
</tr>
<tr>
<td>4.4.1 General security concepts</td>
<td>110</td>
</tr>
<tr>
<td>4.4.2 Specifications</td>
<td>111</td>
</tr>
<tr>
<td>4.4.3 XML Key Management (XKMS)</td>
<td>112</td>
</tr>
<tr>
<td>4.4.4 Extensible Access Control Markup Language (XACML) and Extensible Rights Markup Language (XrML)</td>
<td>112</td>
</tr>
<tr>
<td>4.4.5 Security Assertion Markup Language (SAML) and .NET Passport</td>
<td>112</td>
</tr>
</tbody>
</table>
4.4.6 XML-Encryption and XML-Digital Signature ................................. 113
4.4.7 Secure Sockets Layer (SSL) .......................................................... 113
4.4.8 The WS-Security framework ......................................................... 115
4.4.9 Concepts and syntax ..................................................................... 117
4.5 WS-ReliableMessaging .................................................................... 118
4.5.1 WS-Addressing .............................................................................. 119
4.5.2 Concepts ......................................................................................... 119
4.5.3 Acknowledgements ......................................................................... 121
4.5.4 Syntax ............................................................................................ 123
4.6 WS-Policy .......................................................................................... 125
4.6.1 Concepts ......................................................................................... 126
4.6.2 Syntax ............................................................................................ 126
4.7 WS-Attachments ............................................................................... 127

Part II
Integrating technology 131

Chapter 5
Integrating XML into applications 133

5.1 Strategies for integrating XML data representation ....................... 135
5.1.1 Positioning XML data representation in your architecture .......... 135
5.1.2 Think “tree” (a new way of representing data) ............................. 138
5.1.3 Easy now… (don’t rush the XML document model) ...................... 139
5.1.4 Design with foresight ..................................................................... 140
5.1.5 Focus on extensibility and reusability ............................................ 142
5.1.6 Lose weight while modeling! (keeping your documents trim) ....... 142
5.1.7 Naming element-types: performance vs. legibility ..................... 143
5.1.8 Applying XML consistently ............................................................ 144
5.1.9 Choosing the right API (DOM vs. SAX vs. Data Binding) ............ 145
5.1.10 Securing XML documents ............................................................. 147
5.1.11 Pick the right tools ....................................................................... 148
5.1.12 Don’t try this at home (fringe optimization strategies) ............... 150

5.2 Strategies for integrating XML data validation .............................. 151
5.2.1 XSD schemas or DTDs? ................................................................. 151
5.2.2 Positioning DTDs in your architecture ......................................... 155
5.2.3 Positioning XSD schemas in your architecture ........................................ 156
5.2.4 Understand the syntactical limitations of XSD schemas ..................... 158
5.2.5 Understand the performance limitations of XSD schemas ................. 160
5.2.6 Other fish in the sea (more schema definition languages) ............... 160
5.2.7 Supplementing XSD schema validation .............................................. 162
5.2.8 Integrating XML validation into a distributed architecture ................ 163
5.2.9 Avoiding over-validation ..................................................................... 165
5.2.10 Consider targeted validation ............................................................. 166
5.2.11 Building modular and extensible XSD schemas .................................. 167
5.2.12 Understand the integration limitations of your database ................. 169
5.3 Strategies for integrating XML schema administration ..................... 170
  5.3.1 XML schemas and the silent disparity pattern .................................... 170
  5.3.2 A step-by-step process ...................................................................... 171
5.4 Strategies for integrating XML transformation .................................... 174
  5.4.1 Positioning XSLT in your architecture ............................................ 174
  5.4.2 Pre-transform for static caching ...................................................... 177
  5.4.3 Create dynamic XSLT style sheets ................................................. 178
  5.4.4 Simplify aesthetic transformation with CSS .................................... 178
  5.4.5 Understand the scalability limitations of XSLT ................................. 178
  5.4.6 Strategic redundancy ....................................................................... 179
5.5 Strategies for integrating XML data querying ...................................... 179
  5.5.1 Positioning XQuery in your architecture ......................................... 180
  5.5.2 Multi-data source abstraction ......................................................... 180
  5.5.3 Establishing a data policy management layer ................................... 182
  5.5.4 Unifying documents and data ......................................................... 183

Chapter 6

Integrating Web services into applications .................................................. 187

  6.1 Service models .................................................................................... 188
    6.1.1 Utility services ............................................................................. 189
    6.1.2 Business services ......................................................................... 191
    6.1.3 Controller services ....................................................................... 191
  6.2 Modeling service-oriented component classes and Web service interfaces ........................................................................................................... 194
    6.2.1 Designing service-oriented component classes (a step-by-step process) ........................................................................................................ 195
6.2.2 Designing Web service interfaces
(a step-by-step process) ............................................................... 206

6.3 Strategies for integrating service-oriented encapsulation .......... 214
  6.3.1 Define criteria for consistent logic encapsulation
  and interface granularity ........................................................... 215
  6.3.2 Establish a standard naming convention ............................... 215
  6.3.3 Parameter-driven vs. operation-oriented interfaces.............. 215
  6.3.4 Designing for diverse granularity ....................................... 216
  6.3.5 Utilize generic services consistently .................................... 217
  6.3.6 Establish separate standards for internal
  and external services .............................................................. 218
  6.3.7 Considering third-party Web services ................................. 219

6.4 Strategies for integrating service compositions ...................... 220
  6.4.1 Everything in moderation, including service compositions ....... 221
  6.4.2 Modeling service compositions ......................................... 221
  6.4.3 Compound service compositions ....................................... 224

6.5 Strategies for enhancing service functionality ....................... 225
  6.5.1 Outputting user-interface information ................................. 225
  6.5.2 Caching more than textual data ........................................ 226
  6.5.3 Streamlining the service design with usage patterns ............. 227

6.6 Strategies for integrating SOAP messaging ......................... 228
  6.6.1 SOAP message performance management ........................... 228
  6.6.2 SOAP message compression techniques ............................. 228
  6.6.3 Security issues with SOAP messaging ................................. 230
  6.6.4 Easing into SOAP .......................................................... 231

Chapter 7

Integrating XML and databases .................................................. 233

7.1 Comparing XML and relational databases ............................ 234
  7.1.1 Data storage and security .................................................. 235
  7.1.2 Data representation .......................................................... 235
  7.1.3 Data integrity and validation ............................................. 236
  7.1.4 Data querying and indexing .............................................. 236
  7.1.5 Additional features .......................................................... 236

7.2 Integration architectures for XML and relational databases ....... 237
  7.2.1 Storing XML documents as database records ...................... 240
  7.2.2 Storing XML document constructs as database records ......... 242
Contents

7.2.3 Using XML to represent a view of database queries .................... 243
7.2.4 Using XML to represent a view of a relational data model .......... 245
7.2.5 Using XML to represent relational data within an in-memory database (IMDB) .................................................... 246

7.3 Strategies for integrating XML with relational databases ............ 247
7.3.1 Target only the data you need ...................................................... 248
7.3.2 Avoiding relationships by creating specialized data views .......... 249
7.3.3 Create XML-friendly database models ........................................ 249
7.3.4 Extending the schema model with annotations ......................... 250
7.3.5 Non-XML data models in XML schemas ................................... 251
7.3.6 Developing a caching strategy ..................................................... 251
7.3.7 Querying the XSD schema ......................................................... 252
7.3.8 Control XML output with XSLT ................................................... 252
7.3.9 Integrate XML with query limitations in mind ............................ 253
7.3.10 Is a text file a legitimate repository? .......................................... 254
7.3.11 Loose coupling and developer skill sets .................................... 254

7.4 Techniques for mapping XML to relational data ....................... 255
7.4.1 Mapping XML documents to relational data ................................. 255
7.4.2 The Bear Sightings application ................................................... 256
7.4.3 Intrinsic one-to-one and one-to-many relationships with XML ...... 256
7.4.4 Mapping XML to relational data with DTDs ................................. 258
7.4.5 Mapping XML to relational data with XSD schemas .................... 265

7.5 Database extensions ................................................................. 271
7.5.1 Proprietary extensions to SQL .................................................... 271
7.5.2 Proprietary versions of XML specifications ............................... 272
7.5.3 Proprietary XML-to-database mapping ..................................... 272
7.5.4 XML output format ................................................................. 272
7.5.5 Stored procedures ................................................................. 273
7.5.6 Importing and exporting XML documents .................................. 273
7.5.7 Encapsulating proprietary database extensions within Web services ................................................................. 274

7.6 Native XML databases ............................................................... 274
7.6.1 Storage of document-centric data .............................................. 274
7.6.2 Integrated XML schema models ............................................... 275
7.6.3 Queries and data retrieval ....................................................... 275
7.6.4 Native XML databases for intermediary storage ........................ 276
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>The mechanics of application integration</td>
<td>281</td>
</tr>
<tr>
<td>8.1</td>
<td>Understanding application integration</td>
<td>282</td>
</tr>
<tr>
<td>8.1.1</td>
<td>Types of integration projects</td>
<td>282</td>
</tr>
<tr>
<td>8.1.2</td>
<td>Typical integration requirements</td>
<td>282</td>
</tr>
<tr>
<td>8.1.3</td>
<td>Progress versus impact</td>
<td>283</td>
</tr>
<tr>
<td>8.1.4</td>
<td>Types of integration solutions</td>
<td>284</td>
</tr>
<tr>
<td>8.2</td>
<td>Integration levels</td>
<td>286</td>
</tr>
<tr>
<td>8.2.1</td>
<td>Data-level integration</td>
<td>287</td>
</tr>
<tr>
<td>8.2.2</td>
<td>Application-level integration</td>
<td>288</td>
</tr>
<tr>
<td>8.2.3</td>
<td>Process-level integration</td>
<td>289</td>
</tr>
<tr>
<td>8.2.4</td>
<td>Service-oriented integration</td>
<td>290</td>
</tr>
<tr>
<td>8.3</td>
<td>A guide to middleware</td>
<td>291</td>
</tr>
<tr>
<td>8.3.1</td>
<td>“EAI” versus “middleware”</td>
<td>291</td>
</tr>
<tr>
<td>8.3.2</td>
<td>Shredding the Oreo</td>
<td>291</td>
</tr>
<tr>
<td>8.3.3</td>
<td>Common middleware services and products</td>
<td>292</td>
</tr>
<tr>
<td>8.3.4</td>
<td>A checklist for buying middleware</td>
<td>294</td>
</tr>
<tr>
<td>8.4</td>
<td>Choosing an integration path</td>
<td>298</td>
</tr>
<tr>
<td>8.4.1</td>
<td>Two paths, one destination</td>
<td>299</td>
</tr>
<tr>
<td>8.4.2</td>
<td>Moving to EAI</td>
<td>299</td>
</tr>
<tr>
<td>8.4.3</td>
<td>Common myths</td>
<td>299</td>
</tr>
<tr>
<td>8.4.4</td>
<td>The impact of an upgrade</td>
<td>300</td>
</tr>
<tr>
<td>8.4.5</td>
<td>Weighing your options</td>
<td>301</td>
</tr>
<tr>
<td>9</td>
<td>Service-oriented architectures for legacy integration</td>
<td>303</td>
</tr>
<tr>
<td>9.1</td>
<td>Service models for application integration</td>
<td>304</td>
</tr>
<tr>
<td>9.1.1</td>
<td>Proxy services</td>
<td>305</td>
</tr>
<tr>
<td>9.1.2</td>
<td>Wrapper services</td>
<td>307</td>
</tr>
<tr>
<td>9.1.3</td>
<td>Coordination services (for atomic transactions)</td>
<td>308</td>
</tr>
</tbody>
</table>
Contents

9.2 Fundamental integration components ............................................ 310
  9.2.1 Adapters .............................................................................. 310
  9.2.2 Intermediaries ..................................................................... 312
  9.2.3 Interceptors ......................................................................... 314

9.3 Web services and one-way integration architectures .................... 314
  9.3.1 Batch export and import ...................................................... 315
  9.3.2 Direct data access ................................................................. 319

9.4 Web services and point-to-point architectures ............................ 324
  9.4.1 Tightly coupled integration between homogenous legacy applications .................................................. 324
  9.4.2 Tightly coupled integration between heterogeneous applications .................................................. 325
  9.4.3 Integration between homogenous component-based applications .................................................. 332
  9.4.4 Integration between heterogeneous component-based applications .................................................. 336

9.5 Web services and centralized database architectures ................... 340
  9.5.1 Traditional architecture ......................................................... 340
  9.5.2 Using a Web service as a data access controller .................... 341

9.6 Service-oriented analysis for legacy architectures ....................... 344

Chapter 10

Service-oriented architectures for enterprise integration .................. 353

10.1 Service models for enterprise integration architectures .............. 354
  10.1.1 Process services ................................................................. 354
  10.1.2 Coordination services (for business activities) .................... 356

10.2 Fundamental enterprise integration architecture components ...... 358
  10.2.1 Broker ............................................................................... 360
  10.2.2 Orchestration ..................................................................... 363

10.3 Web services and enterprise integration architectures ............... 368
  10.3.1 Hub and spoke ................................................................. 369
  10.3.2 Messaging bus ................................................................. 372
  10.3.3 Enterprise Service Bus (ESB) ............................................. 375
Chapter 11

Service-oriented integration strategies

11.1 Strategies for streamlining integration endpoint interfaces .......... 381
  11.1.1 Make interfaces more generic................................................. 381
  11.1.2 Consolidate legacy interfaces.................................................. 382
  11.1.3 Consolidate proxy interfaces................................................... 383
  11.1.4 Supplement legacy logic with external logic .............................. 385
  11.1.5 Add support for multiple data output formats........................... 387
  11.1.6 Provide alternative interfaces for different SOAP clients............. 387

11.2 Strategies for optimizing integration endpoint services................. 389
  11.2.1 Minimize the use of service intermediaries.............................. 389
  11.2.2 Consider using service interceptors........................................ 389
  11.2.3 Data processing delegation..................................................... 391
  11.2.4 Caching the provider WSDL definition..................................... 392

11.3 Strategies for integrating legacy architectures............................ 394
  11.3.1 Create a transition architecture by adding partial integration layers.............................................................................. 394
  11.3.2 Data caching with an IMDB.......................................................... 394
  11.3.3 Utilizing a queue to counter scalability demands.......................... 395
  11.3.4 Adding a mini-hub...................................................................... 397
  11.3.5 Abstract legacy adapter technology.......................................... 398
  11.3.6 Leveraging legacy integration architectures.............................. 398
  11.3.7 Appending Web services to legacy integration architectures ........ 400

11.4 Strategies for enterprise solution integration.............................. 401
  11.4.1 Pragmatic service-oriented integration ...................................... 402
  11.4.2 Integrating disparate EAI products........................................... 403
  11.4.3 Respect your elders (building EAI around your legacy environments).................................................................................. 404
  11.4.4 Build a private service registry................................................... 406

11.5 Strategies for integrating Web services security.......................... 406
  11.5.1 Learn about the Web services security specifications.................. 407
  11.5.2 Build services with a standardized service-oriented security (SOS) model................................................................. 407
  11.5.3 Create a security services layer.................................................. 407
  11.5.4 Beware remote third-party services.......................................... 409
  11.5.5 Prepare for the performance impact.......................................... 409
  11.5.6 Define an appropriate system for single sign-on.......................... 410
Contents

11.5.7 Don’t over-describe your services .......................................................... 410
11.5.8 Fortify or retreat integrated legacy systems ........................................ 411
11.5.9 Take advantage of granular security ................................................... 412
11.5.10 Web services and port 80 ................................................................. 413
11.5.11 SOAP attachments and viruses ......................................................... 413
11.5.12 Consider the development of security policies ................................... 414
11.5.13 Don’t wait to think about administration ........................................... 414

Part IV

Integrating the enterprise 417

Chapter 12

Thirty best practices for integrating XML 419

12.1 Best practices for planning XML migration projects ................................. 420
  12.1.1 Understand what you are getting yourself into ..................................... 420
  12.1.2 Assess the technical impact ............................................................... 422
  12.1.3 Invest in an XML impact analysis ...................................................... 424
  12.1.4 Assess the organizational impact ....................................................... 425
  12.1.5 Targeting legacy data ........................................................................ 426

12.2 Best practices for knowledge management within XML projects ................. 429
  12.2.1 Always relate XML to data ............................................................... 429
  12.2.2 Determine the extent of education required by your organization ........ 430
  12.2.3 Customize a training plan ................................................................. 430
  12.2.4 Incorporate mentoring into development projects ............................... 433

12.3 Best practices for standardizing XML applications ...................................... 434
  12.3.1 Incorporate standards ....................................................................... 434
  12.3.2 Standardize, but don’t over-standardize ............................................. 435
  12.3.3 Define a schema management strategy .............................................. 436
  12.3.4 Use XML to standardize data access logic ........................................ 438
  12.3.5 Evaluate tools prior to integration .................................................... 439

12.4 Best practices for designing XML applications ......................................... 439
  12.4.1 Develop a system for knowledge distribution ...................................... 439
  12.4.2 Remember what the “X” stands for ................................................. 441
12.4.3 Design with service-oriented principles (even if not using Web services) ........................................ 441
12.4.4 Strive for a balanced integration strategy ........................................ 442
12.4.5 Understand the roles of supplementary XML technologies .......... 443
12.4.6 Adapt to new technology developments ........................................ 444

Chapter 13

Thirty best practices for integrating Web services 447

13.1 Best practices for planning service-oriented projects .............. 448
  13.1.1 Know when to use Web services .................................................. 448
  13.1.2 Know how to use Web services .................................................... 449
  13.1.3 Know when to avoid Web services ................................................. 449
  13.1.4 Moving forward with a transition architecture ......................... 450
  13.1.5 Leverage the legacy ..................................................................... 450
  13.1.6 Sorry, no refunds (Web services and your bottom line) .......... 451
  13.1.7 Align ROIs with migration strategies .......................................... 452
  13.1.8 Build toward a future state ........................................................... 453

13.2 Best practices for standardizing Web services .................... 454
  13.2.1 Incorporate standards ................................................................. 454
  13.2.2 Label the infrastructure ............................................................... 455
  13.2.3 Design against an interface (not vice versa) ............................... 456
  13.2.4 Service interface designer ........................................................... 458
  13.2.5 Categorize your services ............................................................. 458

13.3 Best practices for designing service-oriented environments .... 459
  13.3.1 Use SOAs to streamline business models ..................................... 459
  13.3.2 Research the state of second-generation specifications .......... 459
  13.3.3 Strategically position second-generation specifications ............ 460
  13.3.4 Understand the limitations of your platform ............................ 460
  13.3.5 Use abstraction to protect legacy endpoints from change ......... 461
  13.3.6 Build around a security model .................................................... 462

13.4 Best practices for managing service-oriented development projects ........................................................................ 465
  13.4.1 Organizing development resources ............................................. 465
  13.4.2 Don’t underestimate training for developers .............................. 466

13.5 Best practices for implementing Web services .................. 467
  13.5.1 Use a private service registry ....................................................... 467
Contents  

13.5.2 Prepare for administration ................................................................. 469
13.5.3 Monitor and respond to changes in the service hosting environments ................................................. 470
13.5.4 Test for the unknown ........................................................................ 471

Chapter 14
Building the service-oriented enterprise (SOE) 473

14.1 SOA modeling basics ......................................................................... 474
14.1.1 Activities ........................................................................................... 476
14.1.2 Services ............................................................................................. 477
14.1.3 Processes .......................................................................................... 477
14.2 SOE building blocks ........................................................................... 479
14.2.1 SOE business modeling building blocks ........................................... 480
14.2.2 SOE technology architecture building blocks ................................... 487
14.2.3 Service-oriented security model ....................................................... 496
14.3 SOE migration strategy ....................................................................... 498
14.3.1 Overview of the Layered Scope Model (LSM) ................................. 498
14.3.2 Intrinsic Layer .................................................................................. 501
14.3.3 Internal layer ..................................................................................... 503
14.3.4 A2A layer ........................................................................................ 506
14.3.5 EAI layer ........................................................................................ 509
14.3.6 Enterprise layer ................................................................................ 512
14.3.7 The extended enterprise ................................................................. 513
14.3.8 Customizing the LSM ..................................................................... 513
14.3.9 Alternatives to the LSM ................................................................. 515

About the Author 517

About the Photographs 519

Index 521
CHAPTER 1

Introduction

1.1 Why this guide is important  page 2
1.2 The XML & Web Services Integration Framework (XWIF)  page 4
1.3 How this guide is organized  page 5
1.4 www.serviceoriented.ws  page 13
1.5 Contact the author  page 13
1.1 Why this guide is important

"Hype," by definition, is an exaggeration of fact. Both XML and Web services have had their share. When looking back at the rise of these technologies and the excitement that surrounded them, many who bought into the hype are beginning to feel disappointed. Organizations are realizing that their technical environments are not magically transformed simply by adding XML or Web services to the mix.

I actually believe that much of this publicity has been warranted. This platform’s potential is real, and its importance cannot be understated. When properly applied, it not only improves the technology of an organization, but also the manner in which business automation is delivered. When properly applied.

What’s been exaggerated isn’t as much the potential, but its perceived simplicity. A well-designed, service-oriented environment can simplify and streamline many aspects of information technology, but achieving this state is no simple matter. The technology set introduced by XML and Web services is diversely complex. In order to truly leverage its benefits, you first need to appreciate the implications of this complexity. Then, you need to strategize.

1.1.1 The hammer and XML

It all starts with XML. Like a hammer, XML is a tool. If you pay attention to how you use it, you’ll hit the nail every time; if you don’t, chances are your thumb will take a beating. On its own, it does not solve or create problems—the results of using XML are directly related to how intelligently it is applied.

For years, industry analysts have theorized and speculated about the benefits XML will introduce to the age of online data sharing. Because this technology platform provides a potential ideal for a universal data format, it will lead the world into a new era of information unity and parity.

The potential is real, but the manner in which XML is being applied in the real world is anything but ideal. XML is a specification, a revolutionary innovation that exists in a document that describes a simple idea, with huge implications. The fact that XML has been adopted into the IT mainstream is good. It establishes a common technology used for a common purpose. Simply using XML, however, in no way guarantees that you
Why this guide is important

will realize any of its true benefits. You will be staying current, complying with a worldwide platform shift, and you will not feel left out when reading about how others are riding the XML wave, but... you will not see anything revolutionary happening in your world.

1.1.2 XML and Web services

If XML is a hammer, then Web services are... what? The nail? The hand that holds it? Whatever it is you’re building, Web services are the building blocks you can use after you’ve first pounded out a solid foundation with XML. That doesn’t mean you can’t start using Web services without first properly integrating XML, but then there’s nothing stopping you from building that dream house in the swamplands either.

This guide, in fact, is mostly about integration with Web services technologies and service-oriented design principles. This makes it no less of a book about XML, since the Web services platform is a natural continuation of the XML movement.

1.1.3 Web services and Service-Oriented Architecture

As you read through this book, you will notice that the path to building service-oriented architecture is riddled with pitfalls and risks. Too often, organizations investing in Web services discover the errors of their ways once entire solutions have been built and deployed. This is not necessarily a bad or neglectful occurrence. It’s simply a tribute to the vastness of this platform.

With its complex and comprehensive feature set, though, comes a load of power. Use this technology the right way, and you truly can build a better enterprise. That statement goes beyond IT, because service-oriented concepts can reach out and change the way you model your business. Grasping the potential is an important first step. Equally as important, though, is understanding what’s involved with realizing this potential. That takes us back to integration strategy.

1.1.4 Service-Oriented Architecture and the hammer

Unfortunately, the majority of corporate IT departments do not employ any form of integration or migration strategy. Without a planned integration, standards cannot be positioned, and the resulting ad hoc usage of these technologies only ends up contributing to existing disparity. It’s the equivalent of construction workers building a home without direction and without a blueprint. With the absence of a planned and coordinated effort, a group of hammering workers will not only not create a quality foundation, they won’t be building anything resembling a foundation at all.
1.1.5 The hammer and you

Strategizing with a foreknowledge of how to best incorporate XML, Web services, and service-oriented design principles into the various domains that make up your automated enterprise, however, will put you on a path at the end of which lies a sophisticated and adaptive automation environment. It will allow you to transition toward an integrated enterprise with superior data sharing and unprecedented control of your corporate business models.

This guide is your map. The strategies, recommendations, and best practices provided here collectively form a framework that offers direction and guidance through the twists and turns along the road to building service-oriented architecture and, ultimately, a service-oriented enterprise. So, grab your hammer and enjoy the ride!

1.2 The XML & Web Services Integration Framework (XWIF)

As an independent consultant, I’ve worked for many companies. More often than not, I’ve been part of projects that involved highly complex environments, unique problems, and difficult integration issues. Solutions frequently required an element of creativity that ventured beyond traditional mindset boundaries. Many of the ideas expressed in this guide, therefore, may be new to you, and hopefully will provide you with alternative perspectives to common integration problems.

The contents of this book are part of an integration framework that I’ve been developing for a number of years through my company, XMLTC Consulting Inc. The XML & Web Services Integration Framework (XWIF) consists of an enterprise standardization strategy, supported by a series of best practices, integration strategies, and processes for planning and delivering service-oriented integration projects.

Each piece of this collective intelligence is designed with the common goal of transitioning an organization toward a service-oriented enterprise.

<table>
<thead>
<tr>
<th>Table 1.1</th>
<th>An Overview of XWIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>XML &amp; Web Services Integration Framework</td>
<td></td>
</tr>
<tr>
<td>Best practices</td>
<td>Standards</td>
</tr>
<tr>
<td>Strategies</td>
<td>Service Models</td>
</tr>
</tbody>
</table>

Much of what XWIF preaches is a common-sense approach to resolving typical integration issues with XML and Web services. Some of the guidelines provided are in use elsewhere in the industry, whereas others are unique to XWIF. Many best practices and
How this guide is organized

strategies, and all processes in this guide were developed exclusively as part of this framework.¹

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>This book isn’t about XWIF, nor does it discuss this framework in any detail. Much of the information provided here was borrowed from XWIF and assembled into this generic field guide. To learn more about XWIF, visit <a href="http://www.xwif.com">www.xwif.com</a>.</td>
</tr>
</tbody>
</table>

1.3 How this guide is organized

The Field Guide is different from most IT books; it doesn’t prescribe to the traditional tutorial or process-oriented formats. This guide provides a collection of strategies and best practices that have one common theme: the integration of XML, Web services, and service-oriented architecture.

As I put this book together, it became evident that I had to include background information on the many technologies it discussed. Therefore, the three chapters in Part I contain a series of lightweight tutorials for the primary technologies that form contemporary XML and Web services architectures.

Since the guide is intended for a range of IT professionals that no doubt will be using it under different circumstances, there was no perfect way of organizing its many topics. After a number of iterations, I decided to categorize the XWIF strategies and best practices into Parts II, III, and IV, as illustrated in Figure 1.1.

![Figure 1.1](image)

Three categories representing Parts II, III, and IV of this guide.

¹ Even though the framework is occasionally referenced throughout this book, I’ve avoided prefixing every single strategy, process, and best practice with “XWIF.”
Here is a quick reference overview of what is covered in each part and chapter.

1.3.1 Part I: The technical landscape

Nearly 30 XML and Web services specifications are discussed throughout this part of the book, with a focus on the 17 core standards listed in Table 1.2.

Table 1.2 Reference Matrix of Technology Tutorials

<table>
<thead>
<tr>
<th>XML technologies (Chapter 2)</th>
<th>Web services technologies (Chapter 3)</th>
<th>Second-generation Web services technologies (Chapter 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XML</td>
<td>WSDL</td>
<td>WS-Coordination</td>
</tr>
<tr>
<td>DTD</td>
<td>SOAP</td>
<td>WS-Transaction</td>
</tr>
<tr>
<td>XSD</td>
<td>UDDI</td>
<td>BPEL/WS</td>
</tr>
<tr>
<td>XSLT</td>
<td></td>
<td>WS-Security</td>
</tr>
<tr>
<td>XQuery</td>
<td></td>
<td>WS-ReliableMessaging</td>
</tr>
<tr>
<td>XPath</td>
<td></td>
<td>WS-Policy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WS-Attachments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WS-Addressing</td>
</tr>
</tbody>
</table>

Note that Chapter 3 also covers numerous concepts relating to the Web services framework, including:

- requestor and provider roles
- intermediaries
- initial sender and ultimate receiver roles
- message paths
- message exchange patterns
- correlation
- choreography
- activities

Also note that Chapter 3 introduces service-oriented architecture (SOA) concepts. Later, Chapter 14 continues this discussion with a detailed tutorial on SOA design principles.
1.3.2 Part II: Integrating technology

As shown in Figure 1.2, Part II confines the scope of topics to single application environments in order to focus on strategies for integrating technology within application tiers.

![Diagram showing integration, business, and data tiers]

**Figure 1.2**
The three chapters in Part II roughly correspond to the three backend tiers of a distributed application architecture.

Within Part II we clearly separate integration issues relating to XML and Web services. This allows XML strategies to be used independently of service-oriented environments, if required.

**Integrating XML into applications (Chapter 5)**
The scope of this chapter is the integration of core XML technologies with the purpose of establishing a fundamental data management architecture. Numerous strategies for addressing common integration issues are provided, organized according to the functional areas most likely to be affected by the integration, as follows:

- XML data representation strategies for conceptually and technically incorporating XML as a data representation format and delivery mechanism
- XML data validation strategies that explore the utilization of schema definitions, with an emphasis on XSD
- an XML schema administration process that highlights the importance of centralizing ownership of XML schema definitions
XML transformation strategies that cover the integration of XSLT for structural and aesthetic transformation of XML documents

XML data querying strategies that position XQuery as a technology to centralize and abstract data access logic

These sections assume you have a base knowledge of the discussed technologies. If you don't, you should study the tutorials in Chapter 2 first.

*Integrating Web services into applications (Chapter 6)*

Here we focus on fundamental design concepts that allow you to establish a foundation for a service-oriented architecture, and prepare an application for future interoperability. The scope of this chapter, therefore, is limited to the integration of Web services technology within application environments.

The following XWIF service models are established:

- utility services
- business services
- controller services

XWIF also supplies us with these two modeling processes:

- modeling service-oriented component classes
- modeling Web service interfaces

A collection of integration and optimization strategies are provided next, addressing the use of service assemblies, Web services performance, and interface design.

*Integrating XML and databases (Chapter 7)*

XML opens up a whole new world of data modeling that contrasts traditional approaches to structuring and defining schemas. This chapter is dedicated to exploring techniques for integrating the hierarchical structure of XML documents with traditional relational repositories. Since this is a common area for which knowledge and resources typically are limited, we explore issues with more syntactical detail than in other chapters.

First, we compare XML and relational databases in order to establish their fundamental differences and to contrast how each platform relates to and manages data. Next, the basics of data mapping are covered, as well as issues relating to performance and platform
How this guide is organized

disparity. We then get into the details of mapping the hierarchical XML data model to relational databases.

Finally, we take a look at the common ways in which current database products support XML through the use of proprietary extensions. The implications of using these extensions, along with some techniques on how to mitigate their impact, also are provided. This chapter concludes with an overview of native XML databases.

1.3.3 Part III: Integrating applications

We now carry the discussion forward into the realm of application integration. The chapters in Part III are almost entirely centered around the use of Web services, as numerous traditional and service-oriented integration scenarios are explored and contrasted. Figure 1.3 illustrates the scope of Part III chapters, as they relate to application tiers.

The mechanics of application integration (Chapter 8)
Fundamental integration concepts are introduced, and the differences between traditional and contemporary application integration architectures are discussed. This chapter is more of a primer for cross-application integration, as it also provides a guide to middleware products, and explores common paths for evolving an enterprise integration environment.

If integration architecture is new to you, I recommend you read through this chapter prior to proceeding with Chapters 9 and 10.

Service-oriented architectures for legacy integration (Chapter 9)
Here we dive into the multi-varied world of legacy integration architectures. We begin by describing the following set of XWIF services models:

• proxy services
• wrapper services
• coordination services (for atomic transactions)

We then explain the roles of common integration components, including:

• legacy adapters
• intermediary services
• service interceptors
Many legacy integration architectures are then explored. Each of the following sections separately illustrates an integration architecture in a traditional and service-oriented state:

- one-way integration architecture: batch export and import
- one-way integration architecture: direct data access
How this guide is organized

- point-to-point architecture: tightly-coupled integration between homogenous legacy applications
- point-to-point architecture: tightly-coupled integration between heterogeneous applications
- point-to-point architecture: integration between homogenous component-based applications
- point-to-point architecture: integration between heterogeneous component-based applications
- centralized database architecture

These sections are supplemented further with architectural comparison matrices that contrast key architectural aspects within traditional and service-oriented contexts. The chapter concludes with an analysis process for assessing the feasibility of introducing service-oriented design principles within legacy architectures.

**Service-oriented architectures for enterprise integration (Chapter 10)**

The scope now broadens to encompass enterprise integration architectures. The roles of broker and orchestration components are demonstrated, along with the introduction of the following XWIF service models:

- process services
- coordination services (for business activities)

Both traditional and contemporary EAI architectures are then explored, including:

- hub and spoke
- messaging bus (publish and subscribe)
- enterprise service bus (ESB)

How Web services can be integrated within these environments is illustrated, and supplemented with numerous design considerations.

**Service-oriented integration strategies (Chapter 11)**

To supplement and expand on the topics covered in Chapters 9 and 10, the following collection of integration strategies are provided:

- strategies for streamlining integration endpoint interfaces
- strategies for optimizing integration endpoint services
1.3.4 Part IV: Integrating the enterprise

This part of the book provides a clear roadmap to a standardized service-oriented enterprise, and consists of a collection of best practices and processes for planning and implementing an enterprise-wide integration strategy.

Here's a brief overview of the chapters:

Thirty best practices for integrating XML (Chapter 12)

Chapter 12 describes a wide variety of best practices and recommendations for various aspects of XML integration, including:

- planning XML migration projects
- knowledge management within XML projects
- standardizing XML applications
- designing XML applications

Thirty best practices for integrating Web services (Chapter 13)

Chapter 13 details a set of best practices that provide guidance and insight for managing and integrating Web services. The following areas are covered:

- planning service-oriented projects
- standardizing Web services
- designing service-oriented environments
- managing service-oriented development projects
- implementing Web services

Building the service-oriented enterprise (SOE) (Chapter 14)

Our last chapter contains perhaps the most important information within this guide. First, it delves into the details of service-oriented modeling concepts and design principles. A detailed tutorial breaks down the components of a service-oriented architecture into activities, services, and processes.

It then applies these concepts to a service-oriented enterprise by establishing a series of business modeling and technology building blocks for the design of service-oriented
environments. Examples are provided, establishing problems that are then solved using these service-oriented design principles.

Finally, the XWIF Layered Scope Model (LSM) is introduced, establishing a comprehensive migration strategy for the controlled integration of XML and Web services technologies through a series of phases that gradually transition an organization toward the service-oriented enterprise. This last section draws upon information provided throughout the Field Guide, by listing the XWIF service models, processes, and strategies most appropriate for each LSM phase.

1.3.5 The extended enterprise

Service-oriented concepts and architecture allow an enterprise to be extended beyond its organizational boundaries. The enterprise standardization process in Chapter 14 identifies a migration path into the extended enterprise; however, the XWIF business-to-business interchange model is not an area of integration we cover in this guide.

1.4 www.serviceoriented.ws

Updates, samples, a glossary of terms, and various other supporting resources can be found at www.serviceoriented.ws. I am interested in your feedback. Any experiences you’d like to share, or suggestions you may have as to how I can continue to improve this book would be much appreciated.

1.5 Contact the author

To contact me directly, visit my bio site at www.thomaserl.com
About the Author

Thomas Erl is an independent consultant with XMLTC Consulting in Vancouver, Canada. His previous book, Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services, became the top-selling book of 2004 in both Web Services and SOA categories. This guide addresses numerous integration issues and provides strategies and best practices for transitioning toward SOA.

Thomas is a member of OASIS and is active in related research efforts, such as the XML & Web Services Integration Framework (XWIF). He is a speaker and instructor for private and public events and conferences, and has published numerous papers, including articles for the Web Services Journal, WLDJ, and Application Development Trends.

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SOA Systems Inc. is a consulting firm actively involved in the research and development of service-oriented architecture, service-orientation, XML, and Web services standards and technology. Through its research and enterprise solution projects SOA Systems has developed a recognized methodology for integrating and realizing service-oriented concepts, technology, and architecture.

For more information, visit www.soasystems.com.

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