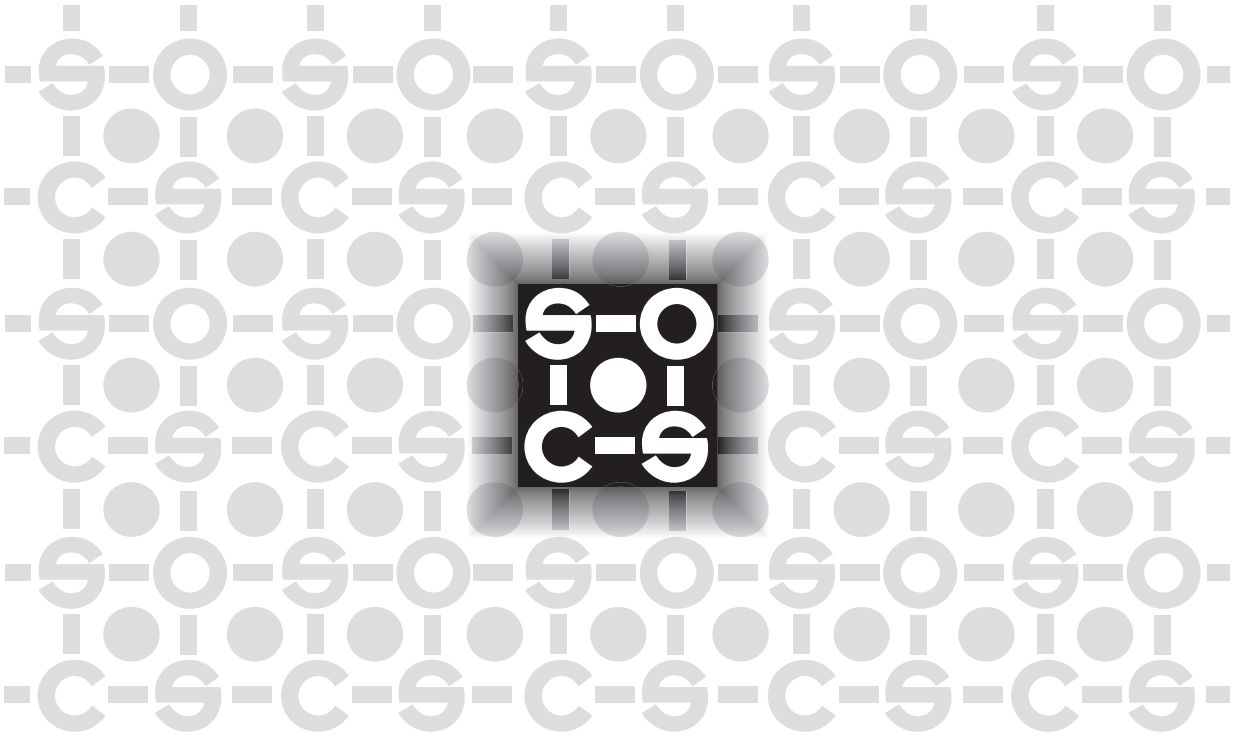
SOA Design Patterns



The Prentice Hall Service-Oriented Computing Series from Thomas Erl aims to provide the IT industry with a consistent level of unbiased, practical, and comprehensive guidance and instruction in the areas of service-oriented architecture, service-orientation, and the expanding landscape that is shaping the real-world service-oriented computing platform.

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SOA Design Patterns

Thomas Erl

(with additional contributors)

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To the SOA pioneers that blazed the trail we now so freely base our roadmaps on, and to the SOA community that helped me refine the wisdom of the pioneers into this catalog of patterns.

- Thomas Erl

Contents

Foreword

The entire history of software engineering can be characterized as one of rising levels of abstraction. We see this in our languages, our tools, our platforms, and our methods. Indeed, abstraction is the primary way that we as humans attend to complexity—and software-intensive systems are among the most complex artifacts ever created.

I would also observe that one of the most important advances in software engineering over the past two decades has been the practice of patterns. Patterns are yet another example of this rise in abstraction: A pattern specifies a common solution to a common problem in the form of a society of components that collaborate with one another. Influenced by the writings of Christopher Alexander, Kent Beck and Ward Cunningham began to codify various design patterns from their experience with Smalltalk. Growing slowly but steadily, these concepts began to gain traction among other developers. The publication of the seminal book *Design Patterns* by Erich Gamma, John Vlissides, Ralph Johnson, and Richard Helm marked the introduction of these ideas to the mainstream. The subsequent activities of the Hillside Group provided a forum for this growing community, yielding a very vibrant literature and practice. Now the practice of patterns is very much mainstream: Every well-structured software-intensive system tends to be full of patterns (whether their architects name them intentionally or not).

The emerging dominant architectural style for many enterprise systems is that of a service-oriented architecture, a style that at its core is essentially a message passing architecture. However, therein are many patterns that work (and anti-patterns that should be avoided).

Thomas' work is therefore the right book at the right time. He really groks the nature of SOA systems: There are many hard design decisions to be made, ranging from data-orientation to the problems of legacy integration and even security. Thomas offers wise counsel on each of these issues and many more, all in the language of design patterns. There are many things I like about this work. It's comprehensive. It's written in a very accessible

pattern language. It offers patterns that play well with one another. Finally, Thomas covers not just the technical details, but also sets these patterns in the context of economic and other considerations.

SOA Design Patterns is an important contribution to the literature and practice of building and delivering quality software-intensive systems.

—*Grady Booch, IBM Fellow*
September, 2008

Acknowledgments

This book was in development for over three years, a good portion of which was dedicated to external reviews. Patterns were subjected to three review cycles that spanned a period of over twelve months and involved over 200 IT professionals. Pre-release galleys of my first and second manuscript drafts were printed and shipped to SOA experts and patterns experts around the world. Additionally, I had the full manuscript published at SOAPatterns.org for an open industry review. Even though these review phases added much time and effort to the development of this book, they ultimately elevated the quality of this work by a significant margin.

Special thanks to Prentice Hall for their patience and support throughout the book development process. Specifically, I'd like to thank Kristy Hart and Jake McFarland for their tremendous production efforts and tireless commitment to achieving printed perfection, Mark Taub who stood by this book project through a whirlwind of changes, reviews, more changes, extensions, and delays, Stephane Nakib and Heather Fox for their on-going guidance, and Eric Miller for his assistance with publishing the online review version of the first manuscript draft. I am fortunate to be working with the best publishing team in the industry.

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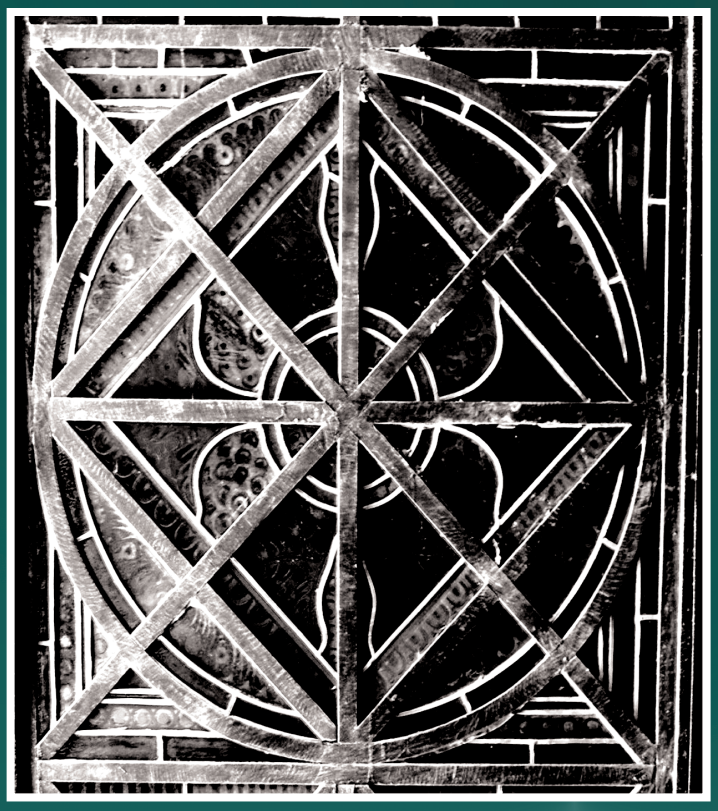


Chapter 5

Understanding SOA Design Patterns

The first step to forming an effective working relationship with SOA design patterns is attaining a sound comfort level with pattern-related terminology and notation. This provides us with the knowledge required to navigate through the upcoming chapters with insight as to how the patterns can be applied individually and in various combinations.

Purpose of this Introductory Chapter

This important chapter covers these fundamental topics and further describes how design pattern descriptions are organized into standardized profiles. The remaining sections single out specific pattern types and discuss some common design considerations.

5.1 Fundamental Terminology

What's a Design Pattern?

The simplest way to describe a pattern is that it provides a proven solution to a common problem individually documented in a consistent format and usually as part of a larger collection.

The notion of a pattern is already a fundamental part of everyday life. Without acknowledging it each time, we naturally use proven solutions to solve common problems each day. Patterns in the IT world that revolve around the design of automated systems are referred to as *design patterns*.

Design patterns are helpful because they:

- represent field-tested solutions to common design problems
- organize design intelligence into a standardized and easily "referencable" format
- are generally repeatable by most IT professionals involved with design
- can be used to ensure consistency in how systems are designed and built
- can become the basis for design standards
- are usually flexible and optional (and openly document the impacts of their application and even suggest alternative approaches)

- can be used as educational aids by documenting specific aspects of system design (regardless of whether they are applied)
- can sometimes be applied prior and subsequent to the implementation of a system
- can be supported via the application of other design patterns that are part of the same collection

Furthermore, because the solutions provided by design patterns are proven, their consistent application tends to naturally improve the quality of system designs.

Let's provide a simple (non SOA-related) example of a design pattern that addresses a user interface design problem:

Problem: *How can users be limited to entering one value of a set of predefined values into a form field?*

Solution: *Use a drop-down list populated with the predefined values as the input field.*

What this example also highlights is the fact that the solution provided by a given pattern may not necessarily represent the only suitable solution for that problem. In fact, there can be multiple patterns that provide alternative solutions for the same problem. Each solution will have its own requirements and consequences, and it is up to the practitioner to choose.

In the previous example, a different solution to the stated problem would be to use a list-box instead of a drop-down list. This alternative would form the basis of a separate design pattern description. The user-interface designer can study and compare both patterns to learn about the benefits and trade-offs of each. A drop-down list, for instance, takes up less space than a list box but requires that a user always perform a separate action to access the list. Because a list box can display more field lines at the same time, the user may have an easier time locating the desired value.

NOTE

Even though design patterns provide proven design solutions, their mere use cannot guarantee that design problems are always solved as required. Many factors weigh in to the ultimate success of using a design pattern, including constraints imposed by the implementation environment, competency of the practitioners, diverging business requirements, and so on. All of these represent aspects that affect the extent to which a pattern can be successfully applied.

What's a Compound Pattern?

A compound pattern is a coarse-grained pattern comprised of a set of finer-grained patterns. Compound patterns are explained in detail at the beginning of Chapter 22.

What's a Design Pattern Language?

A *pattern language* is a set of related patterns that act as building blocks in that they can be carried out in *pattern sequences* (or *pattern application sequences*), where each subsequent pattern builds upon the former. As explained shortly in the *Historical Influences* section, the notion of a pattern language originated in building architecture as did the term "pattern sequence" used in association with the order in which patterns can be carried out.

Some pattern languages are open-ended, allowing patterns to be combined into a variety of creative sequences, while others are more structured whereby groups of patterns are presented in a suggested application sequence. In this case, the pattern sequence is generally based on the granularity of the patterns, in that coarser grained patterns are applied prior to finer-grained ones that then build upon or extend the foundation established by the coarse-grained patterns. In these types of pattern languages, the manner in which patterns can be organized into pattern sequences may be limited to how they are applied within their groups.

Structured pattern languages are helpful because they:

- can organize groups of field-tested design patterns into proposed, field-tested application sequences
- ensure consistency in how particular design goals are achieved (because by carrying out sets of inter-dependent patterns in a proven order, the quality of the results can be more easily guaranteed)
- are effective learning tools that can provide insight into how and why a particular method or technique should be applied as well as the effects of its application
- provide an extra level of depth in relation to pattern application (because they document the individual patterns plus the cumulative effects of their application)
- are flexible in that the ultimate pattern application sequence is up to the practitioner (and also because the application of any pattern within the overall language can be optional)

This book in its entirety provides an open-ended, master pattern language for SOA. The extent to which different patterns are related can vary, but overall they share a common

objective and endless pattern sequences can be explored. The relationship diagrams explained in the upcoming *Pattern Relationship Figures* section will often hint at common application sequences for a given pattern.

Chapters 6 and 11 single out sets of closely related patterns and structure them into groups organized into recommended application sequences that essentially establish primitive design processes. As a result, these collections of patterns could be classified as "mini" structured pattern languages that are still part of the overall master pattern language.

What's a Design Pattern Catalog?

A design pattern catalog is simply a documented collection of related design patterns. Therefore, this book is also referred to as a catalog for design patterns associated with SOA and service-orientation.

SUMMARY OF KEY POINTS

- A design pattern is a formal documentation of a proven solution to a common problem.
- A design pattern language is a group of related design patterns that can be applied in a variety of creative application sequences.
- A design pattern catalog is a collection of related design patterns documented together.
- This book contains a design pattern catalog that documents a master pattern language for SOA.

5.2 Historical Influences

Because service-orientation has deep roots in past distributed computing design platforms, many of the SOA design patterns have origins and influences that can be traced back to established design concepts, approaches, and previously published design pattern catalogs.

As illustrated in Figure 5.1, object-orientation, EAI, enterprise application architecture, and software architecture in general represent areas for which well-recognized design pattern catalogs exist, each of which has influenced design patterns in this book. Starting with the original pattern language created by Christopher Alexander, let's briefly discuss these influences separately.

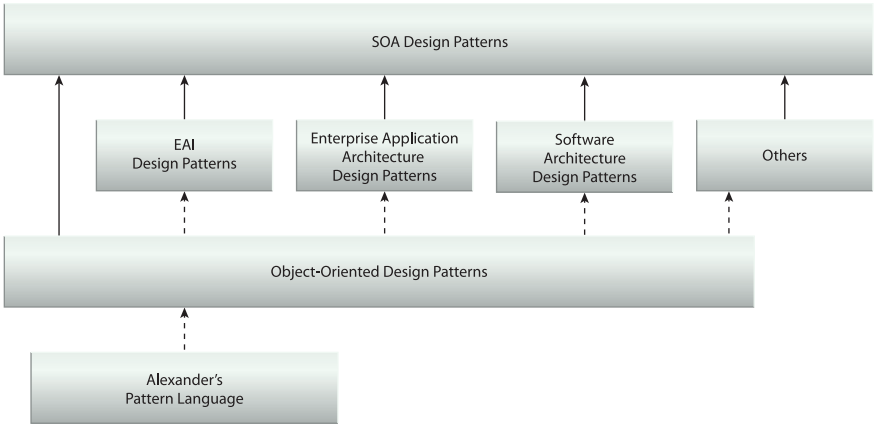


Figure 5.1
The primary influences of SOA design patterns.

Alexander's Pattern Language

It's been well documented how the notion of the design pattern owes its existence to the work of Christopher Alexander. Just about every design pattern publication pays tribute to Alexander's pattern language as a fundamental influence and source of inspiration.

Alexander pioneered the concept of patterns in relation to building architecture and related areas, such as city and community structure. He documented a collection of patterns and organized them into a pre-defined series he called a "sequence." The result was an architectural pattern language that inspired the IT community to create their own patterns for the design of automated systems.

Alexander's work is more than just a historical footnote for design patterns; it provides insight into how patterns in general should and should not be structured and organized.

For example, some lessons learned from Alexander's work include:

- *Pattern language sequences need to add value.* Often related patterns are better documented independently from each other even if there is some potential for them to be organized into a sequence. The primary purpose of any application sequence established by a pattern language is *not* to provide a logical organization for a set of related patterns but to demonstrate a proven process that provides value on its own.
- *Patterns do not need to be normalized.* There is often a perception that each design pattern should own an individual domain. In reality, the problem and solution space represented by individual patterns sometimes naturally overlaps. For example, you can easily have two patterns that propose different solutions to the same problem.

Beyond just the idea of organizing solutions into a pattern format, Alexander helped advocate the importance of clarity in how pattern catalogs need to be documented. He preached that patterns need to be individually clear as to their purpose and applicability and that pattern languages need to further communicate the rationale behind any sequences they may propose.

NOTE

As provided by research from Dr. Peter H. Chang from Lawrence Technological University, earlier origins also exist. For example, George Polya published the book *How to Solve It* (Princeton University Press) back in 1945, which included a "problem solving plan" that can be viewed at www.math.utah.edu/~pa/math/polya.html (based on the second edition released in 1957). Furthermore, Marvin Minsky published the paper *Steps Toward Artificial Intelligence* for MIT in 1960 that included coverage of pattern recognition and made further reference to Polya's work.

Object-Oriented Patterns

A variety of design patterns in support of object-orientation surfaced over the past 15 years, the most recognized of which is the pattern catalog published in *Design Patterns: Elements of Reusable Object-Oriented Software* (Gamma, Helm, Johnson, Vlissides; Addison-Wesley, 1995). This set of 23 patterns produced by the "Gang of Four" expanded and helped further establish object-orientation as a design approach for distributed solutions. Some of these patterns have persisted within service-orientation, albeit within an augmented context and new names.

For example, the following patterns in this book are related:

- Capability Composition (521) is associated with Composite
- Service Façade (333) is derived from Façade
- Legacy Wrapper (441) is derived from Adapter
- Non-Agnostic Context (319) is associated with Mediator
- Decoupled Contract (401) is associated with Bridge

Concepts established by several additional object-orientation patterns have factored into other SOA patterns. The incorporation of these patterns within service-orientation is a testament to their importance and evidence of how object-orientation as a whole has influenced the evolution of SOA.

Another relevant object-oriented-related influence is the paper "Using Pattern Languages for Object-Oriented Programs" published by Kent Beck and Ward Cunningham for the 1987 OOPSLA conference. This paper is notable not only for its brevity, but for its vision and its explicit emphasis on the use of sequences in organizing patterns.

NOTE

The comparative analysis in Chapter 14 of *SOA Principles of Service Design* provides a study of how object-oriented design concepts and principles relate to service-orientation.

Software Architecture Patterns

As design patterns became a mainstream part of IT, a set of important books emerged establishing formal conventions for pattern documentation and providing a series of common design patterns for software architecture in general. These pattern catalogs were developed in five separate volumes over a period of a dozen years as part of the *Pattern-Oriented Software Architecture* series (F. Buschmann, K. Henney, M. Kircher, R. Meunier, H. Rohnert, D. Schmidt, P. Sommerlad, M. Stal, Wiley 1996–2007).

Because of the general nature of the patterns, the contributions made by this series are too voluminous to document individually. Here are some examples of how SOA design patterns relate:

- Service Layers (143) is associated with Layers
- Service Broker (707) compound pattern is associated with Broker
- Concurrent Contracts (421) is associated with Extension Interface
- Metadata Centralization (280) is associated with Lookup
- Event-Driven Messaging (599) is derived from Publisher-Subscriber
- Process Abstraction (182) is associated with Whole-Part
- Asynchronous Queuing (582) is associated with Messaging and Message Channel
- Atomic Service Transaction (623) is associated with Coordinator and Task Coordinator
- Inventory Endpoint (260) is a specialization of Message Endpoint
- Partial State Deferral (356) is associated with Partial Acquisition

It is also worth noting that Volume 4 of the series (entitled *A Pattern Language for Distributed Computing*) focuses on connecting existing patterns relevant to building distributed systems into a larger pattern language. This book documents the roots of various previously published patterns, including those that are part of other pattern catalogs listed in this section.

Enterprise Application Architecture Patterns

As distributed computing became an established platform for solution design, an emphasis on enterprise architecture emerged bringing with it its own set of design patterns, many of which built upon object-oriented concepts and patterns. A respected pattern catalog in this field was published in *Patterns of Enterprise Application Architecture* (Fowler, Addison-Wesley, 2003).

You might notice that many of the influences originating from enterprise architecture patterns are located in the two pattern languages provided in Chapters 6 and 11. Service-orientation is, at heart, a design paradigm for distributed computing, and although distinct, it still relies and builds upon the fundamental patterns and concepts associated with enterprise application architecture in general.

For example, the following patterns in this book are related:

- Service Encapsulation (305) is associated with Gateway and Service Layer
- Decoupled Contract (401) is associated with Implementation Separated Interface
- Service Façade (333) is derived from Remote Façade
- Stateful Services (248) is derived from Server Session State
- Partial State Deferral (356) is derived from Lazy State
- State Repository (242) is derived from Database Session State

Studying these types of influences can lead to further revelations as to how SOA has evolved into a unique architectural model.

EAI Patterns

Several pattern catalogs centered around the use of messaging to fulfill integration requirements emerged during the EAI era. These patterns establish sound approaches for robust messaging-based communication and address various integration-related challenges.

A recognized publication in this field is *Enterprise Integration Patterns* (Hohpe, Woolf, Addison-Wesley, 2004).

Because EAI is one of the primary influences of service-orientation, this book contains service interaction patterns based on the use of messaging primarily in support of service composition scenarios.

Some examples of SOA patterns related to design patterns documented in *Enterprise Integration Patterns*:

- Service Messaging (533) is derived from Message, Messaging, and Document Message
- Data Model Transformation (671) is derived from Message Translator
- Canonical Schema (158) is associated with Canonical Data Model
- Service Agent (543) is associated with Event-Driven Consumer
- Process Centralization (193) is associated with Process Manager
- Intermediate Routing (549) is derived from Content-Based Router

Several references to additional EAI patterns are interspersed in the upcoming chapters (Chapter 18, in particular).

SOA Patterns

The intention behind this collection of SOA patterns is not to replace or compete with the catalogs provided by previous publications, but instead to build upon and complement them with a catalog focused solely on attaining the strategic goals associated with service-orientated computing.

This catalog is comprised of new patterns, existing patterns that have been augmented, and patterns that are intentionally similar to patterns in other catalogs. The latter group is included so that these patterns can be explained within the context of SOA and to also formally highlight them as a supporting part of the service-orientation design paradigm.

Learning about the design solutions and techniques provided by SOA design patterns can provide insight into the mechanics required to enable service-orientation and also help clarify exactly how SOA represents a distinct architectural model. When exploring these distinctions, it is important to take into account:

- which of the past design techniques are preserved and emphasized
- which of the past design techniques are de-emphasized
- new design techniques
- new approaches to carrying out existing techniques

Note that there are several more useful design patterns in the previously mentioned books which are not mentioned in this pattern catalog. Some provide detailed solutions that are not necessarily specific to SOA, but still very helpful.

SUMMARY OF KEY POINTS

- The pattern language invented by Christopher Alexander inspired the use of design patterns in the IT world.
- The object-orientation platform has an established set of design patterns that are at the root of several of the patterns in this catalog. Additional influences can be traced back to patterns created for enterprise application architecture, EAI, and general software architecture pattern catalogs.

5.3 Pattern Notation

Throughout this book design patterns need to be referenced and explained in text and illustrations. A simple notation is used to consistently represent different types of patterns.

Pattern Symbols

As shown in Figure 5.2, specific symbols are used to represent:

- a design pattern
- a compound design pattern
- a group of related design patterns

Additionally, colors are incorporated to indicate if a displayed design pattern is just being referenced and not actually discussed, versus one that is the current topic of discussion.

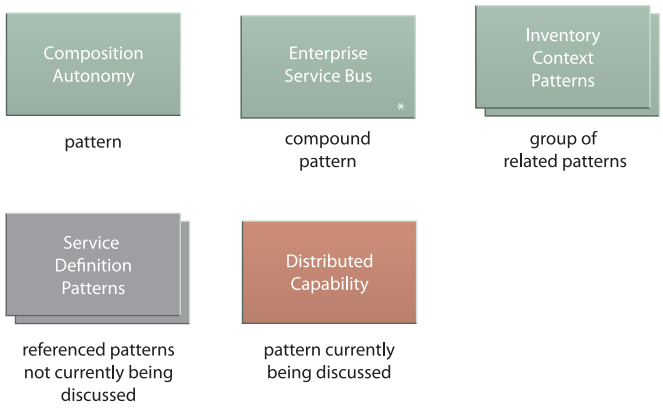


Figure 5.2
The standard symbols used to represent different types of design patterns and how design patterns relate to the current subject being covered.

Pattern Figures

The symbols displayed in Figure 5.2 are used in the following three primary types of diagrams:

- pattern application sequence figures
- pattern relationship figures
- compound pattern hierarchy figures

Let's take a closer look at each:

Pattern Application Sequence Figures

When documenting design pattern languages, it is helpful to display the suggested sequence in which patterns should be applied. Figures 5.3 and 5.4 show pattern application sequences for groups of related patterns and for individual patterns belonging to a particular group, respectively.

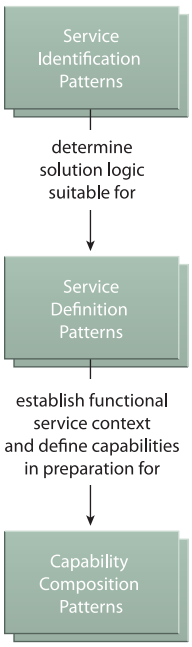


Figure 5.3
The pattern groups from Chapters 11 and 17 displayed in a recommended application sequence.

Pattern Relationship Figures

As explained in the upcoming *Pattern Profiles* section, this book explores numerous inter-pattern relationships and provides one pattern relationship diagram (Figure 5.5) for each documented design pattern.

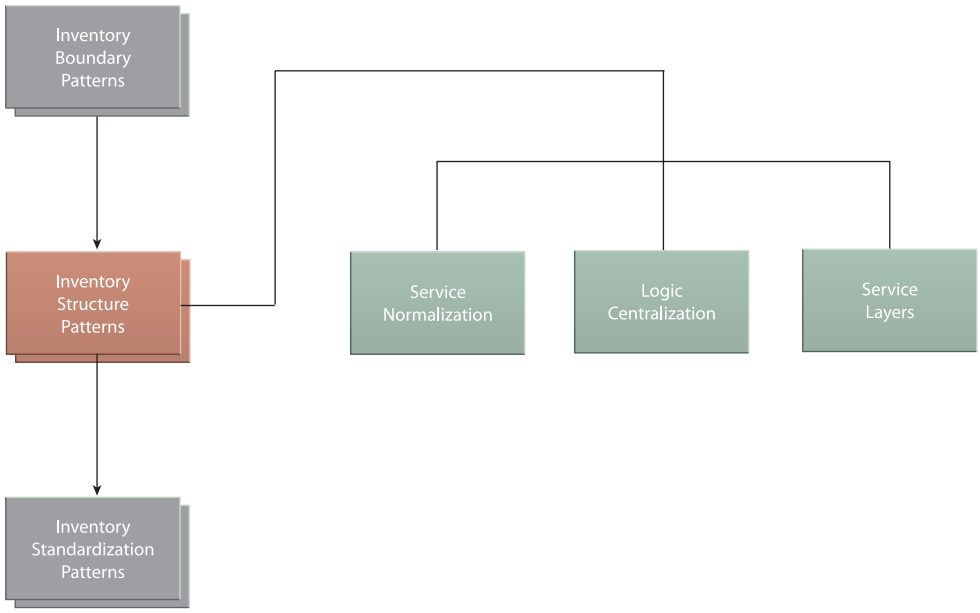


Figure 5.4

The inventory structure patterns group from Chapter 6 is highlighted in this diagram. In this case, there is no recommendation as to the order in which the three patterns on the right should be applied.

A style convention applied to all pattern relationship diagrams is the use of color, as follows:

- Each pattern relationship diagram explores the relationships of one pattern. Therefore, that design pattern is highlighted in red, as per the previously established symbol notation.
- Pattern relationships are documented in a unidirectional manner. For relationships where the pattern currently being discussed affects or relates to other patterns, a red line is used along with an arrow pointing to the other pattern. When the relationship line documents how other patterns relate to the current pattern, the lines are green, and the arrows are reversed.

Note that directionality of relationships is preserved in different diagrams. For example, the green relationship line emitting from Service Normalization (131) and pointing to Logic Centralization (136) in the preceding figure would be reversed (and colored red) in the pattern relationship figure for Service Normalization (131).

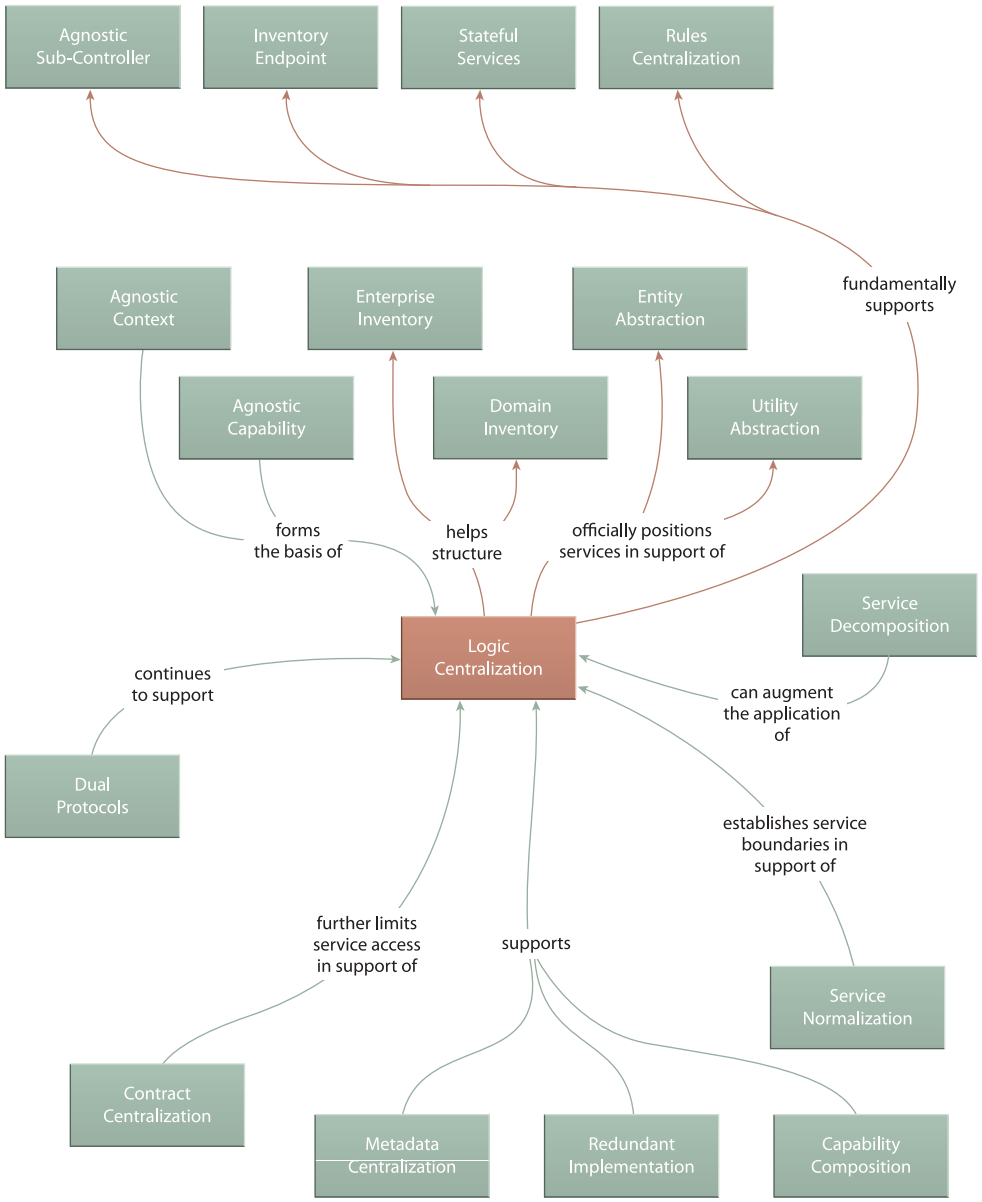


Figure 5.5
An example of a pattern relationship diagram.

Compound Pattern Hierarchy Figures

Compound patterns are comprised of combinations of design patterns. When illustrating a compound pattern, a hierarchical representation is usually required, where the compound pattern name is displayed at the top, and the patterns that comprise the compound are shown underneath.

These types of diagrams (Figures 5.6 and 5.7) can be considered simplified relationship figures in that they only identify which patterns belong to which compound, without getting into the details of how these patterns relate. Compound patterns are documented separately in Chapter 22, but compound hierarchy figures are displayed throughout the upcoming chapters.

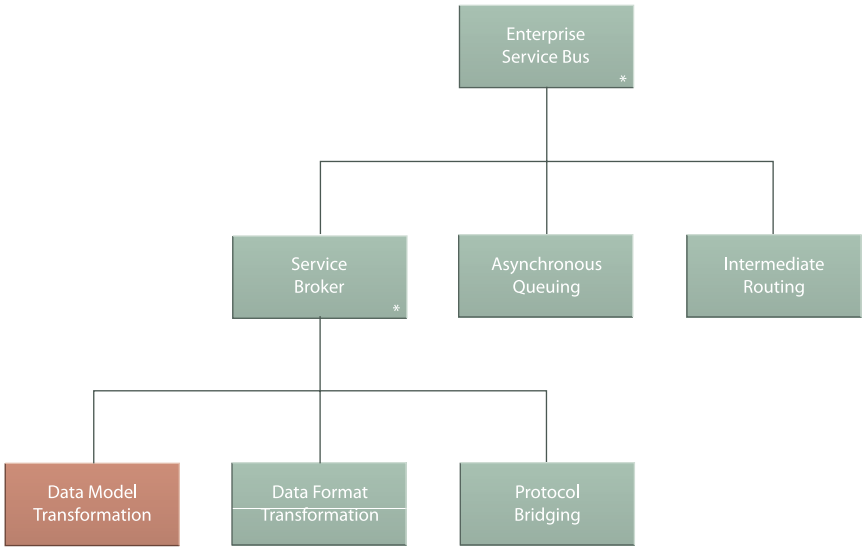


Figure 5.6

Enterprise Service Bus (704) is a compound pattern comprised of several core patterns, one of which is a compound pattern in its own right and therefore represents a nested pattern hierarchy. In this case, Data Model Transformation (671) is highlighted, indicating that it is the current pattern being discussed.

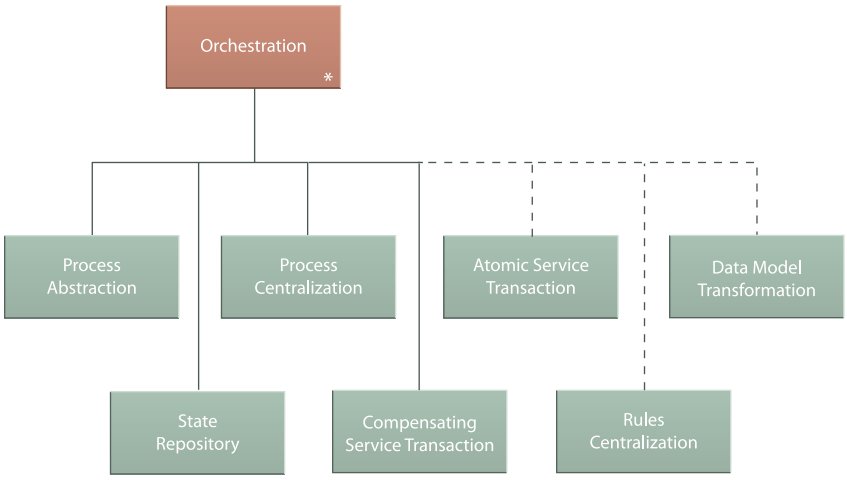


Figure 5.7
There are additional patterns associated with Orchestration (701) that can be considered optional extensions. In this case, the hierarchy lines are dashed.

NOTE

Another notation used for some forms of compound patterns involves showing patterns combined with a plus ("+") symbol. These diagrams are limited to Chapter 22 and are formally described there.

Capitalization

All design pattern names (including names of compound patterns) are capitalized throughout this book. The names for groups of related patterns are capitalized when displayed in Figures but not when referenced in body text.

Page Number References

As you may have already noticed in earlier parts of this chapter, each pattern name is followed by a page number in parentheses. This number, which points to the first page of the corresponding pattern profile, is provided for quick reference purposes. Its use has become a common convention among pattern catalogs. The only time the number is not displayed is when a pattern name is referenced within that pattern's profile section.

5.4 Pattern Profiles

Each of the patterns in this catalog is described using the same profile format and structure based on the following parts:

- Requirement
- Icon
- Summary
- Problem
- Solution
- Application
- Impacts
- Relationships
- Case Study Example

The following sections describe each part individually.

Requirement

This is a concise, single-sentence statement that presents the fundamental requirement addressed by the pattern in the form of a question. Every pattern description begins with this statement.

For example:

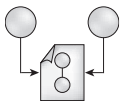
How can a service be designed to minimize the chances of capability logic deconstruction?

Note that the inside cover of this book lists all of the patterns together with their respective requirement statements.

Icon

Each pattern description is accompanied by an icon image that acts as a visual identifier.

An example of a pattern icon:



The icons are displayed together with the requirement statements in each pattern profile as well as on the inside book cover.

Summary

Following the requirement statement, a summary table is displayed, comprised of statements that collectively provide a concise synopsis of the pattern for quick reference purposes.

The following parts of the profile are summarized in this table:

- Problem
- Solution
- Application
- Impacts

Additionally, the profile table provides references to related service-orientation design principles and service-oriented architectural types via the following sections:

- Principles
- Architecture

The parts of the pattern description not represented in the summary table are the *Relationships* and *Case Study Example* sections.

NOTE

All pattern summary tables in this book are also published online at SOAPatterns.org.

Problem

The issue causing a problem and the effects of the problem are described in this section, typically accompanied by a figure that further illustrates the "problem state." It is this problem for which the pattern provides a solution. Problem descriptions may also include common circumstances that can lead to the problem (also known as "forces").

Solution

This represents the design solution proposed by the pattern to solve the problem and fulfill the requirement. Often the solution is a short statement followed by a diagram that concisely communicates the final solution state. "How-to" details are not provided in this section but are instead located in the *Application* section.

Application

This part is dedicated to describing how the pattern can be applied. In can include guidelines, implementation details, and sometimes even a suggested process.

Impacts

Most patterns come with trade-offs. This section highlights common consequences, costs, and requirements associated with the application of a pattern.

Note that these consequences are common but not necessarily predictable. For example, issues related to typical performance requirements are often raised; however, these issues may not impact an environment with an already highly scalable infrastructure.

Relationships

The use of design patterns can tie into all aspects of design and architecture. It is important to understand the requirements and dependencies a pattern may have and the effects of its application upon other patterns.

These diagrams are not exhaustive in that not all possible relationships a given design pattern can have are shown. Through the use of pattern relationship figures, this section merely highlights common relationships with an emphasis on how patterns support or depend on each other.

NOTE

Because there are two patterns in each relationship, almost every relationship is shown twice in this book: once in the *Relationships* section of each of the two patterns. To avoid content redundancy, most relationships are only described once. Therefore, if you find a relationship shown in a diagram that is not described in the accompanying text, refer to the description for the other pattern involved in that relationship. Note, however, that some relationships are considered self-explanatory and are therefore not described at all.

Details regarding the format of pattern relationship figures are provided in the *Pattern Notation* section earlier in this chapter.

Case Study Example

Most pattern profiles conclude with a case study example that demonstrates the sample application of a pattern in relation to the storylines established in Chapter 2.

SUMMARY OF KEY POINTS

- Each design pattern is documented with the same profile structure.
- Design pattern profiles begin with a requirements statement and an icon and then provide a summary table followed by sections with detailed descriptions.

5.5 Patterns with Common Characteristics

Each pattern in this book is distinct and unique and is considered an equal member of the overall pattern catalog. However, it is worth highlighting certain groups of similar patterns to better understand how they were named and why they share common characteristics.

NOTE

The following sections do not attempt to group patterns into formal categories. The upcoming chapters in Parts II, III, and IV already are subdivided by chapters representing specific pattern types. These sections here only point out that within and across these types, collections of patterns share common qualities and were labeled to reflect this.

Canonical Patterns

Canonical design patterns propose that the best solution for a particular problem is to introduce a design standard. The successful application of this type of pattern results in a canonical convention that guarantees consistent design across different parts of an inventory or solution.

The canonical design patterns in this book are:

- Canonical Protocol (150)
- Canonical Schema (158)
- Canonical Expression (275)
- Canonical Resources (237)
- Canonical Versioning (286)

Centralization Patterns

Centralization simply means limiting the options of something to one. Applying this concept within key parts of a service-oriented architecture establishes consistency and fosters standardization and reuse and, ultimately, native interconnectivity.

The following centralization patterns are covered in the upcoming chapters:

- Logic Centralization (136)
- Metadata Centralization (280)
- Process Centralization (193)
- Rules Centralization (216)
- Schema Centralization (200)
- Contract Centralization (409)
- Policy Centralization (207)

A common characteristic across centralization patterns is a trade-off between increased architectural harmony and increased governance and performance requirements. As explained shortly in the *Measures of Pattern Application* section, patterns can be applied to different extents. A key factor when assessing the application measure for centralization patterns is at what point the benefit outweighs the architectural impact.

NOTE

Centralization patterns are also very much related to the use of design standards. To constantly require that certain parts of a service-oriented architecture are centralized requires that supporting conventions be regularly followed.

SUMMARY OF KEY POINTS

- Canonical and centralization patterns need to be consistently applied to realize their benefits.
- Canonical and centralization patterns require the use of supporting design standards.

5.6 Key Design Considerations

"Enterprise" vs. "Enterprise-wide"

Having discussed the notion of services as enterprise resources back in Chapter 4, it is important that there is a clear distinction between something that exists as a resource as part of an enterprise and something that is actually an enterprise-*wide* resource.

- An enterprise resource is not a resource that is necessarily made available across the entire enterprise. Instead, it is a resource positioned for use within the enterprise, outside of and beyond any one particular application boundary. In other words, it is a "cross-silo" resource.
- An enterprise-wide resource, on the other hand, is truly intended for use across all service inventories within an enterprise.

This difference in terminology is especially relevant to design patterns associated with specific enterprise boundaries, such as Domain Inventory (123). Note also that a service positioned as an enterprise resource is expected to be an inventory-wide resource, meaning that it is interoperable from anywhere within the inventory boundary.

Design Patterns and Design Principles

Most of the upcoming design patterns reference design principles where appropriate to highlight a dependency or relationship or perhaps to describe the effect a design pattern may have on service-orientation.

Specifically, the relationship between service-orientation design principles and patterns can be defined as follows:

- Design principles are applied collectively to solution logic in order to shape it in such a manner that it fosters key design characteristics that support the strategic goals associated with service-oriented computing.

- Design patterns provide solutions to common problems encountered when applying design principles—*and*—when establishing an environment suitable for implementing logic designed in accordance with service-orientation principles.

In many ways, design principles and patterns are alike. Both provide design guidance in support of achieving overarching strategic goals. In fact, it would not be unreasonable to think of the eight service-orientation principles as super patterns that are further supported by the patterns in this book.

Service-orientation design principles have another role in that they collectively define service-orientation as a design paradigm. Ultimately, it is best to view design patterns as providing support for the realization of design principles and their associated goals. (Design principles were introduced in the *Principles of Service-Orientation* section in Chapter 4.)

NOTE

We just stated that design principles could be thought of as super patterns. Why then weren't they documented as such? When the manuscript for this book was undergoing a review by Ralph Johnson and his pattern review group at UIUC, the question came up as to how to determine whether something is a legitimate pattern.

Ralph responded by stating, "When people ask me, 'Is this a pattern?' I usually say, 'That is not the right question.' The right question is whether pattern form is the best way to communicate this material." This is a good way to think of the purpose of this book.

Each pattern provides a specific solution to a distinct problem. The guidance provided by a design principle is much broader and can, in fact, end up solving a variety of problems. Therefore, design principles are better off documented in their form.

Design Patterns and Design Granularity

Design granularity, as it pertains to service-orientation, is itself something worth being familiar with prior to reading the upcoming chapters. Provided here are brief descriptions of common granularity-related terms:

- *Service Granularity* – The overall quantity of functionality encapsulated by a service determines the service granularity. A service's granularity is set by its functional context, which is usually established during the service modeling phase.
- *Capability Granularity* – The quantity of functionality encapsulated by a specific service capability determines the level of corresponding capability granularity.

- *Data Granularity* – The quantity of data exchanged by a specific service capability determines the level of its data granularity.
- *Constraint Granularity* – The extent of validation logic detail defined for a given service capability within the service contract determines the capability's level of constraint granularity. Generally, the more specific the constraints and the larger the amount of constraints, the more fine-grained the capability's constraint granularity is.

The effect of design patterns on service-related design granularity can vary. For example, when applying multiple patterns (or compound patterns) to the same service, the end-levels of design granularity may be distinctly defined by that combination of patterns (and they may fluctuate between the application of one pattern to another).

Measures of Design Pattern Application

It is important to acknowledge that most patterns do not propose a black or white design option. Design patterns can often be applied at different levels. Although the effectiveness of a given pattern will generally be equivalent to the extent to which it is realized, there may be practical considerations that simply limit the degree to which a pattern can be applied in the real world (as is often the case when designing service logic that is required to encapsulate legacy functionality).

This consideration affects both design patterns and design principles. For example, individual service-orientation design principles can rarely be applied to their maximum potential. The point is to pursue the design goals of a design pattern or principle to whatever extent feasible and to strive for an end-result that realizes the pattern or principle to a meaningful extent.

SUMMARY OF KEY POINTS

- Some specific terminology is used within design pattern profiles. The distinction between "enterprise" and "enterprise-wide" is especially important.
- Design pattern profiles contain references to related design principles, revealing links between the patterns and the realization of service-orientation itself.
- As with design principles, most design patterns can be applied to various measures. Sometimes it isn't possible to fully apply a design pattern due to environmental constraints.

Index of Patterns

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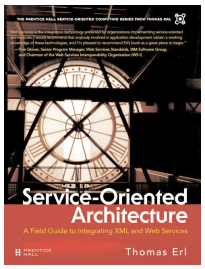

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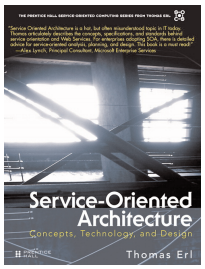

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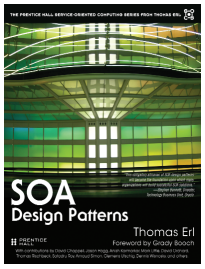

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