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Architecting Composite Applications and Services with TIBCO®

Paul C. Brown

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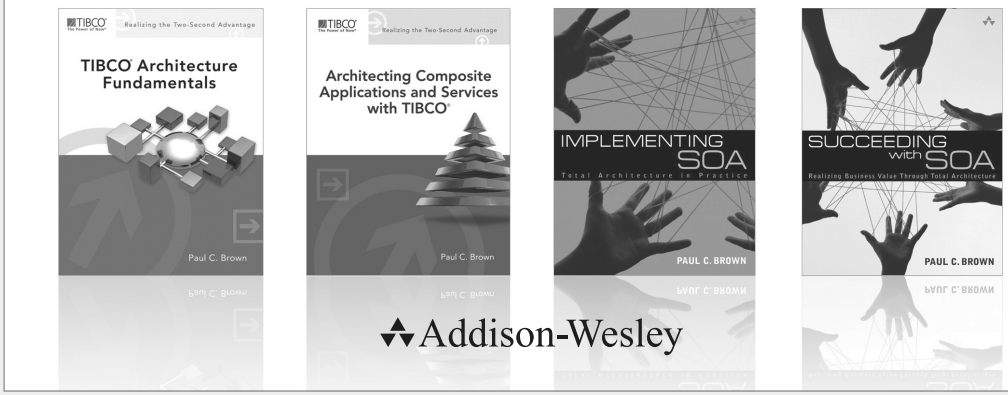

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The series emphasizes the unification of business process and system design in an approach known as *total architecture*. A technology-neutral description of this approach to distributed systems architecture is described in *Implementing SOA: Total Architecture in Practice*. Techniques for addressing the related organizational and management issues are described in *Succeeding with SOA: Realizing Business Value through Total Architecture*.

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Paul C. Brown

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To Michael Fallon and the TIBCO Education Team:
Thank you for your perseverance teaching me
the fine art of knowledge transfer.

Contents

Preface

About This Book

In composite applications and services, multiple components collaborate to provide the required functionality. These are distributed solutions for which there are many possible architectures. Some of these will serve the enterprise well, while others will lead to dead-end projects.

The Dual Roles of an Architecture

At the core lies an understanding of the dual role that architecture plays in a distributed design. One role is as an expression of an overall design: how the components collaborate to solve the problem. The other role is as a specification for the components and services that are part of that design. Understanding this dual role leads to an understanding of the information that must be present in an architecture document in order to effectively play this dual role.

This dual perspective on architecture is recursive: Dive in to a component or service and you'll find that it, too, has an architecture that must play both of these roles. It describes how its sub-components collaborate to provide the capabilities of the component. At the same time, it serves as a specification for each of its sub-components. And so on.

This perspective is so important to success that the better parts of three chapters (1, 5, and 6) are devoted to its exploration both by discussion and by example. All of the examples in the book are documented in the same manner.

Design Patterns

The architectures you define provide solutions for your enterprise. Many of these require solutions to well-known problems. To aid you in this work, this book covers a wide variety of design patterns for addressing

common challenges. These include partitioning interfaces and business logic; incorporating rules into your design; asynchronous interactions involving multiple consumers and providers; providing services with both synchronous and asynchronous coordination patterns; distributing workload with and without sequencing constraints; managing replicated data; creating composite components, services, and applications; fault-tolerance, high-availability, and site disaster recovery; and federating services. These build upon the basic service and integration patterns covered in the book *TIBCO® Architecture Fundamentals*.[1]

Relevant TIBCO Products

Components and services need to be implemented, of course, and to do this appropriate technologies need to be selected. TIBCO provides a number of products that are intended to play specific roles in composite applications and services. This book provides an overview of these roles for TIBCO ActiveMatrix® Service Bus, TIBCO ActiveMatrix® Service Grid, TIBCO ActiveMatrix BusinessWorks™, TIBCO Hawk®, TIBCO® Managed File Transfer components, TIBCO® mainframe integration products, TIBCO BusinessConnect™, and TIBCO Collaborative Information Manager™.

Best Practices

A good architecture is a living thing that evolves gracefully over time as the demands facing the enterprise change. Facilitating this evolution requires careful consideration of service and data structure versioning, naming standards, modular data structure design, and the federation of services. This book devotes a chapter to each of these topics.

Performance and Tuning

Your solution must perform well enough to meet the needs of the enterprise. Assuring yourself that you have achieved the performance goals requires suitable benchmarking, and one chapter is devoted to the conduct of such experiments and the interpretation of results. Hand in hand with benchmarking goes tuning, and one chapter is

1. Paul C. Brown, *TIBCO® Architecture Fundamentals*, Boston: Addison-Wesley (2011).

devoted to the tuning of ActiveMatrix® Service Bus and ActiveMatrix BusinessWorks™.

Service Federation

Services will arise in many contexts both within and external to your enterprise. Some of these services will be intended for local use, while others will be intended for more widespread use. One chapter is devoted to service federation, which focuses on organizing services that arise in these different contexts.

Documenting Solution Architectures and Service Specifications

Finally, all of your architecture decisions must be captured in a form that can be communicated to all interested parties, from the business people who chartered the project to the technical teams that will implement, deploy, and operate the components that comprise the finished solution. One chapter is devoted to documenting solution architectures and another to documenting service specifications. Augmenting these chapters are online templates for each of these documents and a worked example of each. These may be found at informit.com/title/9780321802057.

In summary, this book is a guide to successfully architecting composite applications and services employing TIBCO technologies. It presents a comprehensive approach for architecting everything from the overall solution to the individual components and services. It builds upon and extends the basic design patterns and product information presented in the book *TIBCO® Architecture Fundamentals*.

TIBCO Architecture Book Series

Architecting Composite Applications and Services with TIBCO® is the second book in a series on architecting solutions with TIBCO products (Figure P-1). It builds upon the material covered in *TIBCO® Architecture Fundamentals*, which provides material common to all TIBCO-based designs. Each of the more advanced books, including this one, explores a different style of solution, all based on TIBCO technology. Each explores the additional TIBCO products that are relevant to that style of

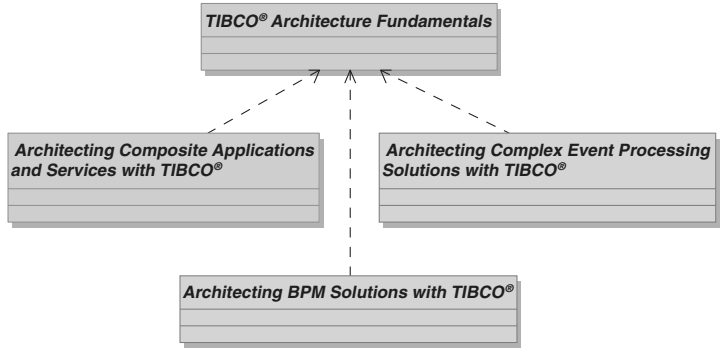

Figure P-1: *TIBCO Architecture Book Series*

solution. Each defines larger and more specialized architecture patterns relevant to the style, all built on top of the foundational set of design patterns presented in *TIBCO® Architecture Fundamentals*.

Intended Audience

Project architects are the intended primary audience for this book. These are the individuals responsible for defining an overall solution and specifying the components and services required to support that solution. Experienced architects will find much of interest, but no specific prior knowledge of architecture is assumed in the writing. This is to ensure that the material is also accessible to novice architects and advanced designers. For this latter audience, however, a reading of *TIBCO® Architecture Fundamentals* is highly recommended. It explores basic concepts in greater detail. This book provides a summary of that material in Chapter 2.

TIBCO specialists in a center of excellence will find material of interest, including background on the TIBCO product stack and design patterns showing best-practice uses of TIBCO products. The material on benchmark testing and tuning ActiveMatrix Service Bus and ActiveMatrix BusinessWorks lay the foundations for building high-performance applications based on these products.

Enterprise architects will find content of interest as well. The material on architecture documentation, component and service specification, versioning, namespace design, modular data structure design,

and benchmarking can be used as a reference for defining or reviewing enterprise standards in these areas. The collection of design patterns, in conjunction with those presented in *TIBCO® Architecture Fundamentals*, provide the basis for a baseline set of standard design patterns for the enterprise.

Technical managers will also find material of interest, particularly the description of the content expected in architecture documents and specifications. The guidelines for conducting benchmark tests will also be of interest.

Detailed Learning Objectives

After reading this book, you will be able to

- Create and document architectures for solutions, component and service specifications, and component and service implementations.
- Describe the intended roles for ActiveMatrix Service Bus, ActiveMatrix® Service Grid, ActiveMatrix BusinessWorks, Hawk®, TIBCO Managed File Transfer components, TIBCO mainframe integration products, BusinessConnect, and TIBCO Collaborative Information Manager in composite applications and services.
- Define a manageable approach to versioning services and their artifacts.
- Establish practical standards for naming services and related artifacts.
- Design modular and manageable data structures.
- Conduct and interpret performance benchmark tests.
- Tune ActiveMatrix Service Bus and ActiveMatrix BusinessWorks™.
- Identify and select appropriate design patterns for
    - Separating interface and business logic
    - Incorporating rules into an architecture
    - Supporting asynchronous interactions involving multiple consumers and providers
    - Simultaneously supporting synchronous and asynchronous coordination patterns
    - Distributing workload with and without sequencing constraints

- Managing replicated data
- Creating composites of components and services
- Fault-tolerance, high-availability, and site disaster recovery
- Federating services

Organization of the Book

This book is divided into four parts (Figure P-2). Part I begins with a discussion of components, services, and architectures that provides the conceptual foundation for the book. It next reviews the material covered in *TIBCO® Architecture Fundamentals,* which is foundational material for this book. Next comes a discussion of some TIBCO products not covered in *TIBCO® Architecture Fundamentals* that play prominent roles in composite applications and services. Finally, the Nouveau Health Care case study is introduced. This rich case study will be used as the basis for many of the examples in the book.

Part II covers the basics of designing services. It starts with a discussion of observable dependencies and behaviors—the externally observable characteristics of a component or service. This understanding is next incorporated into a discussion of service-related documentation. The following three chapters address issues that greatly impact the flexibility of the architecture: versioning, naming standards, and data structures.

Part III describes a number of common design challenges and architectural patterns that can be used to address them. It starts with a number of general building-block patterns. Next are patterns for load distribution, with and without sequencing constraints. Patterns for managing replicated data are then followed by patterns for composing components and services.

Part IV addresses advanced topics. The conduct and interpretation of benchmark experiments are key for achieving performance goals, as is the tuning of key products. Fault-tolerance, high-availability, and site disaster recovery are discussed, followed by a discussion about federating multiple service domains. The book concludes with chapters covering the documentation of a solution and a service specification.

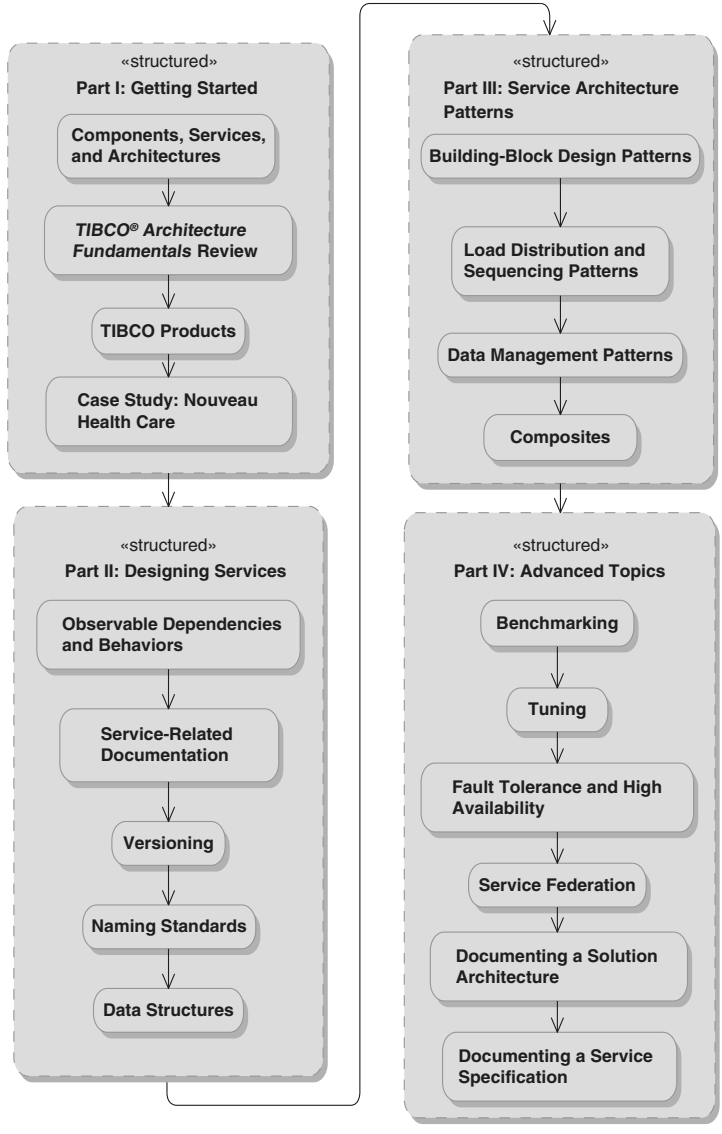

Figure P-2: *Organization of the Book*

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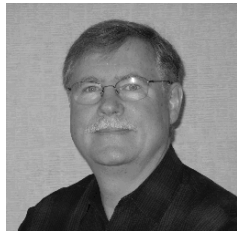
About the Author



Dr. Paul C. Brown is a Principal Software Architect at TIBCO Software Inc., and is the author of *Succeeding with SOA: Realizing Business Value Through Total Architecture* (2007), *Implementing SOA: Total Architecture in Practice* (2008), and *TIBCO® Architecture Fundamentals* (2011), all from Addison-Wesley. He is also a co-author of the SOA Manifesto (soa-manifesto.org). His model-based tool architectures are the foundation of a diverse family of applications that design distributed control systems, process control interfaces, internal combustion engines, and NASA satellite missions. Dr. Brown's extensive design work on enterprise-scale information systems led him to develop the total architecture concept: business processes and information systems are so intertwined that they must be architected together. Dr. Brown received his Ph.D. in computer science from Rensselaer Polytechnic Institute and his BSEE from Union College. He is a member of IEEE and ACM.

Chapter 5

Observable Dependencies and Behaviors

Objectives

When you are creating a design as a collection of interacting components (e.g., services), it is useful to be able to ignore the internals of those components and concentrate on their interactions. However, you still need to know something about the component—how it depends upon the environment in which it operates and how it will behave. This chapter is about how to characterize these dependencies and behaviors. As we shall see in the next chapter, this type of characterization forms the core of component and service specifications.

If you are conceptualizing (defining) the component as part of your design, you will be called upon to create this characterization. If you are using an existing component, then you will be the consumer of the characterization. Either way, you need to understand what is required to appropriately characterize the component.

Behavior is the way in which something, in our case a component, responds to a stimulus. To effectively utilize the component in a solution,

you need to understand how the component will respond to stimuli provided by the other solution components and what stimuli the component will provide to the rest of the solution.

In this work we will use the term *observable dependency* to refer to the relationship between the component and components in the environment upon which it depends. We will use the term *observable behavior* to refer to the behavior as seen by the rest of the solution—without looking inside the component. After reading this chapter you should be able to describe the concepts of observable dependency and observable behavior and explain how they can be characterized. This will provide the foundation for an ensuing discussion of component and service specifications.

The Black Box Perspective

When you have a solution comprised of collaborating components (services), it is easier to understand the solution if you are able to view each component as a black box and not have to worry about what is inside. To do this, you need to be able to characterize two things: (1) the observable dependencies of the black box—the components in its environment upon which it depends, including their interfaces and behaviors, and (2) the observable behavior of the black box—how it responds to stimuli provided by other solution components and which stimuli it provides to those components. That's what this chapter is about.

There is a strong analogy here to the way in which people learn about things in their environment. When presented with an object they want to learn about, people are inclined to pick it up, turn it at different angles, and experiment with different ways in which they can interact with it. On electronic gadgets they press the keys, flip the switches, and touch the screen, all the while observing both the dependencies and the resultant behavior. They are making observations about the object.

You can think about solution components the same way, only the observations you make are not visual. The other components upon which they rely for proper operation characterize their dependencies, and the stimuli are the invocations of interface operations and other events that trigger component responses. Observations are the responses, such as returned data structures and the invocations of other component's interfaces. What you learn about the component are its dependencies and observable behavior.

Of course, experimenting with a component to learn its dependencies and behaviors is likely to be a time-consuming and error-prone activity. Preferably you would like to have someone tell you how the component will behave and the components upon which it depends for proper operation. Such a characterization of dependency and behavior forms the core of the component's specification.

Facets of Observable Dependencies and Behaviors

So what do you need to know about a component to describe its observable dependencies and behaviors? Some important facets include

- External component dependencies upon the component as characterized by the component's interfaces and operations
- The component's dependencies upon external components, consisting of the identification of these components and the characterization of their interfaces and operations
- Usage scenarios: characterizations of the business processes in which the component is expected to participate and the component's participation in those processes
- Triggered behaviors: the structure of component activities that explain the relationships between the component's triggers, responses, inputs, observable state, and outputs
- Observable state: information retained by the component with a presence that is observable through its interactions
- Coordination: the manner in which the component's activity can be coordinated with that of external components
- Constraints: limitations, particularly on the sequencing of triggers
- Nonfunctional behavior: performance, availability, and so on

Example: Sales Order Service

We will use the example of a Sales Order Service supporting an Order-to-Delivery business process to illustrate the various facets of observable dependencies and behaviors. An overview of the Order-to-Delivery business process is depicted in Figure 5-1. This figure presents a usage scenario for the Sales Order Service, which is one of the participants in

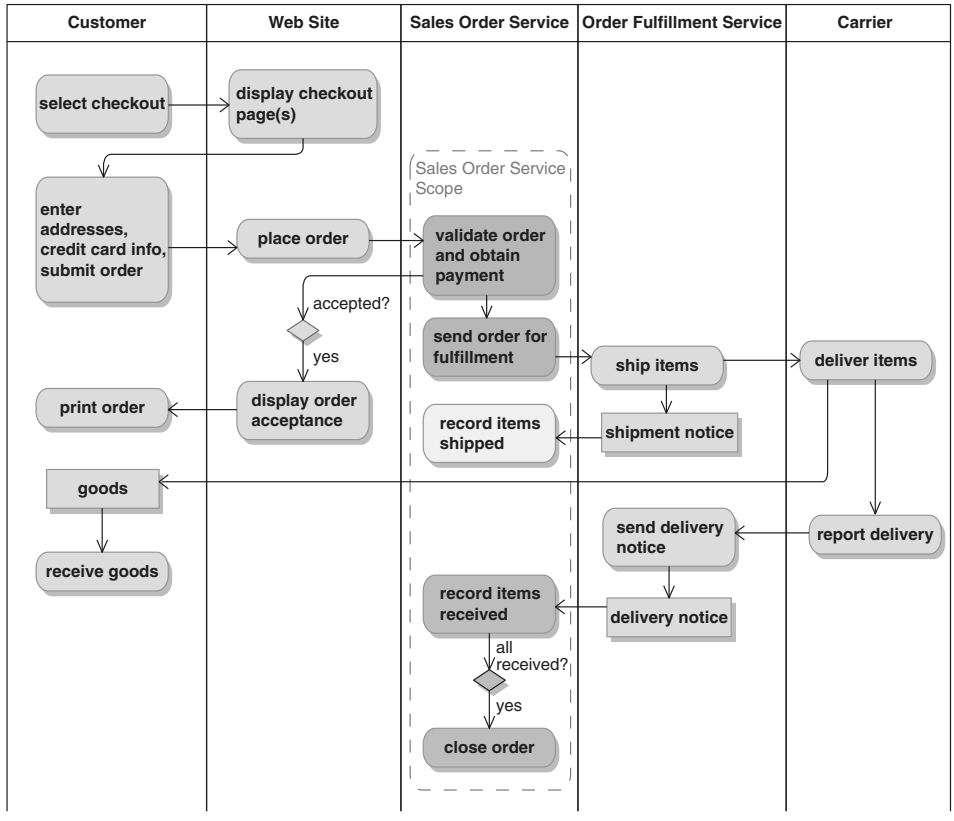


Figure 5-1: *Sales Order Service in the Order-to-Delivery Business Process*

the process. The Sales Order Service manages the full life cycle of an order. Let's examine how it participates in the process and note the relevant observable facets that come into play.

Placing the Order

The Sales Order Service accepts an order from the Web Site via the `placeOrder()` operation of the Sales Order Service Interface (Figure 5-2). The invocation of this operation constitutes a trigger, and the fact that it is invoked by the Web Site indicates a dependency on the interface.

The invocation of the `placeOrder()` operation triggers an associated behavior of the service. This behavior validates the order and obtains payment, in the process deciding whether or not to accept the

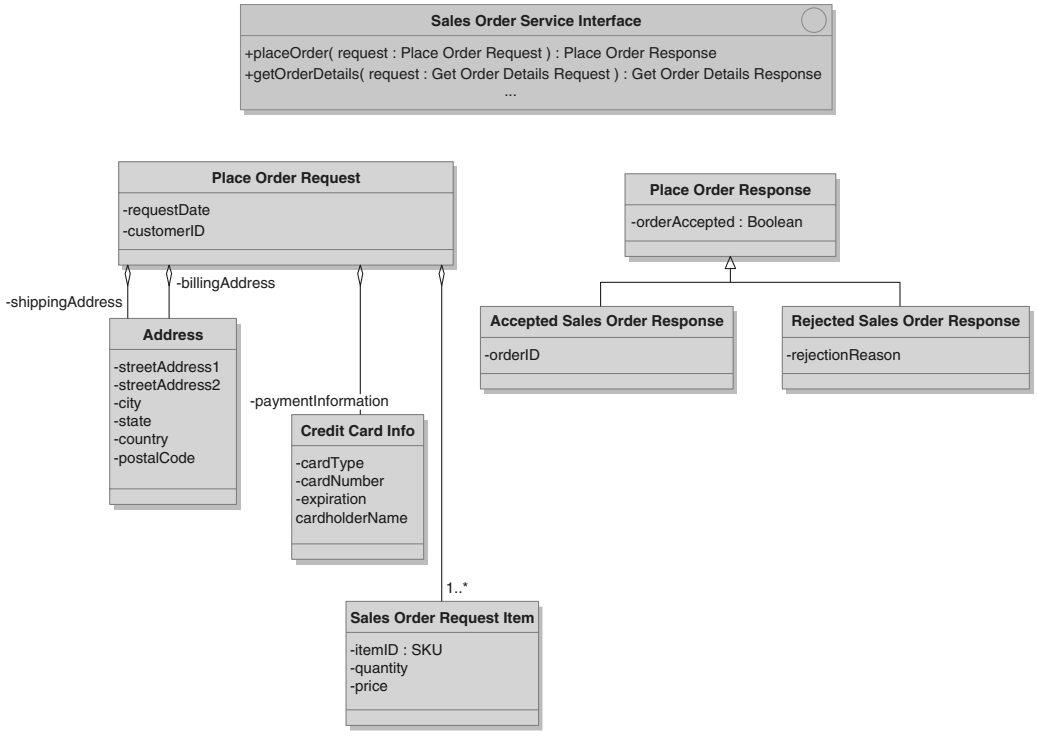


Figure 5-2: *Sales Order Service Interface—*`placeOrder()` *Operation*

order. These activities involve interactions with other components, components that are not part of the service and are thus dependencies. Let's look at the interfaces involved, and later we'll identify the components that provide those interfaces.

The validity of each itemID is established by calling the `validateProductID()` operation of the Product Query Interface (Figure 5-3).

The validity of the customerID is established by calling the `getCustomer()` operation of the Customer Query Interface (Figure 5-4).

Payment is obtained by calling the `obtainPayment()` operation on the Credit Interface (Figure 5-5).

At this point the service returns the Place Order Response to the waiting caller of `placeOrder()`. This data structure indicates whether the order was accepted and, if not accepted, the reason why. The data structure exposes the fact that the service is validating the order and obtaining payment, thus making this portion of the behavior observable to the caller of `placeOrder()`.

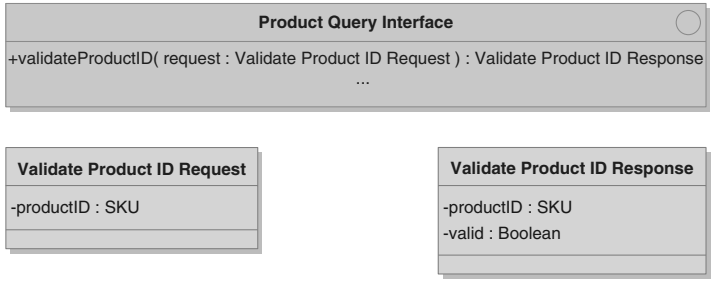


Figure 5-3: *Product Query Interface—*`validateProductID()` *Operation*

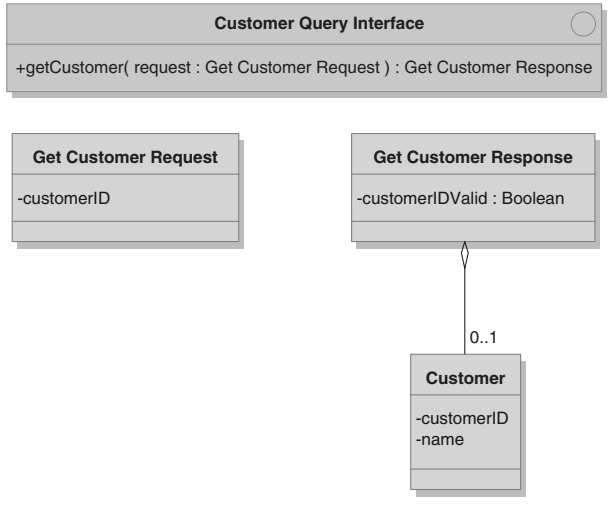


Figure 5-4: *Customer Query Interface—*`getCustomer()` *Operation*

The observable behavior does not end with the return of the Place Order Response data structure. If the order is accepted, the service then sends the order to Order Fulfillment using the `fillOrder()` operation of the Order Fulfillment Interface to accomplish this (Figure 5-6). This is yet another dependency. Note that, as designed, this is an In-Only operation and does not return a response.

At this point the behavior that began with the invocation of the `placeOrder()` operation comes to a conclusion. Putting all the pieces together, the behavior triggered by this invocation is that shown in Figure 5-7. This diagram also indicates components for which there are observable dependencies: Product Service, Customer Service, Credit Service, and Order Fulfillment Service.

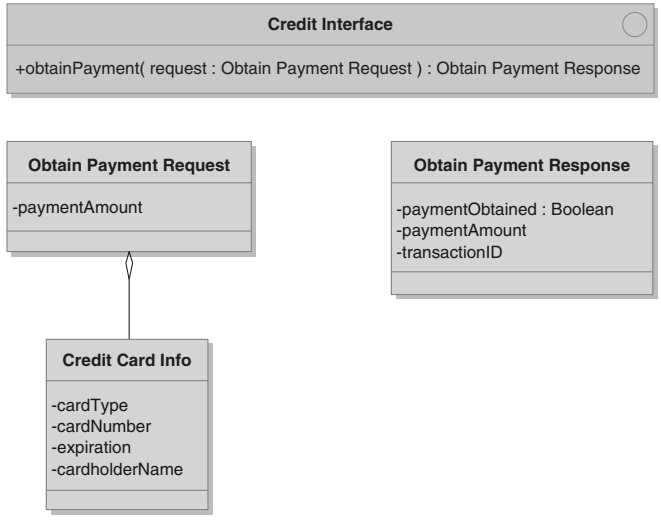


Figure 5-5: *Credit Interface—*`obtainPayment()` *Operation*

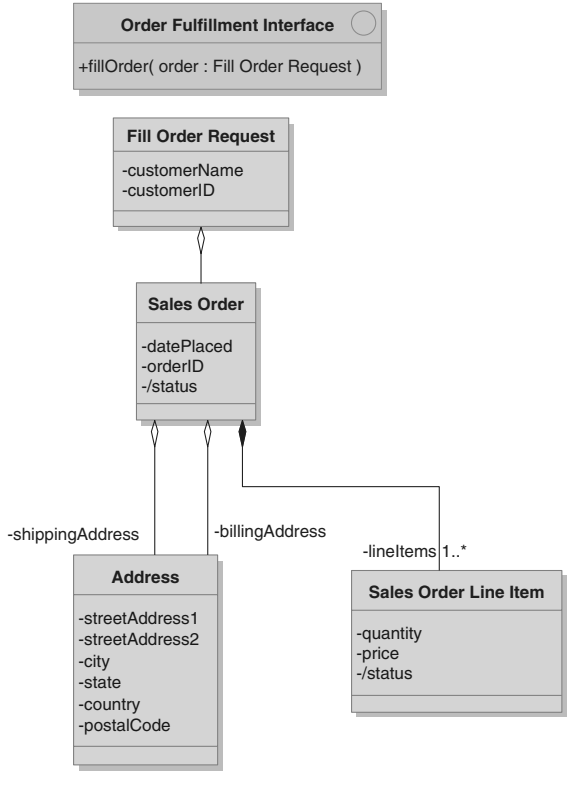


Figure 5-6: *Order Fulfillment Interface—*`fillOrder()` *Operation*

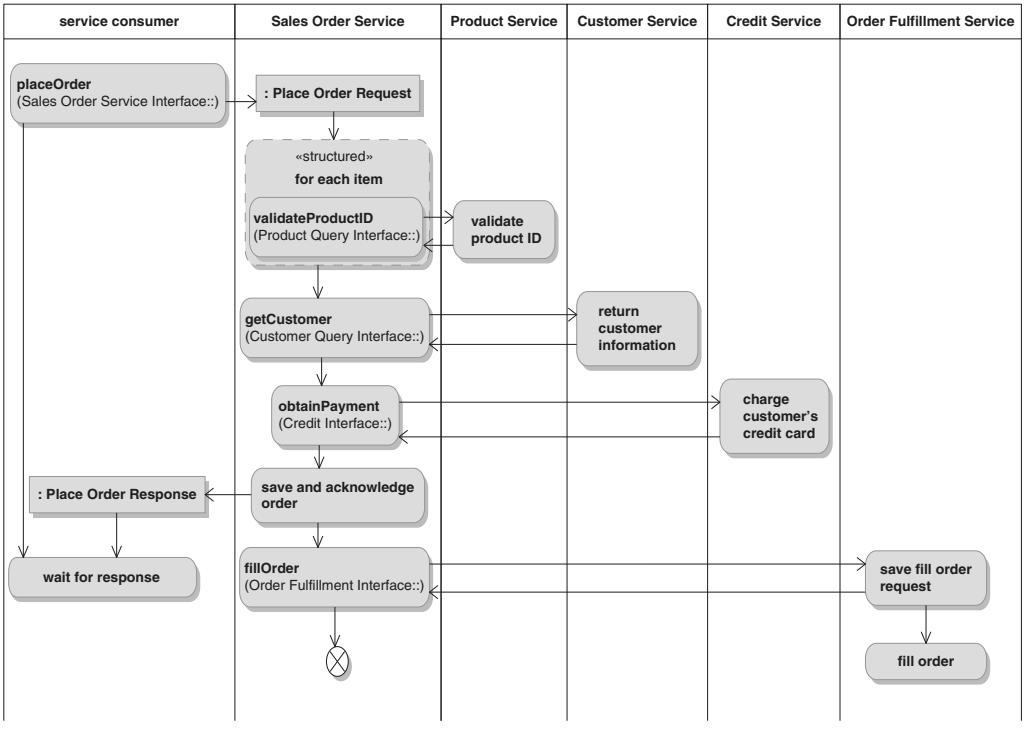


Figure 5-7: *Triggered Behavior for* `placeOrder()`

Order Shipped

When Order Fulfillment ships the items, it sends a copy of the shipment notice to the Sales Order Service. It does this by calling the `orderShipped()` operation of the Sales Order Status Interface (Figure 5-8). This is another dependency: Order Fulfillment depends on this interface. As designed, this is an In-Only operation.

The triggered behavior related to this interaction, the update of order status, is simple, although somewhat obscure from an observability perspective (Figure 5-9). The obscurity arises because the update of the order status cannot be inferred from this interaction alone. It is only the fact that the order status can be retrieved (via other operations), coupled with the fact that this status indicates whether or not the order has shipped, that reveals the fact that the order status exists and has been changed. We have identified an element of observable state.

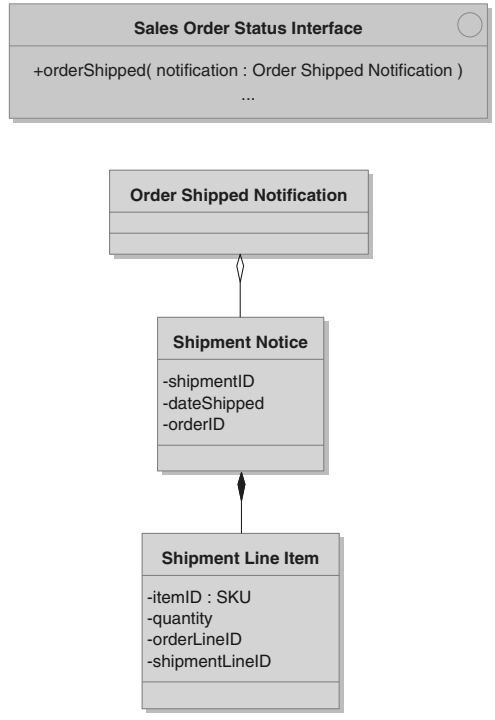


Figure 5-8: *Sales Order Status Interface—*`orderShipped()` *Operation*

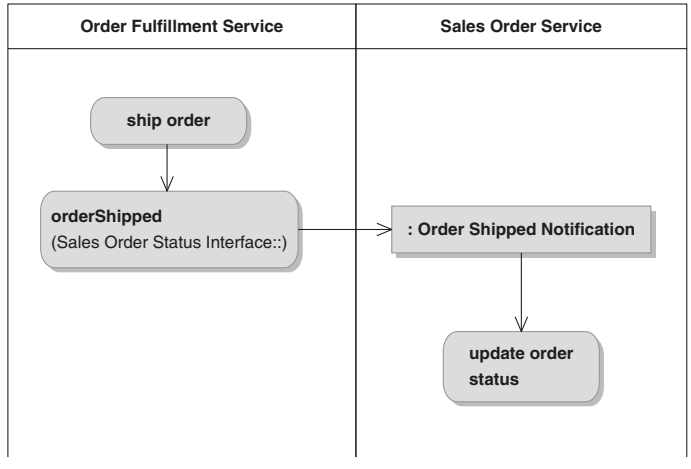


Figure 5-9: `orderShipped()` *Triggered Behavior*

Order Delivered

When the Carrier reports that the shipment has been delivered, Order Fulfillment forwards the delivery notice to the Sales Order Service by calling the `orderDelivered()` operation of the Sales Order Status Interface (Figure 5-10). This is another dependency. Note that this is an In-Only operation and does not return a response.

Figure 5-11 shows the triggered behavior resulting from the invocation of the `orderDelivered()` operation. Once again, the existence of the order status update activity is inferred from information visible through other interface operations.

Observable State Information

Some component operations can reveal that information has been retained within a component. Consider the `getOrder()` operation of the Sales Order Service Interface shown in Figure 5-12. It returns information about the sales order and its line items. In order for the

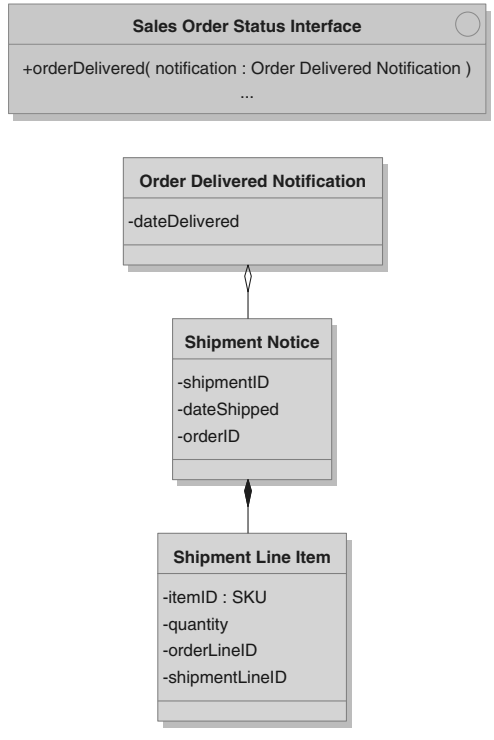


Figure 5-10: *Sales Order Status Interface—*`orderDelivered()` *Operation*

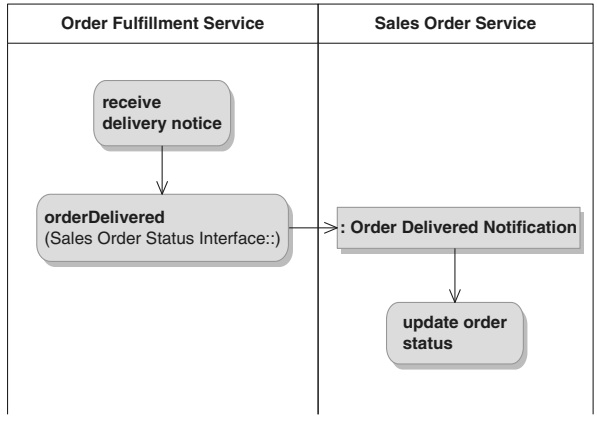


Figure 5-11: `orderDelivered()` *Triggered Behavior*

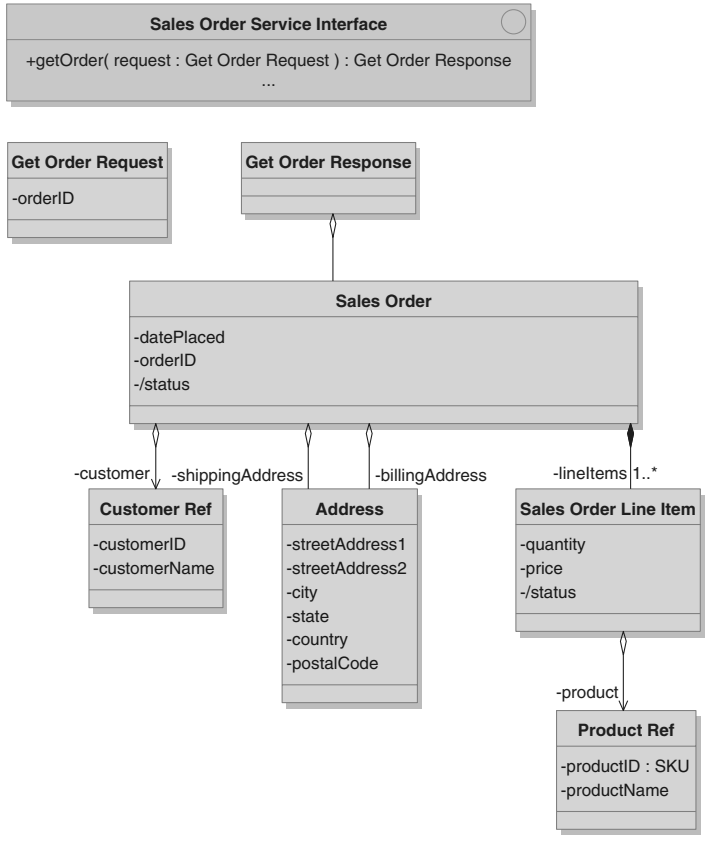


Figure 5-12: *Sales Order Service Interface*—`getOrder()` *Operation*

component to be able to return this information, it must retain it as part of its state. This makes that portion of the state observable.

There are two types of information typically observable through such interfaces: operational information and milestone-level status.

Operational Information

Figure 5-13 shows, at a conceptual level, the operational information involved in the ordering and shipping of goods. It also indicates which components are responsible for managing individual information elements. The Sales Order Service manages operational information related to the sales order, including the Sales Order, the Sales Order Line Items, the billing information, and the shipping and billing addresses. The service is stateful since it retains this information. The fact that the service makes this information (and changes to it) visible at its interfaces makes this state information observable.

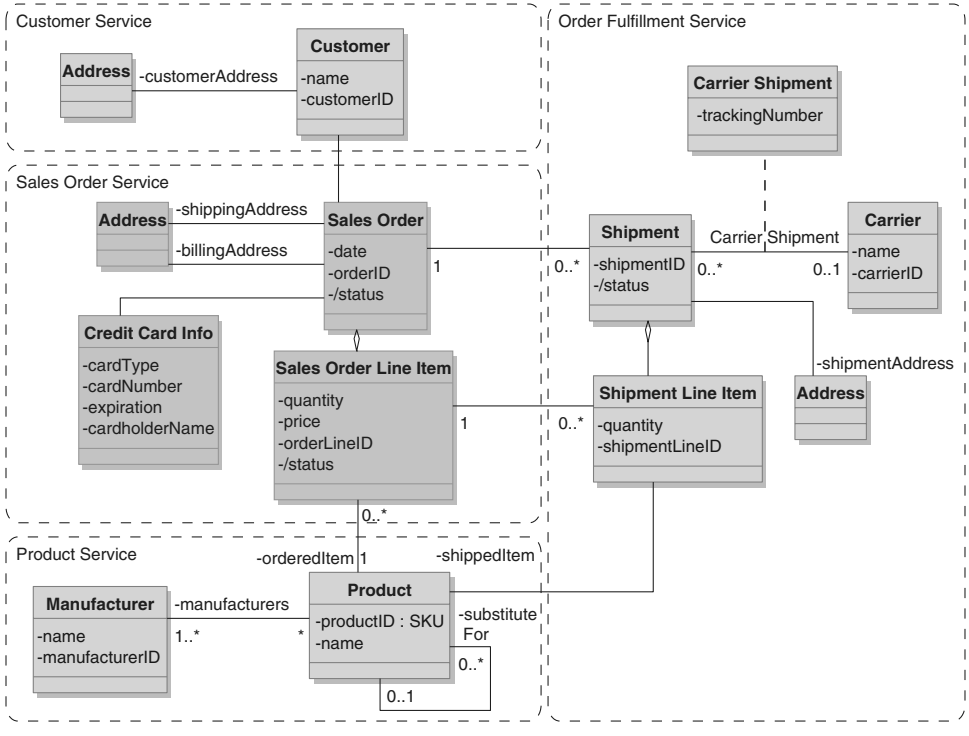


Figure 5-13: *Operational Information in the Order-to-Delivery Process*

When a component retains stateful information, component users need to know the relationship between the interface operations and this stateful information in order to use the operations correctly. Users need to know which operations modify and reveal the state, and the details about which portions of the state are modified or revealed.

Milestone Status

There is another kind of information often visible through service interfaces: milestone-level status. This is usually an abstracted summary of the overall solution state, which includes state information originating outside the component.

For example, the status attribute of the sales order takes on one of a number of values depending upon the overall status of the order (Figure 5-14). Much of the state information being summarized resides outside the scope of the Sales Order Service. Thus, there must be interfaces (and systems implementing or invoking those interfaces) that provide the detailed state information needed to update this summary

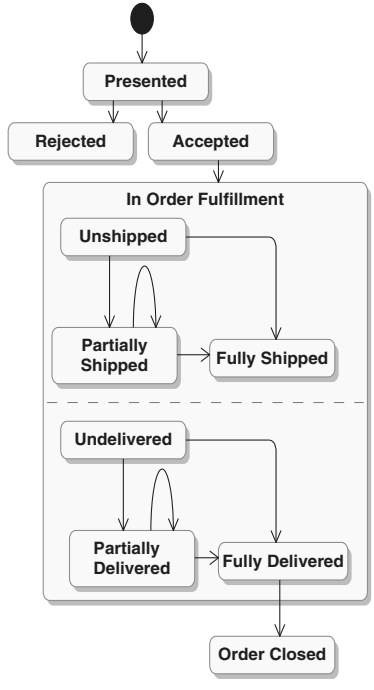


Figure 5-14: *Order Milestone Status*

state information. In this case, these are the `orderShipped()` and `orderDelivered()` operations of the Sales Order Status Interface that are invoked by the Order Fulfillment Service.

Observable State and Cached Information

The Sales Order Service makes use of some state information that it does not directly manage (own): customer information, product information, and information about the related shipments. Other services (components) are the systems of record for this information, but at least some of this information is cached in the Sales Order Service. This situation can raise some interesting design challenges, challenges that when resolved, can impact the observable behavior of the Sales Order Service.

A core design challenge is deciding how to maintain consistency between the cached information as viewed through the Sales Order Service and the same information viewed through its actual system of record. If it is possible (and it almost always is) for inconsistencies to arise, then the component's observable behaviors must indicate the scenarios under which this can arise. Users need to be aware that such inconsistencies are possible and the circumstances under which they can arise.

Let's take a look at how such a situation can arise in the Sales Order Service. If the other systems of record have separate data stores (e.g., databases), then it must be the case that the Sales Order Service retains copies of at least some of the information in its physical data store (Figure 5-15). Since this information is a copy, inconsistencies will arise if the system of record is updated but the copy is not. The more information that is copied, the more likely it is that a discrepancy will arise and be observed.

Maintaining the accuracy of cached information requires interactions with the information's system of record. One common approach is for the system of record to provide facilities to inform interested parties of changes to its information. The system of record provides an interface for interested parties to subscribe to such notifications, and a second interface to actually notify the parties of changes. This approach is often taken when it is likely that more than one party will be interested in the changes. Note that the uses of these interfaces constitute additional observable dependencies.

In the present design, the Sales Order Service has two relationships of this type, one for product information and the other for

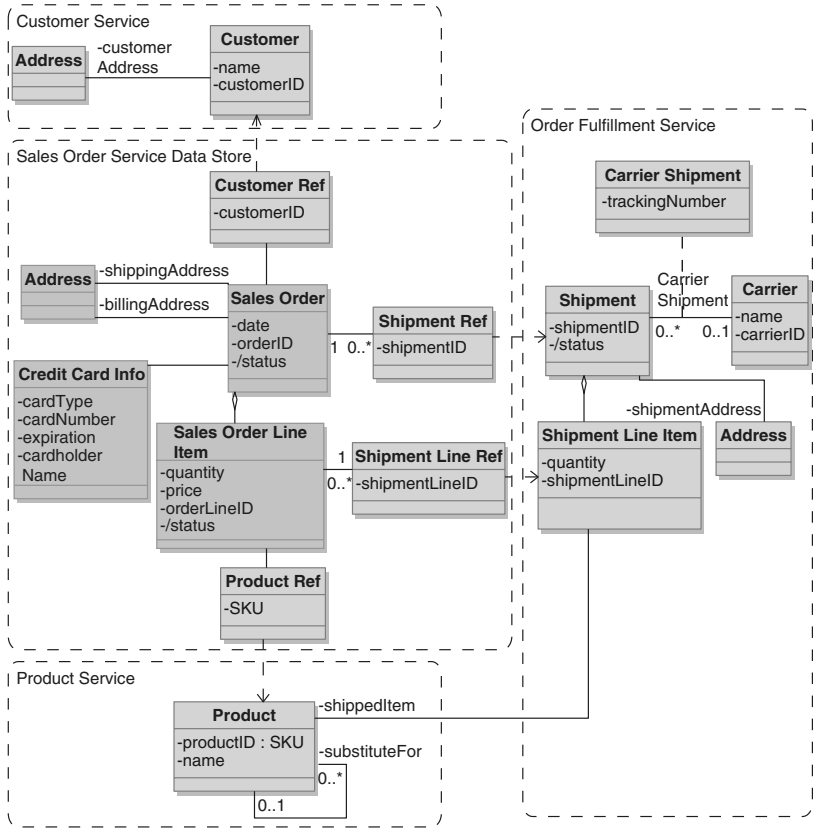


Figure 5-15: *Sales Order Service Data Store*

customer information. Figure 5-16 shows the interfaces provided by the Product Service for this purpose. The Sales Order Service is a user of these interfaces.

Two interesting questions arise with respect to the subscription interface. The first of these relates to the granularity of the subscription: Does the interested party subscribe to changes to particular products, or to all products? The second relates to the timing of the subscription: When does subscription occur? When the component is deployed? When it is started? Does it occur at some other time?

In practice, subscriptions are often realized without implementing subscription interfaces at all. Instead, the design uses a messaging service (e.g., JMS) for the delivery of notifications. The granularity issue is addressed through the choice of the number of destinations (topics or queues) in the design and the determination of which

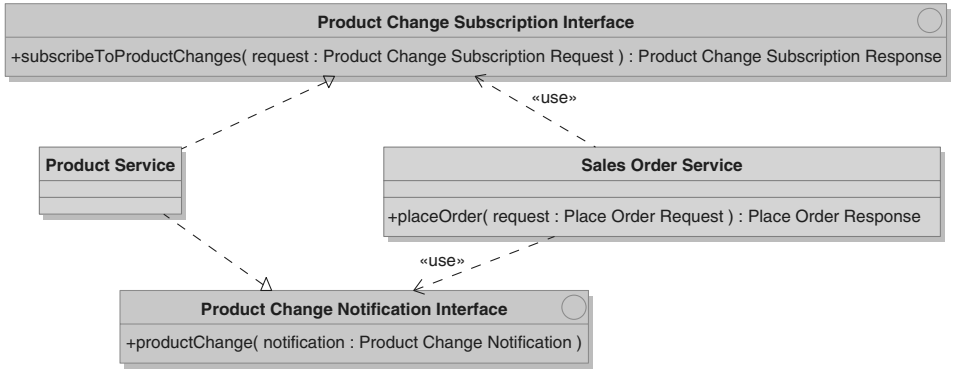


Figure 5-16: *Product Change Notification Context*

notifications will be sent to which destinations. Subscriptions are implemented through deployment-time configuration of components as listeners to specific destinations.

The `productChange()` operation raises another interesting situation from the Sales Order Service's perspective: its invocation triggers activity in the service that is not related to an operation being provided by the Sales Order Service itself (Figure 5-17). It is the arrival of the

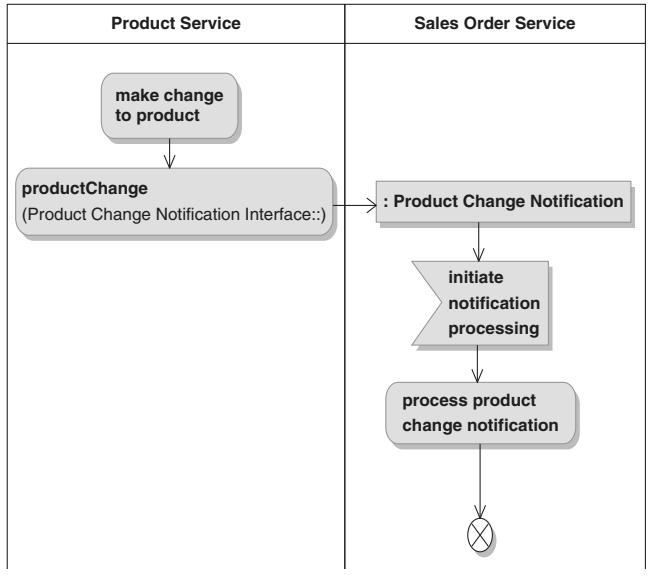


Figure 5-17: *Product Change Notification Process*

notification that triggers the service's activity. This is commonly referred to as an event-driven interaction. As shown, the process depicted in the diagram does not indicate what action should be taken as a result of this notification. However, if the final resolution requires either a change to the observable state of the service (e.g., replacing the item with another item) or an interaction with an external component (such as sending an e-mail notification), these actions constitute changes to the observable behavior that must be documented.

Avoiding Caches: Nested Retrieval

An approach to minimizing inconsistencies is to minimize the amount of cached information in a component. For example, instead of caching a lot of data, the component might only cache an identifier. Then, when the service needs more information about the identified entity, it retrieves it dynamically from the system of record for that entity.

The `placeOrder()` operation described earlier contains two interactions of this type. First, it interacts with the Product Service to validate the productID in the order request. Second, it interacts with the Customer Service for two reasons: to validate the customerID, and to retrieve the customerName, which is a required field for the Fill Order Request (Figure 5-6) data structure used in the `fillOrder()` invocation. Note that only the identifiers for these two entities are retained as part of the Sales Order Service's state.

Characterizing Observable Dependencies and Behaviors

Let's now summarize the information needed to characterize the observable dependencies and behavior of a component.

Context

Context places the component in question into the larger environment in which it must exist and with which it must interact. It defines the dependencies that the component has upon other components. For services, the consumer of the service is often shown only as an abstraction since there may be many service consumers. For components that are not services, the component may require specific

interfaces on the consumer and is designed to work only with that consuming component. In such cases the type of the consuming component is explicitly shown.

Dependencies can be readily shown with an abstracted architecture pattern (Figure 5-18). The difference between this and a full architecture pattern is that the actual communications channels have been replaced with the more abstract `<<use>>` relationship. As the design is refined, these can be replaced with the more concrete communications channels.

This particular diagram indicates another area requiring refinement: The actual mechanisms for subscribing to the Product Change Notification and Customer Change Notification have not been defined, nor is it clear which participant will employ this mechanism to establish the subscriptions. In reality, the implementation of this activity may require manual configuration done at deployment time. The completed component dependency and behavioral description must indicate how this will happen.

Usage Scenarios

The architecture pattern does not indicate how the component (in this case the Sales Order Service) functionally participates in the business processes that comprise the overall solution. For this you need to

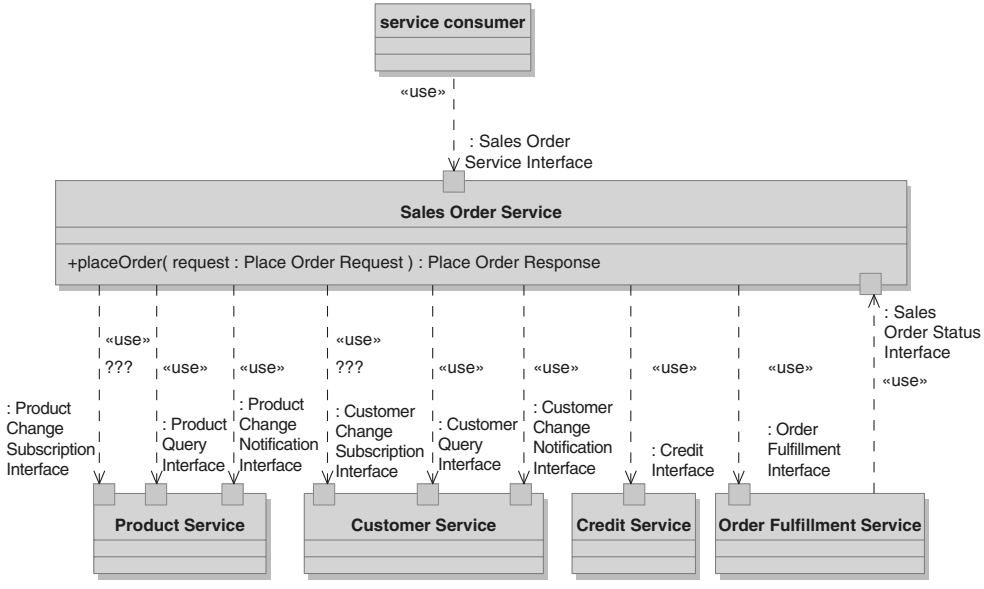


Figure 5-18: *Sales Order Service Context Showing Dependencies*

understand the scenarios that involve the component and show its involvement in the solution's operation. Process-pattern mappings similar to that of Figure 5-1 are well suited for this purpose. For each triggering event of the component, there should be at least one example of a scenario in which the component is expected to participate. If reusability is an issue and the usages are different, there should be a scenario illustrating each type of usage.

To fully characterize the component, more is required than simply the scenario. You need to know how often each scenario occurs, the expected execution time of the scenario, and the required availability of the scenario. It is from this information that the corresponding throughput, response time, and availability characteristics of the component will be derived.

Particularly in the case of services, it is not unusual for some of the scenarios to be speculative, representing potential future usages. Nevertheless, these scenarios need to be documented along with working assumptions about their associated performance and availability characteristics.

From a practical perspective, usage scenarios may only show the fragment of the larger business process in which the component actually participates. However, if the process requires multiple interactions with the component, it is important that the usage scenario span these multiple interactions. If significantly different sequences must be supported, each sequence must be documented.

Triggered Behaviors

The behavior of a component is a description of the sequences of interactions it can have with the components upon which it depends along with the details of those interactions. In most circumstances, this behavior can be readily documented using one or more UML Activity diagrams. The diagrams indicate the behavior's trigger along with the resulting responses, inputs, outputs, and observable state changes.

Figure 5-7 is an example of a triggered behavior. Its trigger is the invocation of the `placeOrder()` process, and its initial input is the Place Order Request. Responses include the calls to `validateProductID()`, `getCustomer()`, and `obtainPayment()`; the return of the Place Order Response; and the invocation of the `fillOrder()` operation. The data structures associated with these operations provide details of the interactions. Prior to sending the Place Order Response, the order information is saved and becomes part of the component's observable state.

This, of course, is just one possible behavior for this trigger. Other scenarios are required to describe the expected behavior when one or more of the dependent components becomes unavailable or returns unexpected results.

To fully characterize a component's behavior, a triggered behavior description is required for each possible trigger. Triggering events may include the invocation of interface operations, the receipt of notifications, the expiration of timers, and component life-cycle events such as start, stop, deployment, and un-deployment. In the Sales Order Service example, it is likely that the subscriptions to product and customer change notifications would actually be made via configuration changes implemented as part of the deployment process. Here the deployment would be the event, and one of the participants in the process is the person doing the deployment.

Observable State

The observable state of a component reflects the information or other types of status (such as physical machine state) that can be altered or viewed by interactions among the component and other components. A model of this state information will help the user of the component understand the component's behavior. The model should clearly distinguish between information for which the component is the system of record and information that is a cached copy of information originating in another component.

Figure 5-15 is an example of an observable state model related to the Sales Order Service. It shows the information for which the Sales Order Service is the system of record and the information that it has cached from other components. It also indicates the relationship between the cached information and the system-of-record information from which it is derived.

Some state information can be a derived summary of information that is distributed across a number of components. The status of the Sales Order is such an example. When this type of information is present, the allowed values that it can assume must be modeled (Figure 5-14), and the triggers and triggered behaviors that result in its update must also be captured (Figures 5-9 and 5-11).

Coordination

The work of a component does not occur in isolation, and the performance of this work needs to be coordinated with that of other compo-

nents in the solution. Consequently, the available coordination approaches are a significant part of the component's observable behavior.

Some coordination patterns are readily captured in the modeling of individual triggered behaviors. For example, in the `placeOrder()` process of Figure 5-7 it is clear that the interaction between the service consumer and the Sales Order Service uses synchronous request-reply coordination.

Other coordination patterns may involve multiple triggering events and therefore multiple triggered behaviors. For example, `placeOrder()` sends a `fillOrder()` request to the Order Fulfillment Service, but the responses from the Order Fulfillment Service are returned asynchronously. These interactions involve the Order Fulfillment Services's invocations of the `orderShipped()` (Figure 5-9) and `orderDelivered()` (Figure 5-11) operations. The overall coordination is only apparent when the usage scenario (Figure 5-1) is considered.

Capturing coordination is important because changing coordination patterns involves changes in both components. In the Sales Order Service example, shipment and delivery notices are delivered to the Sales Order Service by calling operations on its Sales Order Status Interface. This makes the design of the Order Fulfillment Service specific to the Sales Order Service.

There is an alternative approach. Consider a situation in which other components in addition to the Sales Order Service need to know about shipments and deliveries. With the present design, accommodating this requirement would necessitate an Order Fulfillment Service change to individually notify each of the additional components.

Alternatively, the Order Fulfillment Service could provide a subscription interface where any component could register to be informed about shipments and deliveries (Figure 5-19). Thus any number of components could subscribe without requiring any design changes in the Order Fulfillment Service. However, to switch to this design the Sales Order Service has to be modified to utilize the new approach to learning about shipments and notifications.

Constraints

Usage scenarios show allowed sequences of interactions with the component, but they do not illustrate sequences that are not allowed. These need to be documented as well.

Consider the Sales Order Service Interface shown in Figure 5-20. This interface has some obvious constraints upon its usage. You can't get, modify, or cancel an order that hasn't been placed. However, there

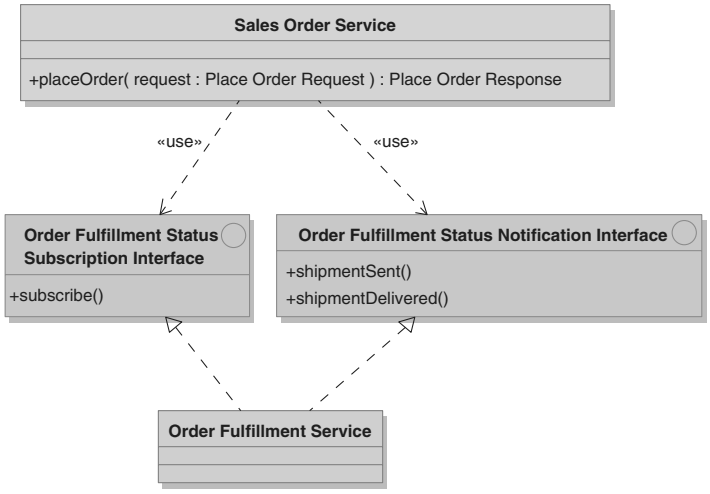


Figure 5-19: *Alternative Design for Shipment and Delivery Notification*

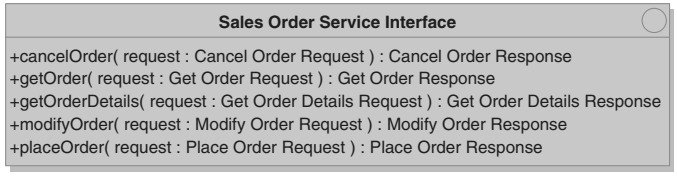


Figure 5-20: *Full Sales Order Service Interface*

may be some less obvious constraints. Depending upon business rules, you may not be able to modify or cancel an order that has already shipped. Users of a component need to understand these constraints.

Nonfunctional Behavior

A component may provide all the functionality required for a usage scenario, but still may not be suitable for nonfunctional reasons. Its throughput capability may be insufficient to support the volume of activity required by the scenario or its response time may be inadequate. The availability of the component may not be sufficient to give the usage scenario its required availability.

Nonfunctional requirements are not arbitrary—they are (or should be) derived from the business requirements. The connection between the business requirements and the individual components is established through the usage scenarios. For example, the business might

require that customers be able to place orders at a peak rate of 100 per second. With reference to Figure 5-1, this means that the Sales Order Service must be able to accept order requests at this rate. If the business requires that orders be acknowledged within three seconds, this means that the Sales Order Service must be able to validate orders and obtain payment within three seconds with orders coming in at a rate of 100 per second. Similar reasoning can be used to determine the rate at which shipment and delivery notices will occur and be processed.

This same type of thinking applies to other types of nonfunctional requirements as well. If the business requires that online ordering capability be available 24/7, then this means that the Sales Order Service must be available 24/7. Availability, outage time restrictions, and security requirements must also be connected back to the business requirements via the usage scenarios.

There is another reason for establishing this connection between business requirements and component requirements: It captures the design assumptions that went into specifying the component. When a new utilization for the service comes along, this makes it easy to determine whether the new usage is consistent with the original design assumptions. If it is not, then it is necessary to open the black box and determine whether the actual design is capable of meeting the new requirements.

For all of these reasons, it is important to document the nonfunctional behavior of the component. It is an observable characteristic of the component.

Some Composites May Not Be Suitable for Black Box Characterization

For the black box approach to work, the component must appear to be a coherent whole. For a monolithic self-contained component, that's not a problem. But for a composite, a component comprising other components (Figure 5-21), some conditions must be satisfied for it to be treated as a black box:

- It must (to all appearances) be managed as a single unit.
- It must have a single organization responsible for its operation.
- Access to the constituent parts must be exclusively through the interface(s) of the black box. Note that this does not preclude exposing a sub-component's interface as one of the composite's interfaces.

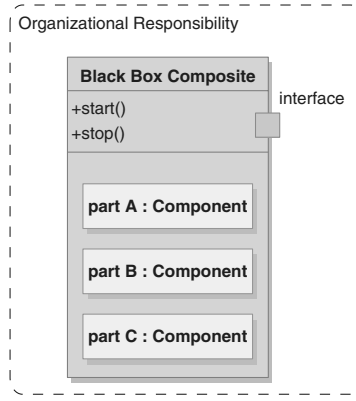


Figure 5-21: *Black Box Perspective*

Key indicators that the composite is not a black box include

- Different organizations are responsible for operating (starting and stopping) different parts of the composite.
- Decisions to start and stop the composite are separate from decisions to start and stop its component parts.
- A component part can be accessed directly via its own interfaces, interfaces that are not declared to be part of the composite's interfaces. This is particularly important when the constituent component is stateful.

An example of a component that should not be treated as a black box is a service (interface) wrapping the functionality of a stateful back-end system that other solution components access directly. In this situation, state changes made via the service interface may be visible through the back-end system's interface, and vice versa. Characterizing the observable behavior of the service will not explain the state changes that are visible through the service interface but did not originate as the result of a service interaction.

Any of these conditions make it important for the user of the composite to be aware of the composite's architectural structure—aware of those components that are independently accessible or managed. Under such circumstances, you can't treat the composite, including its component parts, as a single entity—a black box. Instead, each of the components becomes a black box in its own right. The context and usage scenarios for the "composite" then indicate how these supporting components collaborate with the composite.

Summary

When you want to use a component as part of a solution, you need to understand the behavior of that component so that you can determine whether it is suitable for use in the solution. What you need to know are the aspects of the component's behavior that are observable from outside the component. You treat the component as a black box and focus on its observable behavior.

Understanding observable behavior requires characterizing a number of things, including

- Context: the component's dependencies upon external components and vice versa
- Usage scenarios: characterizations of the business processes in which the component is expected to participate
- Triggered behaviors: structures of activities that explain the relationships among the component's triggers, responses, inputs, observable state, and outputs
- Observable state (information retained from one trigger to the next)
- Coordination: the manner in which the component's activity can be coordinated with that of external components
- Constraints: limitations, particularly on the sequencing of triggers
- Nonfunctional Behavior: performance, availability, and so on

Some composites cannot be safely considered as black boxes. These include components whose constituent parts are operated independently or are accessible by means other than the composite's interfaces.

Chapter 8

Naming Standards

Objectives

This chapter provides guidance for an enterprise architect defining the standardized structure of names for web services and other IT elements in the enterprise. It explores the issues and best practices involved in defining and managing enterprise naming standards. The topic is of particular importance because the structuring of the names and the challenges involved in maintaining the consistency in naming WSDL and XML schema namespaces, services, ports, operations, and other artifacts in the web services space have a significant impact on the complexity of managing an SOA environment.

Although the discussion and examples are focused largely on web services (i.e., services defined with a WSDL), the basic naming principles also apply to schemas, JMS destination names, uniform resource identifiers (URIs) and uniform resource locators (URLs). Several of the important names in a WSDL are required to be URIs.

There are many possible approaches to designing names for use in SOA environments. This chapter sets forth one concise set of best-practice concepts for designing names that can be readily tailored to the needs of your enterprise. In explaining the concepts, particular emphasis is placed on explaining the rationale behind the approach so that the refinements that will inevitably be required in practice can be designed with the same principles.

After reading this chapter you should be able to

- Describe the principles guiding name structure design.
- Apply the principles to the ideal design of names for WSDL and schema artifacts.
- Describe the choices available for addressing real-world complications in name structure design.

Using This Chapter

The intent of this chapter is to provide guidance in the formulation of naming standards. It begins with a discussion of the concepts and general principles for structuring names. These principles represent a rationale for structuring names that should, as a rule, always be adhered to.

But principles are not enough: There are circumstances under which the principles alone will not provide a unique solution. As these cases arise in this chapter, guidelines are provided to indicate reasonable ways of addressing the situation and guidance for selecting an appropriate approach.

Next, some complicating realities are discussed. Practical constraints imposed by the implementation technology constrain the structures of names. Organizational issues of various types introduce complications that require guidelines for resolution. The existence of multiple environments (development, test, production) and the need for flexible deployment (for fault tolerance, high availability, site disaster recovery, or simply administrative convenience) add wrinkles of their own. Versioning must also be taken into consideration.

The chapter concludes with some practical guidance for creating SOA naming standards.

Concepts

Abstract Services

Any discussion of service naming standards has to begin by putting a stake in the ground in terms of defining what a service is. Here you run into a difference of abstraction between the working definitions used in

the broader SOA community and those provided specifically by web services (i.e., defined by the WSDL schemas).

Thomas Erl provides the following statement that is generally representative of the broader SOA community perspective: "Each [abstract] service is assigned its own distinct functional context and is comprised of a set of capabilities related to this context. Those capabilities suitable for invocation by external consumer programs are commonly expressed via a published service [interface] contract (much like a traditional API)." [1]

The structure of the concepts in this statement is shown in Figure 8-1. Here the term *Interface Contract* is used to reinforce the fact that the concept being represented is an interface. This also emphasizes that an Abstract Service may have multiple interfaces. This concept structure provides a useful framework for exploring the structure of names.

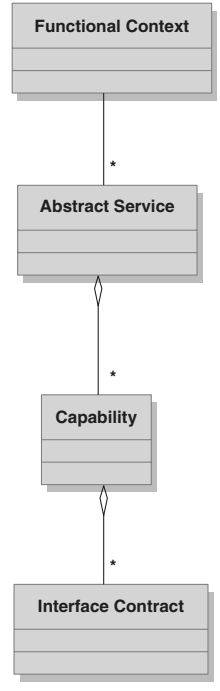


Figure 8-1: *Abstract Service Concepts*

1. Thomas Erl, *SOA: Principles of Service Design*, Upper Saddle River, NJ: Prentice Hall (2008), p. 39.

WSDL Interface Definitions

The Web Services Description Language (WSDL) is designed to define service interfaces. A WSDL file contains two different kinds of definitions: abstract definitions (often referred to as types or meta-data) and concrete definitions (Figure 8-2). The abstract definitions specify the types of portTypes (interfaces), operations, messages, and message parts. The message parts, in turn, reference schema data types (see the sidebar on incorporating schema data types). The concrete specifications define the instances of services, ports (endpoints), and their bindings to protocols. WSDL and schema definitions each occur in a context uniquely identified by their respective namespace URIs.

Two of the names are particularly important: the address of the port (endpoint) and the `soapAction` of the operation binding. Their importance stems from the fact that these are the two primary names used in the communications between the service consumer and provider when SOAP bindings are being used. The address specifies the place to which messages are being sent, and the soapAction is the sole indication of the operation that is being invoked. It is from these two pieces of information that the recipient determines the abstract definitions (meta-data) that characterize the message structure and the operation to be performed.

The WSDL part definitions reference data types from a schema definition. It is a best practice for each message part to have its own dedicated schema type associated with it. This allows each data structure to be specific to the operation it supports and avoids unnecessary updates if these data types are shared. The namespace URI for this schema should be the same as the WSDL namespace URI except for their respective endings (schema or WSDL). The use of different endings is primarily for human readability.

Best Practice: Dedicated Data Types for Message Parts

Use a different dedicated data type for each message part, and define these data types in a schema dedicated to the WSDL. The namespace for the schema and WSDL should be the same except for their respective endings (schema or WSDL).

The dedicated data types for message parts may well contain elements having data types that belong to a common data model. Those

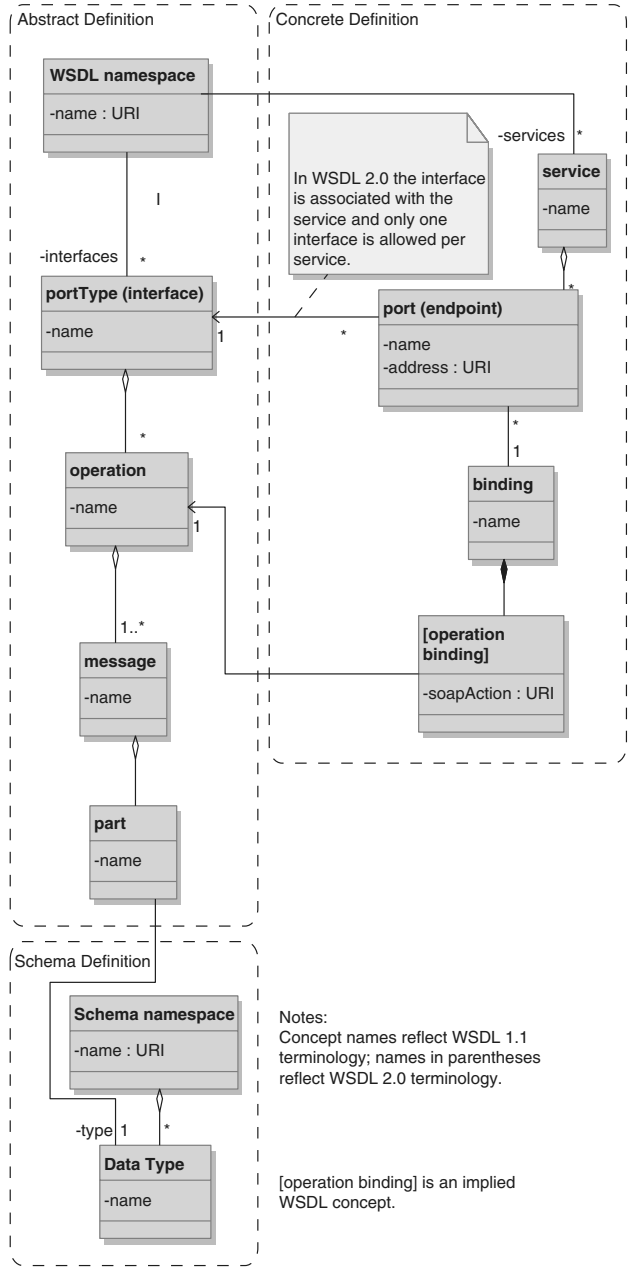


Figure 8-2: *Simplified WSDL Concepts*

data types, which are designed to be shared, should be defined in their own schema, one that has a definition that will be in its own XSD file. The namespace for the common data model XSD should reflect the intended scope of utilization of the contained data types (more on this later).

Best Practice: Incorporate Schema Data Types, Not Elements

Definitions that occur in an XML Schema Definition (XSD) are often incorporated into other schema and WSDL definitions. Both WSDL and XSD standards provide two options for doing this. One is to incorporate a data type, in which case the WSDL or XSD incorporating the type defines a local element of that type. The other is to incorporate an element definition and use it as-is—including its name. The best practice is to incorporate the data type.

The rationale behind this best practice is that the name of an element reflects the role that the element plays in the context in which it is being used. The author of the shared schema has no way of knowing how those definitions are going to be employed and therefore may not be in a position to choose appropriate element names. Furthermore, new usages may require new names.

Consider the concept of an address, a likely candidate for a shared schema definition. If the shared schema defines an Address data type, then it is easy for one consuming data structure to define a homeAddress element and another to define a workAddress element.

This approach is open ended: You do not need to know all of the usages ahead of time to create the correct element names. You can later create other data structures that define a shippingAddress or billingAddress, or any other address role you can imagine. The flexibility occurs because these roles are defined in the new data structures—not the shared schema.

The alternative, creating the elements in the shared schema, not only requires a change to the shared schema each time a new role is added (which requires a new element with that role name), but these shared schema changes impact all of the other consumers of the shared schema. For this reason, the best practice is to incorporate data types, not elements.

Relating Abstract and WSDL-Defined Services

The correspondence between Erl's abstract concepts and the WSDL definitions is shown in Figure 8-3. The functional context corresponds to a functional area that may contain many WSDL-defined service interfaces. The subdivisions of the functional context, the abstract

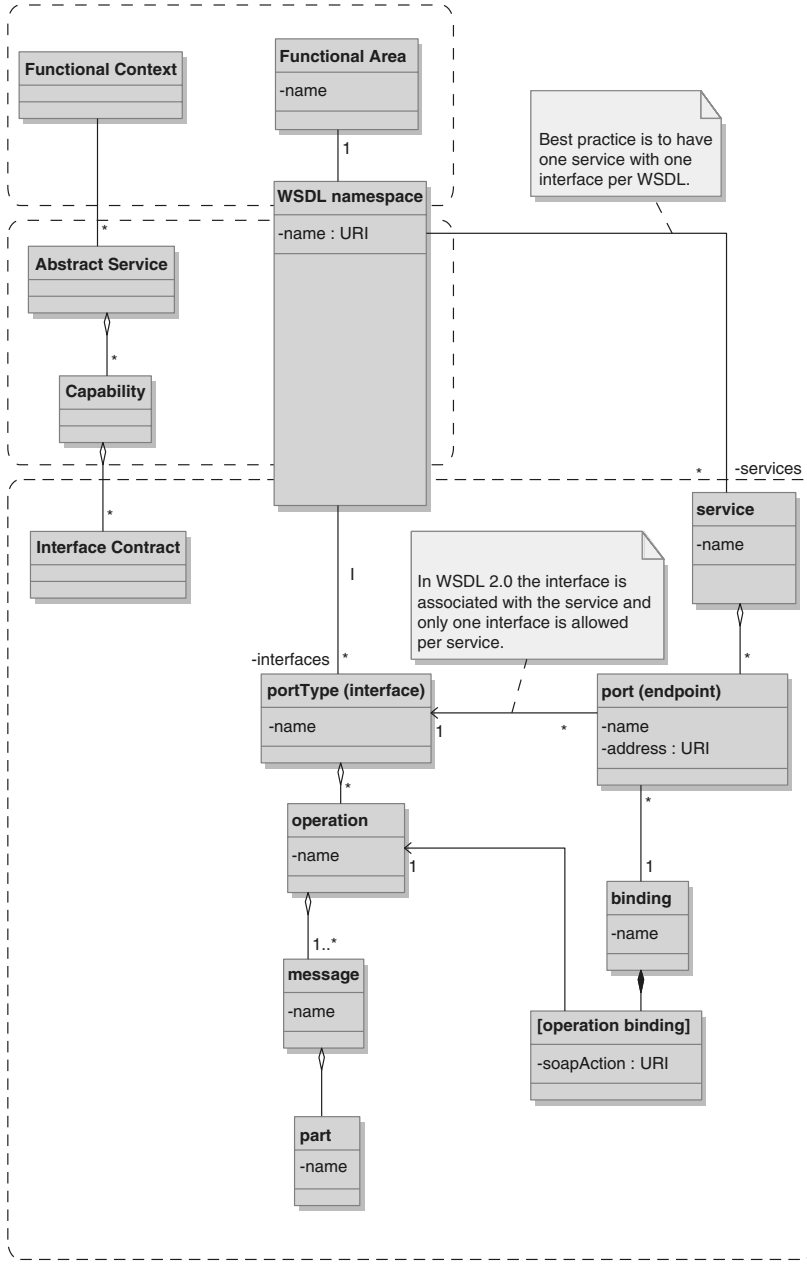


Figure 8-3: *Correspondence between Abstract Services and WSDL Definitions*

service and capability, are largely implicit in the structure of the WSDL namespace (this will be discussed in detail later). The interface contract encompasses the interface definition but, as was discussed in Chapter 6, there is a lot more to the contract than just the interface definition. The interface contract may encompass multiple WSDLs, particularly if the best practice recommendation (Chapter 7) of only having one interface per WSDL is followed. *In the ensuing discussion, unless explicitly stated otherwise, the term* service *is a reference to the abstract service concept, not the WSDL definition.*

Why Are Names Important?

When you use a service, that service and its operations need to be readily identifiable and distinguishable from other services and operations. This is accomplished by giving a unique name to each abstract service and, within the service, to each port type (interface) and operation of that service. Unique names are also required for the messages, data structures, and other artifacts used in the definition of the service interface. When you use JMS destinations (queues and topics), it is also important to distinguish them from other destinations. This gives you the flexibility to move these destinations to other EMS servers.

There are two significant challenges that you will encounter when creating names:

1. Ensuring that each name is reasonably descriptive
2. Ensuring that each name is unique

Naming standards establish how names are structured and organized and how (by whom) uniqueness is guaranteed, and thus determine how both challenges are addressed.

Names Are Difficult to Change

Unfortunately, once established, names tend to become deeply embedded in service providers, service consumers, and the components that mediate interactions between the two. Thus changing established names is expensive—often prohibitively so. You are going to be stuck with the names you choose for a long time, so it is worth an investment of time in considering the standards that govern their structure.

Name Structures Define Search Strategies

In SOA, the structure of a name not only identifies the item being named, but often indicates how to find the item. When people are looking for an artifact, they often begin with only a vague notion of what they are looking for. While indexes and keyword associations can be of use, the structure of the name implicitly defines a search strategy for locating items. Consider, for example, the Nouveau Health Care Payment Manager's Claim Payment Interface. Its WSDL might have the URL

```
http://insurance.nouveau.com/finance/paymentManager/
  claimPayment/wsdl/claimPayment.wsdl
```

This name not only uniquely identifies the WSDL file, it tells us where to find it: Go to the machine designated by `insurance.nouveau.com` (at the default port 80), look in the `finance/paymentManager/claimPayment/wsdl` directory, and obtain the file `ClaimPayment.wsdl`.

Name Structures Define Routing Strategies

Although it is not formally a part of the web services paradigm, ports (endpoints) often make use of names in directing service requests to the actual service provider. The component (and often the machine) that accepts service requests is often different than the component actually servicing those requests. Appropriate naming can aid the receiving component in routing requests to the provider.

For example, the port (endpoint) address (the address to which service requests are directed) is designated by a URI, which is a form of name. Consider the address of the claim payment interface for Nouveau Health Care, given as

```
https://insurance.nouveau.com:443/finance/paymentManager/
  claimPayment
```

Also consider the address of the claim submission interface, given as

```
https://insurance.nouveau.com:443/claims/claimRouter/
  claimSubmission
```

The actual component to which both kinds of requests are directed is designated by the first part of the address URI, namely the domain name and port (not to be confused with the WSDL concept of port):

```
https://insurance.nouveau.com:443
```

This indicates that requests are received on port `443` of the machine designated by `insurance.nouveau.com`. From there, if the requests are to be serviced by another component, they must be routed to the actual service provider. The presence of the URI path structure in the address below the Internet domain name and port number makes it possible to route requests arriving at port `443` based on this path. Alternately, this information can be ignored and all requests can be routed to a common destination that provides support for all web services sharing the domain name and port.

In contrast, both addresses could have been given as

```
https://insurance.nouveau.com:443
```

In this case, since the path is absent, there is no information that can be used to route requests.

Using the structure of the address is, of course, not the only way to route. Other information such as the `soapAction`, the structure of the WSDL namespace URI, and the port/operation naming structure underneath it can also be used for routing. Regardless of which names are being used, the structure of these names and the consistency with which that structure is used can greatly simplify the routing of service requests.

What Needs a Name?

In an SOA environment there are many things that require names. These include

- WSDL-related names:
  - The WSDL itself (the `name` attribute in the top-level `<definitions>` tag).
  - The WSDL filename.
  - The `targetNamespace` defined by the WSDL (also in the top-level `<definitions>` tag). This name is a URI, and is the logical prefix for the name of each entity defined in the WSDL.
  - The entities defined by the WSDL: services, port types (interface), operations, messages, bindings, and ports (endpoints).
  - The `soapAction`.
  - The `schemaLocation` of each imported XSD file.
  - The `address` of each service port (endpoint).

- Schema-related names:
  - The XSD filename (if the schema is not embedded in a WSDL).
  - The `targetNamespace` defined by the schema (either embedded in the WSDL or a stand-alone XSD). This name is a URI and is the logical prefix for the name of each entity defined in the schema.
  - The entities defined by the schema: types, elements, and attributes.
  - The `schemaLocation` of each imported XSD file.
- JMS-related names:
  - Static destination (topic or queue) names
  - EMS server names
- SCA-related names
  - Composite names
  - Component type names
  - Service names

Some of these items are actual artifacts, such as files. Others are simply logical names for definitions (port types, messages, elements, etc.) or groups of definitions (namespace URIs). All of them will have to be dealt with by the producers and consumers of services. These names, and the standards for defining them, are the focus of this chapter.

Structured Name Design Principles

Use a General-to-Specific Structure

Structured names (think `www.nouveau.com`) are trees. The root of the tree represents the entire tree. Each node below represents a subtree rooted at that node. The root of the Internet (the parent of `com`) is not explicitly named, but the next tier down in the Internet naming system (referred to as top-level domains) consists of nodes such as `.com`, `.net`, `.org`, and `.edu`. Within each of those domains there are subdomains whose names are meaningful only in the context of the parent domain. Thus for uniqueness you refer to `nouveau.com` rather than just `nouveau` (which has different meanings in `.com`, `.net`, `.org`, etc.).

Because of the inherent tree structure, it is important that the logic of the structure you define be organized around a true hierarchy. The outline of such a hierarchy for services derives from the description of a service presented in the concepts discussion earlier. From the abstract concept discussion we have

```
<functionalContext><abstractService><abstractInterface>
```

This is a general-to-specific structure. A functional context may contain more than one service, and each service can contain more than one interface. Conversely, services are specific to a particular functional context, and each interface is specific to a particular service.

Ideally, the actual hierarchy is represented by a uniform sequence of fields in a left-to-right, most-general-to-most-specific fashion. This is the pattern you see in the naming of Java classes:

```
com.nouveau.insurance.finance.paymentManager.claimPayment.
  payClaim
```

Here `com.nouveau.insurance.finance` represents the functional context. The abstract service is the `paymentManager`. The abstract interface is represented by `claimPayment.payClaim`, the interface and operation used for paying a claim. Note that there is hierarchical structure both within the functional context and within the interface.

Unfortunately, many names in the SOA world are required to be URIs or URLs. These include namespace names and WSDL/SOAP `address` and `soapAction` fields. The structuring scheme for URIs does not strictly adhere to a uniform principle. Each URI or URL actually contains two name hierarchies, each with different construction rules. Consider the earlier example:

```
http://insurance.nouveau.com/finance/paymentManager/
  claimPayment/wsdl/claimPayment.wsdl
```

There are three parts to this string involving two different name structures:

1. `http://`, the first part, represents a protocol to be used to access the artifact. From a name structure perspective, we can ignore this.
2. `insurance.nouveau.com`, the second part, is an *Internet domain name* that designates a machine on the Internet. In the Internet domain name, hierarchy is read right to left.

3. `/finance/paymentManager/claimPayment/wsdl/claimPayment.wsdl`, the third part, is called the path. It represents a name hierarchy local to the machine designated by the Internet domain name. The path name hierarchy is read left to right.

What makes the use of two different name hierarchies and their differences in right-to-left and left-to-right reading unambiguous is the use of two different field separators. The Internet domain namespace fields are separated by a period (.), while the local namespace fields are separated by a forward slash (/). The occurrence of the first slash to the right of the Internet domain name is the clue that you have switched naming hierarchies.

If you wanted to make this namespace uniform, reading entirely left to right, you would have to switch the order of the Internet namespace elements:

```
com.nouveau.insurance.finance.paymentManager.claimPayment.wsdl.
  claimPayment.wsdl
```

This is, of course, the kind of structure used for naming Java classes.

Best Practice: General-to-Specific Structure

When the structure of names is not already constrained, establish a uniform left-to-right, general-to-specific hierarchical structure for names following the pattern

`<functionalContext><abstractService><abstractInterface>`

When the structure of names is partially constrained (e.g., URLs and URIs), apply this principle to the lower-level structure of the names (i.e., the path in the URL or URI).

Employ Hierarchical Naming Authorities

Names, to be useful, must be unique. Uniqueness requires that some authority keep track of which names have been assigned so that newly issued names can be assured to be different. Unfortunately, having a single authority to keep track of all names is impractical, particularly for names with global scope.

The systems that have evolved (in numerous places) to address this issue involve the use of hierarchical authorities. This strategy involves two elements. The first is a standardized syntactic structure for defining names as sequences of fields. The Internet domain name structure (e.g., `insurance.nouveau.com`) is one example.

The other element is a policy that establishes authorities for maintaining the uniqueness of individual fields at different levels of the hierarchy. For example, in the Internet domain name structure, the authority for the top-level domain names (`.com`, `.net`, `.org`, etc.) is ICANN (the Internet Corporation for Assigned Names and Numbers). For each of the assigned top-level domain names, ICANN also identifies an authority for maintaining the uniqueness of the next-level names. For the generic top-level domains (`.com`, `.net`, `.org`, etc.) ICANN itself is the naming authority. For sponsored top-level domains (`.edu`, `.gov`, `.mil`) this authority has been delegated to other entities—one for each sponsored domain. For example, the `.edu` domain is administered by EDUCAUSE, the `.gov` domain by the General Services Administration of the US Government, and the `.mil` domain by the US Department of Defense Network Information Center.

Each naming authority does two things:

- It directly manages the field level for which it is responsible.
- It establishes the policy for managing the lower-level fields.

It is in this latter point that the hierarchical authority gains its flexibility: A naming authority can delegate the responsibility for managing subordinate namespaces. For our fictional domain, ICANN would not only establish `nouveau.com` as a domain name, it would delegate the authority for managing the lower levels of the hierarchy to Nouveau Health Care Inc. Nouveau Health Care directly manages the next level of names (such as `www.nouveau.com` and `insurance.nouveau.com`) and (if desired) delegates the responsibility of managing the next level of namespace.

This idea can, and should, be extended within the enterprise. Rather than having a centralized authority for managing all names, the central authority establishes a policy for the structure of names, directly manages the top field(s) of this namespace, and delegates the authority for managing the lower-level fields.

Best Practice: Hierarchical Naming Authorities

Do not fully centralize the management of names in the enterprise. Instead, set up a central authority to (a) establish a generic structure for names, (b) assign the values for the top-level branches of the namespace, and (c) designate appropriate authorities to manage the lower-level structure of individual branches.

Base Naming on Stable Concepts

Because of the difficulty in changing both the structure of names and the individual names that have been chosen, it is prudent to base the namespace structure and individual names on concepts that remain stable over time, with the exception of enterprise identifiers.

Domain Concepts

The concepts that are most likely to remain stable over time are those that generically occur in any discussion of the business. In a discussion of the shipping industry, you would tend to use general terms like package, shipment, track, rate, shipper, recipient, and location. In banking, you would use general terms like customer, account, deposit, withdrawal, payment, and transaction.

What you want to avoid are terms that are likely to change over time, particularly those with branded terminology. Thus you would want to use the generic term "claim" instead of "expressClaim" or "account" instead of "premierAccount." In doing so, you hedge your bets against mergers, acquisitions, and changes in marketing.

Business Processes

The same rule applies when naming operations associated with business processes. You want to stick with generic names that will remain stable over time. Thus the operation for tracking a claim is called simply "track," while the marketing-branded process may be called "Nouveau Track." An idealized (and somewhat simplified) operation name for tracking a Nouveau Health Care claim might be something like

```
com.nouveau.insurance.claims.claimTracker.claimTrack.trackClaim
```

Here the `claimTracker` service presents a `claimTrack` interface with a `trackClaim` operation.

The Exception to the Rule: Enterprise Identifiers

Names, in the context of the world-wide web, must be unique. To guarantee the global uniqueness of names issued by your enterprise, you need to qualify the name with something that identifies the enterprise issuing the name. The most common approach is to base this on the Internet domain name that has been assigned to your enterprise.

This, of course, violates the notion of naming being based on stable concepts—your enterprise could change its name at any time. Mergers and acquisitions are constantly changing this landscape. Despite this potential for change, the use of the enterprise name as a name prefix is necessary. In the examples we have been using so far, ideally structured names in Nouveau Health Care would be prefixed by `com.nouveau`. Note that the order of the fields in this idealized name structure is reversed from the Internet domain names.

The use of the name prefix not only guarantees the global uniqueness of names, but also serves as a hedge against mergers and acquisitions. Without introducing the enterprise-specific prefix, the IT consolidation after a merger or acquisition is liable to create name conflicts. It is likely that two health care insurance providers would both have names like `claimProcessing.claimSubmission.submitClaim`. Adding the prefix averts a conflict with these names as used by the different companies.

Best Practice: Base Naming on Stable Concepts

Base the namespace structure and individual names on concepts that remain stable over time, with the exception of enterprise identifiers.

Avoid Acronyms and Abbreviations

It is good practice to make the names in individual fields of the naming structure as readable and obvious as possible. This argues against using acronyms unless they are widely used across an entire industry and are universally understood. Some common functional abbreviations that might be considered acceptable (at least in English) include

- HR—Human Resources
- MKTG—Marketing
- MFG—Manufacturing
- FIN—Finance

Best Practice: Avoid Acronyms

Avoid using acronyms and abbreviations unless they are universally understood across an industry.

Distinguish Types from Instances

It is not unusual in a WSDL or schema to define a type and then use that type to define an element. For example, you might define a data-type to represent an account balance and then create an instance of that type (an element) as a field in an account to show the current balance. Even if the structure of the defining language allows the same name to be used for both the type and the field name, doing so can be very confusing to a human reader.

Consequently it is a good idea to adopt a standard way of distinguishing type names from instance names. Some examples of such conventions include

- Using leading capitals to indicate types and leading lowercase to indicate instances. Thus the type for the account balance would have the name `AccountBalance`, and the instance field in the account (the element name) would have the name `accountBalance`.
- Appending a distinguishing term to the end of the type name. Thus the type for the account balance would have the name `AccountBalanceType`, and the instance field in the account would have the name `accountBalance`.

It is not unusual to combine the two strategies, as was done in the second example. Note that it is likely that you already have similar standards in place for writing code. If so, you should examine those standards to determine whether they are applicable here as well. If those standards are applicable, you should adopt the existing standard rather than inventing a new one—this will avoid confusion when people are developing code that references WSDL and schema definitions.

Best Practice: Distinguish Types from Instances

Adopt a standard way of distinguishing type names from instance names.

Plan for Multi-Word Fields

It is often useful to be able to use more than one word when constructing a name. This can be accommodated by adopting a convention for capitalizing names that ensures that the resulting multi-word names

are readily readable. Two common conventions that satisfy this criterion are

- Non-leading capitals: Each word in a field other than the first begins with a capital letter, such as `ClaimService` (for a type) or `claimService` (for an instance). The leading capital should be determined by whether the field references a type or an instance (see previous section).
- All letters are capitalized, and an underscore (_) or other separator is used between words, for example, `CLAIM_SERVICE`. This convention pretty much requires that an additional term be used to distinguish types from instances (see previous section).

One convention to be avoided is the use of all capitals with no special characters allowed (e.g., no underscores). Such a convention leads to names like `CLAIMSERVICE`, which is not only hard to read but also may lead to ambiguities.

Best Practice: Plan for Multi-Word Fields

Adopt a convention for capitalizing names that ensures that the resulting multi-word names are readily readable.

Use a Distinct WSDL Namespace URI for Each Interface

To avoid naming conflicts among the messages, ports, and operations of different interfaces, each interface should have its own namespace URI. Equally important, using distinct namespace URIs makes it possible to independently version the interfaces. This will facilitate the graceful evolution of interfaces in the environment.

Best Practice: Use a Unique WSDL Namespace URI for Each Interface

Define each interface in a separate WSDL, and use a unique namespace URI for each WSDL.

Incorporate Interface Major Version Numbers

In keeping with the versioning best practices outlined in Chapter 7, wherever the interface name is incorporated into certain naming structures, the interface's `<major>` version number should be appended to the interface name in those structures. This affects the following items:

- WSDL namespace URLs
- Schema namespace URLs when the schema is dedicated to a specific WSDL (see the section, "Schema Types Specific to an Interface and an Operation" later in this chapter)
- WSDL filenames (also include the interface's `<minor>` version number, as per versioning best practices)
- Schema filenames when the schema is dedicated to the specific WSDL (also include the interface's `<minor>` version number in the filename, as per versioning best practices)
- SOAP addresses (endpoints)
- SOAP action names

For simplicity, the version numbers are omitted from the examples in the following sections.

Applying Naming Principles

Idealized Name Structures

Given the structured name design principles laid out above, an idealized form of structure for naming service operations might have the following structure:

```
<functionalContext><abstractService><interfaceName>
  <operationName>[2]
```

2. In a WSDL the scope of an operation name is the portType (WSDL 1.1) or interface (WSDL 2.0).

For the data types involved in defining the service, you might use one or more of the following structures depending upon the intended scope of utilization for the data type:

```
<functionalContext><abstractService><interfaceName>
  <operationName><datatypeName>
<functionalContext><abstractService><interfaceName>
  <datatypeName>
<functionalContext><abstractService><conceptPackage>
  <datatypeName>
<functionalContext><conceptPackage><datatypeName>
```

The `<conceptPackage>` is explained later in the section on schema shared data types. Similar idealized structures would apply for the messages, elements, and other artifacts involved in defining the service.

Such idealized structures are rarely are seen in their entirety as single strings, with the possible exception of fully qualified Java class names. In most SOA applications, the name structure is fragmented in two different ways:

1. The leading part of the complete name structure appears as the namespace of the WSDL or schema, while the remainder of the structure appears as the name of the artifact being defined within the namespace.
2. Within the namespace URI of the WSDL or schema, part of the name appears as an Internet domain name while the rest appears as the path.

The following sections explore the practical use of these idealized name structures and show how they can be used to guide and standardize the definitions of names. These will be illustrated using the Nouveau Health Care example. Each topic area will first present an idealized name structure and then discuss its practical implementation.

Functional Context

A fact of life is that enterprises frequently acquire or merge with other enterprises. To avoid name conflicts in the ensuing IT consolidation, it is good practice to make the first field in the functional context be an enterprise-specific qualifier, giving

```
<enterpriseID><functionalArea>
```

In practice, the `enterpriseID` is almost always defined using an Internet domain name. For example,

```
nouveau.com
```

Most often the enterprise ID occurs in the context of a URL or URI and has the form

```
http://nouveau.com
```

Many businesses have more than one line of business, with each line of business essentially operating as a separate company (particularly from an IT perspective). When this occurs, it is good practice to include the line of business as part of the `<functionalContext>`. This helps avoid name conflicts among similar functional areas (e.g., sales, human resources, finance) in the different lines of business of the same company. The result is

```
<functionalContext> :== <enterpriseID><lineOfBusiness>
  <functionalArea>
```

Consider Nouveau Health Care and the possibility that it might have two very different lines of business. One is an insurance provider, and the other is an online pharmacy. The idealized enterprise identifiers for Nouveau would then be

```
com.nouveau.insurance
com.nouveau.pharmacy
```

In transforming the idealized form into the form needed for a URL or URI, you have two choices, depending upon whether or not you want the line-of-business name to be part of the Internet domain name or the path. If you want it to be part of the Internet domain name, you end up with

```
http://insurance.nouveau.com
http://pharmacy.nouveau.com
```

If you want the line of business to be part of the path, you end up with

```
http://nouveau.com/insurance
http://nouveau.com/pharmacy
```

This, in practice, may not be an arbitrary choice: Making the line of business part of the Internet domain name allows distinct machines to be used as targets for the different lines of business; making the line of business part of the path forces a single machine to be used as the entry

point for both lines of business. There may be organizational and management issues involved. These are discussed later in this chapter in the Complicating Realities section.

To deal with this type of situation, many enterprises employ network appliances that can make seamless conversions between these two formats. Although this adds flexibility, it requires network configuration—yet another administrative task.

Best Practice: Global Uniqueness

Include an enterprise-specific qualifier to the functional context. If the enterprise has independent lines of business, include the line of business in the functional context as well.

A Notational Convention for Internet Domain Names

This question of how much of the idealized name will become part of the Internet domain name occurs so often that we will adopt a convention for indicating the answer: The portion of the idealized structure that will become the Internet domain name will be outlined with a border. Using this convention, the example of the line-of-business name being part of the Internet domain name would be idealized as

```
<enterpriseID><lineOfBusiness><functionalArea>
```

The example of the line-of-business name being part of the path would be idealized as

```
<enterpriseID><lineOfBusiness><functionalArea>
```

WSDL and XSD Namespace URIs

The idealized structure for a WSDL namespace URI has the form

```
<functionalContext><abstractService><abstractInterface>wsdl
  <wsdlName>
```

Expanding the functional context, we have

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <abstractInterface>wsdl<wsdlName>
```

It is common practice to make the actual name structure a URI. For the Payment Manager service's Claim Payment interface WSDL and including the major version number in the name, this gives

```
http://insurance.nouveau.com/finance/paymentManager/
  claimPayment/wsdl/claimPayment1
```

The idealized structure for a schema namespace URI has the form

```
<functionalContext><abstractService><abstractInterface>schema
  <schemaName>
```

Expanding the functional context, we have

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
<abstractInterface>schema<schemaName>
```

It is common practice to make the actual name structure a URI. For the Claim Payment schema associated with the Claim Payment WSDL and including the schema major version number, this gives

```
http://insurance.nouveau.com/finance/paymentManager/
  claimPayment/schema/claimPayment1
```

Best Practice: WSDL and Schema Namespace URIs

Include the full functional context, abstract service name, abstract interface name, and WSDL or schema name in the WSDL and schema namespace URIs. Insert `wsdl` or `schema` prior to the WSDL or schema name to differentiate WSDL and schema namespaces.

WSDL and XSD Filenames

It is a good practice is to use the WSDL or schema namespace structure as the basis for defining the structure of the filename (i.e., the path to the file). The idea is to make the fully qualified filename a URL (or at least a URI). Making it a URL tells you where to locate the file. With this approach, the idealized structure for a filename is

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService
  <abstractInterface>wsdl<filename>
<enterpriseID><lineOfBusiness><functionalArea><abstractService
  <abstractInterface>schema<filename>
```

In the implementation, there are a couple of options depending on how the systems hosting the files are physically organized. One uses a single machine as the access point for all files:

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interface><filename>
```

Preferable is an approach that uses a different machine per line of business:

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interface><filename>
```

This yields the following type of URL:

```
http://insurance.nouveau.com/finance/paymentManager/
claimPayment/wsdl/ClaimPayment.wsdl
```

In some situations, the file will be present in a file system. In such cases, the full structure of the name should be preserved in the folder hierarchy of the file system. For example, you might have

```
file://<rootPath>/com/nouveau/insurance/finance/paymentManager/
  claimPayment/wsdl/claimPayment.wsdl
```

This, however, can lead to deep folder structures in which there is only a single folder in each of the upper-level folders. When converted to Java class structures, it also leads to a Java class for each level. In such cases, the upper part of the structure can be collapsed into a single folder name:

```
file://<rootPath>/com.nouveau.insurance.finance/paymentManager/
  claimPayment/wsdl/claimPayment.wsdl
```

Best Practice: WSDL and Schema Filenames

Include the full functional context, abstract service name, interface name, and `wsdl` or `schema` in the WSDL and schema filenames.

WSDL Names

To ensure the uniqueness of the WSDL name and to make it clear which WSDL it is, it is a good practice to make the WSDL name the same as the fully qualified filename, which should be a URI or URL.

```
http://insurance.nouveau.com/finance/paymentManager/
  claimPayment/wsdl/claimPayment.wsdl
```

Schema Locations

The schema location, by definition, is a URI and is ideally a URL. If the above naming practice for schema filenames is followed, then the fully qualified filename is the schema location.

```
http://insurance.nouveau.com/finance/paymentManager/
  claimPayment/schema/claimPayment.xsd
```

WSDL-Specific Schema Location

Each WSDL requires a schema that defines the types used in its message definitions. The WSDL standard provides two options for supplying the schema: importing a schema file or placing the schema definitions in-line within the WSDL file. The latter approach is preferred. This is because an `import` statement in the WSDL requires retrieving the file, which requires access to that file. In many environments, providing access to these files is impractical. For this reason it is a best practice to place the WSDL schema definitions directly in the WSDL file rather than using an `import` statement.

Best Practice: WSDL-Specific Schema Location

Place WSDL schema definitions in the WSDL file.

WSDL Message Names

When defining WSDL messages, there are two different namespaces involved, one for the message itself and the other for the schema that defines the element type used in the message. While technically the two namespace URIs are allowed to be the same, it creates a very confusing situation when looking at the WSDL. For this reason, it is good practice to include WSDL or schema as the last field in the namespace URIs to keep them distinct, which is the earlier-recommended best practice.

The messages themselves are defined within the WSDL namespace. Typically each message is intended to play a particular role with respect to a specific operation, so it is good practice to include the `<operationName>` as part of the message name. This gives you the following idealized structure for the fully qualified message name:

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName><operationName><messageName>
```

There is a wrinkle in turning this idealized structure. The name given to the message in the WSDL file is defined directly in the context of the WSDL namespace, not under the operation. Thus if two operations have the same message name (such as `requestMessage` or `responseMessage`), there will be a conflict. To avoid this, you simply concatenate the operation name with the message name to give the implementation, for example, `PayClaimRequestMessage`. For the claim payment operation, this gives us the following message definitions in the WSDL.

```
<message name = "PayClaimRequestMessage">
  <part name = "request" type = "ns:PayClaimRequest"/>
</message>
<message name = "PayClaimResponseMessage">
  <part name = "response" type = "ns:PayClaimResponse"/>
</message> <message name="processShipmentRequest">
```

Each message has parts, and each part has a name that is also defined in the WSDL namespace. Since the scope of the part name is local to the message definition, the actual name is not particularly important.

Each part requires a type definition. The type refers to a datatype that is defined in the schema namespace referenced by the WSDL.

Port Type, Service, and Binding Names

An idealized structure for these names has the form

```
<functionalContext><abstractService><interfaceName>
  <portTypeName>
<functionalContext><abstractService><interfaceName>
  <serviceName>
<functionalContext><abstractService><interfaceName>
  <bindingName>
```

Note that, following the best practice recommendations, there is some redundancy here. The best practice is to have a WSDL for each interface and to include the interface name in the WSDL namespace URI. The `portType` is actually the interface, so appending it to the namespace name is redundant. However, since the `portType` is actually defined within this namespace, this is the structure you actually get. A similar situation arises for the service and binding names.

Using the `portType` name as an example and expanding the functional context, you have

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName><portTypeName>
```

In practice, this idealized structure never appears as a single string in the WSDL. Instead, it is divided into two parts. The first part of the structure is represented by the target namespace in the WSDL. By the best practice recommendation, this includes everything up to and including the interface name.

The second part is the `portType` name, which is declared within the scope of the namespace. The names of the `service` and `binding` are similarly declared within the namespace. Here are some example fragments from the `claimPayment.wsdl` file:

```
<definitions
  xmlns:tns=http://insurance.nouveau.com/finance/
    paymentManager/claimPayment/wsdl/claimPayment1
  targetNamespace="http://insurance.nouveau.com/finance/
    paymentManager/claimPayment/wsdl/claimPayment1
  xmlns:ns="http://insurance.nouveau.com/finance/
    paymentManager/claimPayment/schema/claimPayment1">
…
  <portType name="ClaimPayment">
    <operation name="payClaim">
      <input message="tns:PayClaimRequestMessage"
        name="input"/>
      <output message="tns:PayClaimResponseMessage"
        name="output"/>
    </operation>
    …
  </portType>

  <service name="ClaimPaymentService">
    <port name="ClaimPaymentPort"
      binding="tns:ClaimPaymentPortBinding">
      <soap:address location="http://insurance.nouveau.com:5555/
        com.nouveau.insurance.finance.paymentManager.
        claimPayment.endpoint1"/>
    </port>
  </service>
  <binding name="ClaimPaymentPortBinding" type="tns:ClaimPayment">
    <soap:binding style="document" transport="http://
      schemas.xmlsoap.org/soap/http"/>
    <operation name="payClaim">
      <soap:operation style="document" soapAction="/
        com.nouveau.insurance.finance.paymentManager.
        claimPayment1.payClaim"/>
      <input>
        <soap:body use="literal" parts="request"/>
      </input>
        <output>
```

```
        <soap:body use="literal" parts="response"/>
      </output>
    </operation>
  </binding>
</definitions>
```

There is a nuance here worth pointing out: portTypes are not directly associated with services. Instead, a declaration known as a *binding* provides details of the portType's implementation, and then that binding is used in defining a port (an actual interface instance or endpoint) on the service. The port has its own name. For clarity, it is good practice to choose names for ports and portTypes that distinguish between the two.

Operation Names

An idealized structure for operation names has the form

```
<functionalContext><abstractService><interfaceName>
  <operationName>
```

Expanding the functional context, you have

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName><operationName>
```

In practice, this idealized structure never appears as a single string in the WSDL. Instead, it is divided into two parts. The first part of the structure is represented by the target namespace in the WSDL. By the best practice recommendation, this includes everything up to and including the interface name. The second part is the `operation` name, which is declared within the scope of the portType (interface).

SOAP Address Location

The SOAP address location is a URI that indicates the connection point (physical destination) to which operation requests are directed. Depending upon the policy you choose for separating the traffic directed to different services, you should use one of the following idealized structures for this URI:

```
<enterpriseID><lineOfBusiness><functionalArea>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName>
```

The choice between these is not arbitrary. If the first form is used, all requests for a given functional area will be sent to the same location.

The second form offers at least the possibility that requests for different services may be directed to different components, and the third can distinguish based on the interface.

This difference may have significant performance implications for the subsequent implementation, particularly if one interface provides real-time operations involving small data structures and quick response while another provides batch operations involving huge data structures and asynchronous responses. Performance considerations drive you toward separating this traffic, but separation requires sufficient information in the location.

Another consideration is that, for many implementation technologies, the use of a detailed path allows the convenient routing of requests for different services and interfaces.

WSDL 2.0 allows multiple endpoints for an interface, giving yet another possibility:

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName><endpointName>
```

It is generally a good idea to include too much rather than too little information in the location. It is relatively easy to ignore the lower-level details, but you cannot synthesize information that is not present.

For JMS bindings, the idealized structure translates in a very straightforward way into JMS destination names:

```
enterpriseID.lineOfBusiness.functionalArea
enterpriseID.lineOfBusiness.functionalArea.serviceName
enterpriseID.lineOfBusiness.functionalArea.serviceName.
  interfaceName
enterpriseID.lineOfBusiness.functionalArea.serviceName.
  interfaceName.endpointName[3]
```

With HTTP bindings a further implementation consideration, relevant to locations, is the choice of a socket number. The structure of a URL is determined by the transport that has been selected. For http (and https) transports, the syntax is

```
http://<hostIdentifier>:<socketNumber>/<path>
```

This raises the question as to which parts of the idealized namespace should map to the `<hostIdentifier>` and which parts should map

3. A fully qualified destination name provides maximum flexibility in assigning destinations to JMS servers.

to the <path>. Answering this question requires the recognition that the combination <hostIdentifier>:<portNumber> denotes a physical destination, while the <path> is used logically at that destination to further distinguish between requests. There are architectural trade-offs involved in this decision, with considerations that go beyond the scope of this book (e.g., how many sockets should there be versus what load can each socket reasonably handle).

For the purposes of the discussion here, consider the socketNumber to be part of the Internet domain name. Assuming you want to include the structural detail down to the interface level, this gives you the following possibilities for the idealized structure of the location URL:

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName>
```

The first indicates that a single socket will handle all of the service requests for the entire enterprise. This requires centralized management of the port and a common technology touch point for all services. Generally, the technology employed here uses the <path> to redirect different requests to different sockets. The second results in a single socket for each line of business, which again may employ technology to redirect requests to different sockets. The third and fourth choices generally reflect the actual structure of the implementations to which requests of the first or second type are redirected. If you have multiple endpoints per interface, you will need to append an <endpoint> field to each of these possibilities.

Best Practice: Location Names

Include the full functional context, abstract service, and interface in the location name.

`soapAction` Names

The `soapAction` name is nearly identical to the fully qualified operation name as described earlier, with the major version number appended to the interface name. An idealized structure for `soapAction` names has the form

```
<functionalContext><abstractService><interfaceName+major>
  <operationName>
```

Expanding the functional context, you have:

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName+major><operationName>
```

This approach provides the maximum flexibility in defining endpoints. Using this approach, all requests for all operations could be sent to a single endpoint (location) without ambiguity: The `soapAction` uniquely identifies the required operation.

Best Practice: SOAP Action Names

The SOAP action name should be the fully qualified operation name with the major version number appended to the interface name.

Schema Types Specific to an Interface and an Operation

As mentioned in the previous section, schema types are often created that are dedicated to a single operation. The ideal structure for an operation-specific message type name would be

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName><operationName><typeName>
```

This leads to idealized names like

```
com.nouveau.insurance.finance.paymentManager.claimPayment.
  payClaim.Request
com.nouveau.insurance.finance.paymentManager.claimPayment.
  payClaim.Response
```

In reducing this idealized structure to an implementation you encounter a limitation of the schema definition language: It does not support hierarchical names within the namespace. Specifically, the `Request` and `Response` cannot be scoped within the `payClaim` operation

name—they have to be declared directly within the namespace. Thus if other operations have `Request` and `Response` data types (as they likely would), then you'll have a name conflict. The solution to this problem is to concatenate the operation name and the ideal message name, giving type names like `PayClaimRequest` and `PayClaimResponse`.

These definitions would occur (following the earlier recommended best practice) within the schema namespace:

```
http://insurace.nouveau.com/finance/paymentManager/
  claimPaymentInterface/schema/claimPaymentInterface1
```

Schema Shared Data Types (Common Data Model Types)

Even though the types that represent entire messages are often specialized for the operations they support, the subordinate data types that they reference many times can be shared between messages. If these shared data types are specific to the interface, then they can remain in the interface's namespace. But if they are of more general intent, they belong in namespaces of their own.

You might, for example, want to define the standard representation for an address as shown in Figure 8-4. You might want to standardize the use of this data type across all of Nouveau Health Care. To do so, you use the namespace in which the type is defined to indicate the intended scope of utilization.

Types like Address Type often have other closely-related types, such as the ISO Country Code. To keep related concepts grouped together yet separated from other concepts, it is a good practice to define a namespace for the concept and its related elements, which shall be termed a

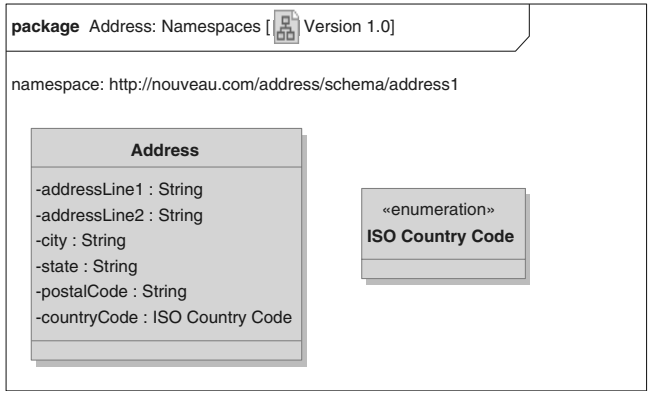


Figure 8-4: *Address Type*

concept package. In this example, the concept package is named `Address` and, in keeping with the versioning best practices, has the version major number appended.

The portion of the namespace that precedes the package name is determined by the intended scope of utilization. This gives the following possibilities for the fully qualified type name:

```
<enterpriseID><conceptPackage>schema<schemaName>
<enterpriseID><lineOfBusiness><conceptPackage>
  schema<schemaName>
<enterpriseID><lineOfBusiness><functionalArea><conceptPackage>
  schema<schemaName>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <conceptPackage>schema<schemaName>
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <abstractInterfaceName><conceptPackage>schema<schemaName>
```

Schema names should be versioned in the same manner as interfaces, with `<major>` and `<minor>` version numbers. Wherever the `<schemaName>` name appears in a name structure, its major version should be appended. This includes the namespace URI for the schema and the XSD filename. Note that the XSD filename also includes the minor version number.

Complicating Realities

Technology Constraints

Reality often constrains the ideal approach. This is particularly true with names. Ideally, names have no restrictions with respect to either the number of fields or the length of any individual field. Unfortunately, this does not hold true in practice. The various technologies being employed have both theoretical restrictions and practical limitations.

Internet domain names limit the number of fields in a name to 127 and allow each field to contain up to 63 octets (bytes). The whole domain name (including "." separators) is limited to 253 octets. In practice, some domain registries may have shorter limits.

The JMS standard places no limitations on names, but vendor implementations often do. For example, Enterprise Messages Service destinations can have up to 64 fields. Individual fields cannot exceed 127 characters. Destination names are limited to a total length of 249 characters.

Whatever naming standards are established, they must obviously take into consideration the constraints of the chosen supporting technologies.

There is a practical limitation to consider as well. By default, every byte (octet) of every name must be transmitted with every message. Thus it is a good practice to avoid excessive length in names, while at the same time preserving the readability of the name.

Naming Authorities

Every position in a naming hierarchy requires an authority for its administration. As discussed earlier, each naming authority (a) directly manages the field level for which it is responsible, and (b) establishes the policy for managing the lower-level fields.

The ability to delegate the management of the lower-level structures is part of the power of hierarchical name structures. At the enterprise level, the authority must

- Assign names to represent each of the lines of business.
- Identify who in each line of business will manage the lower-level structures below the line-of-business field.
- Assign names to represent each enterprise-level service.
- Identify who will manage the lower-level structure for each enterprise service.
- Assign names to represent each enterprise-level concept package
- Identify who will manage the lower-level structure for each enterprise concept package.

Within each line of business, the responsibilities are similar: assigning names for line-of-business services, functional areas, and concept packages, and identifying who will manage the lower-level structures for each.

Complex Organizational Structures

Functional Organizations

If a line-of-business organization is functionally complete (i.e., horizontally integrated), then all of the services and concepts required to operate the line of business are part of that organization. The naming structure we have been discussing reflects the line-of-business's singu-

lar line of authority over all the services and concepts relevant to the organization.

Many organizations, however, are structured functionally rather than by line of business. An organization might have functional groups for marketing, sales, logistics, finance, engineering, manufacturing, and so forth. If such an organization provides capabilities uniformly across multiple lines of business, the top-level structure may be more appropriately based on function rather than line of business:

```
<enterpriseID><functionalArea>
```

Mixed Functional and Line-of-Business Organizations

Some organizations combine these two approaches. A line-of-business organization may well have a functional substructure under each line of business. In such cases, the structure of the functional context must be expanded. This gives a functional context of

```
<enterpriseID><lineOfBusiness><functionalArea>
```

Less frequently it may be appropriate to reverse the hierarchy:

```
<enterpriseID><functionalArea><lineOfBusiness>
```

The challenge here is that there are, in reality, two hierarchies: the functional hierarchy and the line-of-business hierarchy. Yet the representational technologies (WSDL and schema) only allow for one hierarchy, so the two must be combined into a single functional context. This forces one to be somewhat arbitrarily chosen to dominate the other.

Regardless of how the hierarchies are combined, some caution is in order: Enterprises tend to reorganize. Since you are going to be living with the namespace structure even after the reorganization, it is important to choose a structure and names for both functions and lines of business that will remain stable over time. Bear in mind that a single organization may actually serve more than one functional purpose (e.g., sales and marketing could be in one parent organization) or serve more than one line-of-business purpose (e.g., a division that handles multiple lines of business). In such cases, each individual purpose should have a distinct name in the namespace. This makes the namespace structure relatively stable with respect to reorganization.

Geographic Distribution

Another challenge you are liable to encounter is geographic distribution. This is particularly true for multinational enterprises, where the

operations in different countries or regions tend to be conducted by legally distinct entities. This adds yet a third hierarchy to the ways that the enterprise can be viewed (Figure 8-5).

The presence of yet a third hierarchy further complicates the functional context. One possible structure that could emerge is

```
<enterpriseID><geographicRegion><lineOfBusiness><functionalArea>
```

This is but one of six possible combinations, and that does not even count the possibilities of leaving one or more of these hierarchies out of the structure entirely. Altogether, there are 15 possibilities. So how do you select the one for your enterprise?

There are two factors that should drive your thinking. The first one focuses on organizational realities. In this you need to consider the following:

- What does the current organizational structure look like (i.e., what is the actual organizational hierarchy today)?
- What are the realistic prospects for cooperation between organizations?
- Is there a place in the parent organization for a working group to manage namespaces that cross organizational boundaries?
- Is there sufficient authority for such a working group to effectively manage such a namespace (i.e., will the other organizations listen)?

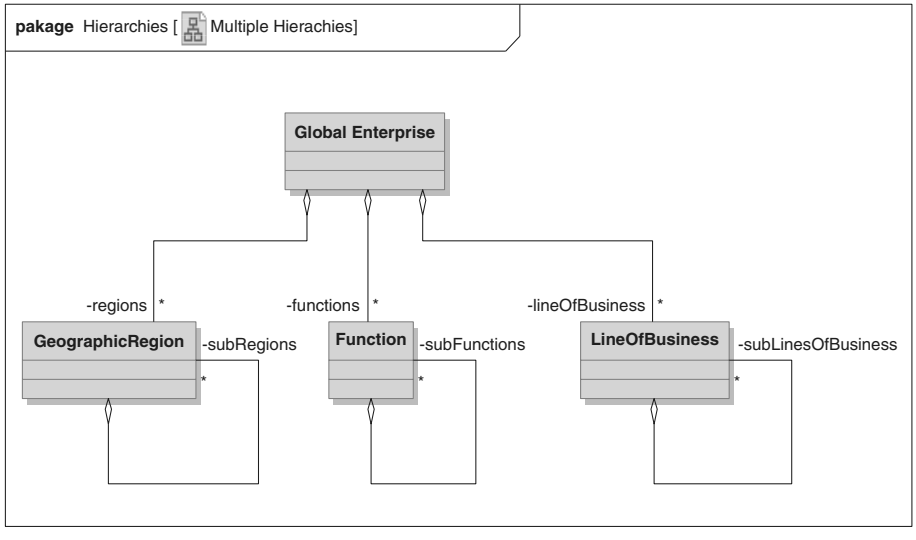


Figure 8-5: *Multiple Hierarchies in the Enterprise*

If the prospects look dim for cooperation between organizational units, then you have little choice other than to adopt a namespace structure that treats the organizations as being independent (see naming authorities earlier).

The other factor to consider is the intended future direction for the enterprise in terms of sharing data, resources, services, and business processes across the organization. If there is an effort underway to increase sharing (which presupposes that there is a reasonable prospect for cooperation between organizations), then the hierarchy you choose should be one that makes the most sense with respect to the chosen direction.

Environments: Values for Address Location Variables

Each service will, in its lifetime, exist in a number of environments, ranging from development through several test environments and, finally, one or more production environments. Thus it becomes necessary to distinguish among the different instances of the service when accessing the service.

The logical place to make this distinction would be in the address location in the WSDL. Unfortunately, the structure of the WSDL does not make provisions for designating different addresses for different environments. Even worse, changing the WSDL to indicate the different environment requires changes to both the consumer and the provider. From a change management and versioning perspective, since the WSDL is the service interface definition, edits to the WSDL could potentially change anything. Therefore, editing the WSDL invalidates whatever testing has been performed and thus defeats the purpose of the WSDL as a specification.

To work around this limitation, most service consumer and service provider implementation technologies allow the address (endpoint) to be provided by a variable whose value is set at deployment time. With this approach, environments must be distinguished within the values provided for the address. These addresses (the provided values) need to be distinct from one another while remaining descriptive of their purpose so that they can be accurately and appropriately set at deployment time.

Referring back to the earlier discussion of addresses, a portion of the idealized address structure maps to the `hostIdentifier`. This is the level at which development, test, and production environments should be distinguished from one another. Using the scheme described

earlier, you have the following possibilities (the portions in the box correspond to the host identifier):

```
<enterpriseID><environment><lineOfBusiness><functionalArea>
  <abstractService><interface>
<enterpriseID><lineOfBusiness><environment><functionalArea>
  <abstractService><interface>
<enterpriseID><lineOfBusiness><abstractService><environment>
  <functionalArea><interface>
<enterpriseID><lineOfBusiness><abstractService><functionalArea>
  <interface><environment>
<enterpriseID><lineOfBusiness><abstractService><functionalArea>
  <interface><environment>
```

For HTTP bindings, manifestation of the `<environment>` can take one of two forms: It can be the `hostIdentifier` itself or the socket on the host. *It is generally not a good practice to use the same* `hostIdentifier` *and socket for multiple environments. It is generally not a good practice to share a* `hostIdentifier` *between a production environment and any other environment.*

For JMS bindings, the manifestation of the `<environment>` can also take one of two forms: It can be the `hostIdentifier` and socket for the JMS server itself or it can be included directly in the queue name. *It is generally not a good practice to share a JMS server between a production environment and any other environment.*

Deployment Flexibility for HA and DR

An address (at least in the http[s] type of addressing) identifies a specific machine to which requests are to be sent. Should this machine move (for fault tolerance, site disaster recovery, or simply administrative convenience), all the interfaces accessed through that machine would become unavailable. One way around this is to use virtual IP addresses or hostnames, allowing the networking infrastructure to reroute requests to another machine. Another approach is to make the address actually an http query with a response that is the real address. Amazon e-commerce web services, for example, use this approach:

```
<soap:address location="https://ecs.amazonaws.com/onca/
  soap?Service=AWSECommerceService"/>
```

Abstracting the logical structure here, the `<hostIdentifier>/<path>` part of the location actually identifies the server to which the query is being submitted, while the value of the `Service` parameter indicates

the desired service. This approach facilitates the flexible rehosting of the actual service providers over time.

For greatest flexibility, it is recommended that the full path name of the interface be used as the argument for this type of query. Thus if one query service is being used to support the entire enterprise, the value for the query would have the structure

```
<lineOfBusiness><abstractService><interfaceName>
```

If the query service supports just a line of business, then the query value would be

```
<abstractService><interfaceName>
```

It is not good practice to use the same query service for different environments.

SOAP over JMS utilizes JNDI lookups in a similar manner. The same considerations apply.

Developing Your Standard

To begin with, you need to identify the organization that will have overall responsibility for the naming standards in your enterprise. If you are in the early stages of adopting SOA, you may not be in a position to mandate that a particular naming structure be followed. Nevertheless, there is no reason that you cannot adopt a structure that can be appropriately generalized to meet the needs of the larger enterprise as outlined in this chapter.

The enterprise-level authority has several responsibilities. One is to define an overall strategy for

- WSDL and schema namespace URIs, including versioning
- Location names, including:
  - Versioning
  - Directing requests to the appropriate environment
  - Using indirection (http query or JNDI lookup) for addresses

Another responsibility is to identify which organizations will be responsible for managing the lower levels of the naming structure. If the enterprise is large, this will likely mean identifying an organization in each line of business that is responsible for names used in that line of business. Each of those organizations, in turn, will have to determine

how much of the naming structure it will directly manage and how much management responsibility it will delegate to other organizations.

Summary

In the complex world of IT, how things are named has a significant influence on the usability of components when building solutions. Clear, descriptive names make it possible for you to identify things without having to look them up. The structure of the name also helps to avoid ambiguity and name conflicts.

There are a number of general principles that should guide the creation of names. Names should have a hierarchical structure. That hierarchical structure should follow a general-to-specific organization. The names chosen should remain stable over time. With the exception of enterprise identifiers, the names used to identify organizations and systems should be avoided and generic names used instead. The use of acronyms should be avoided unless they are universally understood. Type and instance names should be clearly distinguishable. Conventions should be adopted to ensure that multi-word fields are easily readable. For ease in managing versions, each interface should have its own WSDL with its own namespace.

A good idealized name structure has the form

```
<functionalContext><abstractService><abstractInterface>
```

The functional context commonly expands as follows, with the presence of the `<enterpriseID>` avoiding naming conflicts in the event of mergers and acquisitions:

```
<functionalContext> :== <enterpriseID><lineOfBusiness>
  <functionalArea>
```

The `<abstractService>` may encompass multiple interfaces, each with its own WSDL. For service operations, the `<abstractInterface>` commonly expands to

```
<abstractInterface> :== <interfaceName><operationName>
```

Ideally, WSDL namespaces, WSDL filenames, and SOAP addresses (endpoints) should have the idealized form

```
<enterpriseID><lineOfBusiness><functionalArea><abstractService>
  <interfaceName>
```

SOAP action names should have this form with the operation name appended at the end. Schema namespaces and filenames should use the portion of this structure that describes the intended scope of utilization of the schema.

Technology constraints on the length of individual fields and the overall length of identifiers must be taken into consideration when defining names. The enterprise should establish a policy defining the hierarchical structure of names to be used and identifying the organization responsible for establishing the values of the top-level fields and the organizations responsible for ensuring the uniqueness of subordinate field values.

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