BEA WebLogic
Server™

**Developing Security
Providers for WebLogic
Server**

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Developing Security Providers for WebLogic Server

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About This Document

This document provides security vendors and application developers with the information needed to develop new security providers for use with the BEA WebLogic Server™.

The document is organized as follows:

- Chapter 1, "Introduction to Developing Security Providers for WebLogic Server," which prepares you to learn more about developing security providers for use with WebLogic Server. It specifies the audience and prerequisites for this guide, and provides an overview of the development process.

- Chapter 2, "Design Considerations," which explains the general architecture of a security provider and provides background information you should understand about implementing SSPIs and generating MBean types. This section also includes information about using optional management utilities and discusses how security providers interact with WebLogic resources. Lastly, this section suggests ways in which your custom security providers might work with databases that contain information security providers require.

- Chapter 3, "Authentication Providers," which explains the authentication process (for simple logins) and provides instructions about how to implement each type of security service provider interface (SSPI) associated with custom Authentication providers. This topic also includes a discussion about JAAS LoginModules.

- Chapter 4, "Identity Assertion Providers," which explains the authentication process (for perimeter authentication using tokens) and provides instructions about how to implement each type of security service provider interface (SSPI) associated with custom Identity Assertion providers.

- Chapter 5, "Principal Validation Providers," which explains how Principal Validation providers assist Authentication providers by signing and verifying the

authenticity of principals stored in a subject, and provides instructions about how to develop custom Principal Validation providers.

- Chapter 6, "Authorization Providers," which explains the authorization process and provides instructions about how to implement each type of security service provider interface (SSPI) associated with custom Authorization providers.

- Chapter 7, "Adjudication Providers," which explains the adjudication process and provides instructions about how to implement each type of security service provider interface (SSPI) associated with custom Adjudication providers.

- Chapter 8, "Role Mapping Providers," which explains the role mapping process and provides instructions about how to implement each type of security service provider interface (SSPI) associated with custom Role Mapping providers.

- Chapter 9, "Auditing Providers," which explains the auditing process and provides instructions about how to implement each type of security service provider interface (SSPI) associated with custom Auditing providers. This topic also includes information about how to audit from other types of security providers.

- Chapter 10, "Credential Mapping Providers," which explains the credential mapping process and provides instructions about how to implement each type of security service provider interface (SSPI) associated with custom Credential Mapping providers.

- Chapter 11, "Auditing Events From Custom Security Providers," which explains how to add auditing capabilities to the custom security providers you develop.

- Chapter 12, "Writing Console Extensions for Custom Security Providers," which provide information about writing console extensions specifically for use with custom security providers.

- Appendix A, "MBean Definition File (MDF) Element Syntax," which describes all the elements and attributes that are available for use in a valid MDF. An MDF is an XML file used to generate the MBean types, which enable the management of your custom security providers.

Audience for This Guide

Developing Security Providers for WebLogic Server is written for independent software vendors (ISVs) who want to write their own security providers for use with WebLogic Server. It is assumed that most ISVs reading this documentation are sophisticated application developers who have a solid understanding of security concepts, and that no basic security concepts require explanation. It is also assumed that security vendors and application developers are familiar with BEA WebLogic Server and with Java (including Java Management eXtensions (JMX)).

Prerequisites for This Guide

Prior to reading this guide, you should review the following sections in the *Introduction to WebLogic Security*:

- "Security Providers"

- "WebLogic Security Framework"

Additionally, WebLogic Server security includes many unique terms and concepts that you need to understand. These terms and concepts—which you will encounter throughout the WebLogic Server security documentation—are defined in the "Terminology" and the "Security Fundamentals" sections of *Introduction to WebLogic Security*, respectively.

e-docs Web Site

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How to Print the Document

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A PDF version of this document is available on the WebLogic Server documentation Home page on the e-docs Web site (and also on the documentation CD). You can open the PDF in Adobe Acrobat Reader and print the entire document (or a portion of it) in book format. To access the PDFs, open the WebLogic Server documentation Home page, click Download Documentation, and select the document you want to print.

Adobe Acrobat Reader is available at no charge from the Adobe Web site at http://www.adobe.com.

Related Information

The BEA corporate Web site provides all documentation for WebLogic Server. Other WebLogic Server documents that may be of interest to security vendors and application developers working with security providers are:

- *Introduction to WebLogic Security*

- *Managing WebLogic Security*

- *Programming WebLogic Security*

- *Securing WebLogic Resources*

- *Locking Down a Production Environment*

- *Upgrading Security in WebLogic Server Version 6.x to Version 7.0*

Additional resources include:

- *The Security FAQ*

- *JavaDocs for WebLogic Classes*

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When contacting Customer Support, be prepared to provide the following information:

- Your name, e-mail address, phone number, and fax number

- Your company name and company address

- Your machine type and authorization codes

- The name and version of the product you are using

- A description of the problem and the content of pertinent error messages

Documentation Conventions

The following documentation conventions are used throughout this document.

Convention	Usage
Ctrl+Tab	Keys you press simultaneously.
italics	Emphasis and book titles.

Convention	Usage

`monospace text`	Code samples, commands and their options, Java classes, data types, directories, and file names and their extensions. Monospace text also indicates text that the user is told to enter from the keyboard. *Examples*:
	 `import java.util.Enumeration;`
	 `chmod u+w *`
	 `config/examples/applications`
	 `.java`
	 `config.xml`
	 `float`

`monospace italic text`	Placeholders. *Example*: `String CustomerName;`

`UPPERCASE MONOSPACE TEXT`	Device names, environment variables, and logical operators. *Example*s:
	 `LPT1`
	 `BEA_HOME`
	 `OR`

`{ }`	A set of choices in a syntax line.

`[ ]`	Optional items in a syntax line. *Example*:
	 `java utils.MulticastTest -n name -a address`
	 `     [-p portnumber] [-t timeout] [-s send]`

`|`	Separates mutually exclusive choices in a syntax line. *Example*:
	 `java weblogic.deploy [list|deploy|undeploy|update]`
	 `     password {application} {source}`

`...`	Indicates one of the following in a command line: ■ An argument can be repeated several times in the command line. ■ The statement omits additional optional arguments. ■ You can enter additional parameters, values, or other information

Convention	Usage
. . .	Indicates the omission of items from a code example or from a syntax line.

Developing Security Providers for WebLogic Server

1 Introduction to Developing Security Providers for WebLogic Server

The following sections prepare you to learn more about developing security providers:

- "Audience for This Guide" on page 1-1

- "Prerequisites for This Guide" on page 1-2

- "Overview of the Development Process" on page 1-2

Audience for This Guide

Developing Security Providers for WebLogic Server is designed for independent software vendors (ISVs) who want to write their own security providers for use with WebLogic Server. It is assumed that most ISVs reading this documentation are sophisticated application developers who have a solid understanding of security concepts, and that no basic security concepts require explanation. It is also assumed that security vendors and application developers are familiar with BEA WebLogic Server and with Java (including Java Management eXtensions (JMX)).

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■ "WebLogic Security Framework"

Additionally, WebLogic Server security includes many unique terms and concepts that you need to understand. These terms and concepts—which you will encounter throughout the WebLogic Server security documentation—are defined in the "Terminology" and the "Security Fundamentals" sections of *Introduction to WebLogic Security*, respectively.

Overview of the Development Process

This section is a high-level overview of the process for developing new security providers, so you know what to expect. Details for each step are discussed later in this guide.

The main steps for developing a custom security provider are:

■ "Designing the Custom Security Provider" on page 1-3

■ "Creating Runtime Classes for the Custom Security Provider by Implementing SSPIs" on page 1-4

■ "Generating an MBean Type to Configure and Manage the Custom Security Provider" on page 1-4

■ "Writing Console Extensions" on page 1-5

■ "Configuring the Custom Security Provider" on page 1-7

■ "Providing Management Mechanisms for Security Policies, Security Roles, and Credential Maps" on page 1-8

Designing the Custom Security Provider

The design process includes the following steps:

1. Review the descriptions of the WebLogic security providers to determine whether you need to create a custom security provider.

   Descriptions of the WebLogic security providers are available under "The WebLogic Security Providers" in *Introduction to WebLogic Security* and in later sections of this guide under the "Do You Need to Create a Custom *<Provider_Type>* Provider?" headings. *<Provider_Type>* can be Authentication, Identity Assertion, Principal Validation, Authorization, Adjudication, Role Mapping, Auditing, or Credential Mapping.

2. Determine which type of custom security provider you want to create.

   The type may be Authentication, Identity Assertion, Principal Validation, Authorization, Adjudication, Role Mapping, Auditing, or Credential Mapping, as described in "Types of Security Providers" in *Introduction to WebLogic Security.* Your custom security provider can augment or replace the WebLogic security providers that are already supplied with WebLogic Server.

3. Identify which security service provider interfaces (SSPIs) you must implement to create the runtime classes for your custom security provider, based on the type of security provider you want to create.

   The SSPIs for the different security provider types are described in "Security Services Provider Interfaces (SSPIs)" on page 2-3 and summarized in "SSPI Quick Reference" on page 2-10.

4. Decide whether you will implement the SSPIs in one or two runtime classes.

   These options are discussed in "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes" on page 2-7.

5. Identify which required SSPI MBeans you must extend to generate an MBean type through which your custom security provider can be managed. If you want to provide additional management functionality for your custom security provider (such as handling of users, groups, security roles, and security policies), you also need to identify which optional SSPI MBeans to implement.

   The SSPI MBeans are described in "Security Service Provider Interface (SSPI) MBeans" on page 2-11 and summarized in "SSPI MBean Quick Reference" on page 2-19.

6. Determine how you will initialize the database that your custom security provider requires. You can have your custom security provider create a simple database, or configure your custom security provider to use an existing, fully-populated database.

   These two database initialization options are explained in "Initializing the Security Provider Database" on page 2-35.

7. Identify any database "seeding" that your custom security provider will need to do as part of its interaction with security policies on WebLogic resources. This seeding may involve creating default groups, security roles, or security policies.

   For more information, see "Security Providers and WebLogic Resources" on page 2-23.

Creating Runtime Classes for the Custom Security Provider by Implementing SSPIs

In one or two runtime classes, implement the SSPIs you have identified by providing implementations for each of their methods. The methods should contain the specific algorithms for the security services offered by the custom security provider. The content of these methods describe how the service should behave.

Procedures for this task are dependent on the type of security provider you want to create, and are provided under the "Create Runtime Classes Using the Appropriate SSPIs" heading in the sections that discuss each security provider in detail.

Generating an MBean Type to Configure and Manage the Custom Security Provider

Generating an MBean type includes the following steps:

1. Create an MBean Definition File (MDF) for the custom security provider that extends the required SSPI MBean, implements any optional SSPI MBeans, and adds any custom attributes and operations that will be required to configure and manage the custom security provider.

Information about MDFs is available in "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12, and procedures for this task are provided under the "Create an MBean Definition File (MDF)" heading in the sections that discuss each security provider in detail.

2. Run the MDF through the WebLogic MBeanMaker to generate intermediate files (including the MBean interface, MBean implementation, and MBean information files) for the custom security provider's MBean type.

   Information about the WebLogic MBeanMaker and how it uses the MDF to generate Java files is provided in "Understand What the WebLogic MBeanMaker Provides" on page 2-17, and procedures for this task are provided under the "Use the WebLogic MBeanMaker to Generate the MBean Type" heading in the sections that discuss each security provider in detail.

3. Edit the MBean implementation file to supply content for any methods inherited from implementing optional SSPI MBeans, as well as content for the method stubs generated as a result of custom attributes and operations added to the MDF.

4. Run the modified intermediate files (for the MBean type) and the runtime classes for your custom security provider through the WebLogic MBeanMaker to generate a JAR file, called an MBean JAR File (MJF).

   Procedures for this task are provided under the "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" heading in the sections that discuss each security provider in detail.

5. Install the MBean JAR File (MJF) into the WebLogic Server environment.

   Procedures for this task are provided under the "Install the MBean Type into the WebLogic Server Environment" heading in the sections that discuss each security provider in detail.

Writing Console Extensions

Console extensions allow you to add JavaServer Pages (JSPs) to the WebLogic Server Administration Console to support additional management and configuration of custom security providers. Console extensions allow you to include Administration Console support where that support does not yet exist, as well as to customize administrative interactions as you see fit.

To get complete configuration and management support through the WebLogic Server Administration Console for a custom security provider, you need to write a console extension when:

- You decide not to implement an optional SSPI MBean when you generate an MBean type for your custom security provider, but still want to configure and manage your custom security provider via the Administration Console. (That is, you do not want to use the WebLogic Server Command-Line Interface instead.)

  Generating an MBean type (as described in "Generating an MBean Type to Configure and Manage the Custom Security Provider" on page 1-4) is the BEA-recommended way for configuring and managing custom security providers. However, you may want to configure and manage your custom security provider completely through a console extension that you write.

- You implement optional SSPI MBeans for custom security providers that are <u>not</u> custom Authentication providers.

  When you implement optional SSPI MBeans to develop a custom Authentication provider, you automatically receive support in the Administration Console for the MBean type's attributes (inherited from the optional SSPI MBean). Other types of custom security providers, such as custom Authorization providers, do not receive this support.

- You add a custom attribute *that cannot be represented as a simple data type* to your MBean Definition File (MDF), which is used to generate the custom security provider's MBean type.

  The Details tab for a custom security provider will automatically display custom attributes, but only if they are represented as a simple data type, such as a string, MBean, boolean or integer value. If you have custom attributes that are represented as atypical data types (for example, an image of a fingerprint), the Administration Console cannot visualize the custom attribute without customization.

- You add a custom operation to your MBean Definition File (MDF), which is used to generate the custom security provider's MBean type.

  Because of the potential variety involved with custom operations, the Administration Console does not know how to automatically display or process them. Examples of custom operations might be a microphone for a voice print, or import/export buttons. The Administration Console cannot visualize and process these operations without customization.

In any of the preceding situations, if you do not want to write a console extension that allows you to use the WebLogic Server Administration Console, you can use the WebLogic Server Command-Line Interface to manage and configure your custom security providers instead. For more information about the WebLogic Server Command-Line Interface, see "WebLogic Server Command-Line Interface Reference" in the *BEA WebLogic Server Administration Guide*.

Some other (optional) reasons for extending the Administration Console include:

- Corporate branding—when, for example, you want your organization's logo or look and feel on the pages used to configure and manage a custom security provider.

- Consolidation—when, for example, you want all the fields used to configure and manage a custom security provider on one page, rather than in separate tabs or locations.

For more information about console extensions, see *Extending the Administration Console* and Chapter 12, "Writing Console Extensions for Custom Security Providers."

Configuring the Custom Security Provider

Note: The configuration process can be completed by the same person who developed the custom security provider, or by a designated administrator.

The configuration process consists of using the WebLogic Server Administration Console (or the WebLogic Server Command-Line Interface) to supply the custom security provider with configuration information. If you generated an MBean type for managing the custom security provider, "configuring" the custom security provider in the Administration Console also means that you are creating a specific instance of the MBean type.

For more information about configuring security providers using the Administration Console, see "Customizing the Default Security Configuration" in *Managing WebLogic Security*. For instructions about how to use the WebLogic Server Command-Line Interface, see "WebLogic Server Command-Line Interface Reference" in the *BEA WebLogic Server Administration Guide*.

Providing Management Mechanisms for Security Policies, Security Roles, and Credential Maps

Certain types of security providers need to provide administrators with a way to manage the security data associated with them. For example, an Authorization provider needs to supply administrators with a way to manage security policies. Similarly, a Role Mapping provider needs to supply administrators with a way to manage security roles, and a Credential Mapping provider needs to supply administrators with a way to manage credential maps.

For the WebLogic Authorization, Role Mapping, and Credential Mapping providers, there are already management mechanisms available for administrators in the WebLogic Server Administration Console. However, do you not inherit these mechanisms when you develop a custom version of one of these security providers; you need to provide your own mechanisms to manage security policies, security roles, and credential maps. These mechanisms must read and write the appropriate security data to and from the custom security provider's database, but may or may not be integrated with the Administration Console.

For more information, refer to one of the following sections:

- "Provide a Mechanism for Security Policy Management" on page 6-25 (for custom Authorization providers)

- "Provide a Mechanism for Security Role Management" on page 8-27 (for custom Role Mapping providers)

- "Provide a Mechanism for Credential Map Management" on page 10-18 (for custom Credential Mapping providers)

2 Design Considerations

Careful planning of development activities can greatly reduce the time and effort you spend developing custom security providers. The following sections describe security provider concepts and functionality in more detail to help you get started:

- "General Architecture of a Security Provider" on page 2-1

- "Security Services Provider Interfaces (SSPIs)" on page 2-3

- "Security Service Provider Interface (SSPI) MBeans" on page 2-11

- "Management Utilities Available to Developers of Security Providers" on page 2-22

- "Security Providers and WebLogic Resources" on page 2-23

- "Initializing the Security Provider Database" on page 2-35

General Architecture of a Security Provider

Although there are different types of security providers you can create (see "Types of Security Providers" in the *Introduction to WebLogic Security*), all security providers follow the same general architecture. Figure 2-1 illustrates the general architecture of a security provider, and an explanation follows.

Figure 2-1   Security Provider Architecture
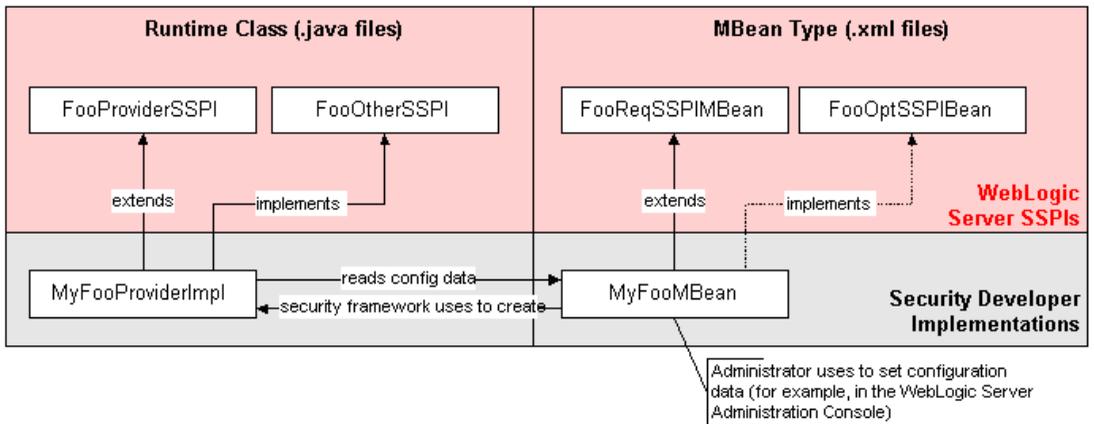
Note: The SSPIs and the runtime classes (that is, implementations) you will create using the SSPIs are shown on the left side of Figure 2-1 and are .java files.

Like the other files on the right side of Figure 2-1, MyFooMBean begins as a .xml file, in which you will extend (and optionally implement) SSPI MBeans. When this MBean Definition File (MDF) is run through the WebLogic MBeanMaker utility, the utility generates the .java files for the MBean type, as described in "Generating an MBean Type to Configure and Manage the Custom Security Provider" on page 1-4.

Figure 2-1 shows the relationship between a single runtime class (MyFooProviderImpl) and an MBean type (MyFooMBean) you create when developing a custom security provider. The process begins when a WebLogic Server instance starts, and the WebLogic Security Framework:

1. Locates the MBean type associated with the security provider in the security realm.

2. Obtains the name of the security provider's runtime class (the one that implements the "Provider" SSPI, if there are two runtime classes) from the MBean type.

3. Passes in the appropriate MBean instance, which the security provider uses to initialize (read configuration data).

Therefore, both the runtime class (or classes) *and* the MBean type form what is called the "security provider."

Security Services Provider Interfaces (SSPIs)

As described in "Overview of the Development Process" on page 1-2, you develop a custom security provider by first implementing a number of security services provider interfaces (SSPIs) to create runtime classes. This section helps you:

- "Understand an Important Restriction" on page 2-3

- "Understand the Purpose of the "Provider" SSPIs" on page 2-3

- "Determine Which "Provider" Interface You Will Implement" on page 2-5

- "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes" on page 2-7

Additionally, this section provides an SSPI Quick Reference that indicates which SSPIs can be implemented for each type of security provider.

Understand an Important Restriction

A custom security provider's runtime class implementation must not contain any code that requires a security check to be performed by the WebLogic Security Framework. Doing so causes infinite recursion, because the security providers are the components of the WebLogic Security Framework that actually perform the security checks and grant access to WebLogic resources.

Understand the Purpose of the "Provider" SSPIs

Each SSPI that ends in the suffix "Provider" (for example, `CredentialProvider`) exposes the services of a security provider to the WebLogic Security Framework. This allows the security provider to be manipulated (initialized, started, stopped, and so on).

Figure 2-2   "Provider" SSPIs
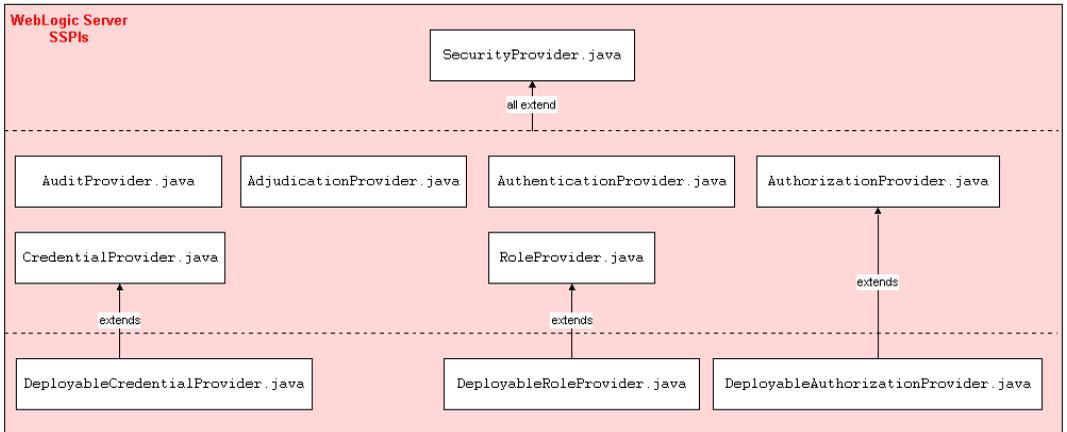
As shown in Figure 2-2, the SSPIs exposing security services to the WebLogic Security Framework are provided by WebLogic Server, and all extend the `SecurityProvider` interface, which includes the following methods:

initialize

```
public void initialize(ProviderMBean providerMBean,
SecurityServices securityServices)
```

The `initialize` method takes as an argument a `ProviderMBean`, which can be narrowed to the security provider's associated MBean instance. The MBean instance is created from the MBean type you generate, and contains configuration data that allows the custom security provider to be managed in the WebLogic Server environment. If this configuration data is available, the `initialize` method should be used to extract it.

The `securityServices` argument is an object from which the custom security provider can obtain and use the Auditor Service. For more information about the Auditor Service and auditing, see Chapter 9, "Auditing Providers" and Chapter 11, "Auditing Events From Custom Security Providers."

getDescription

```
public String getDescription()
```

This method returns a brief textual description of the custom security provider.

shutdown

```
public void shutdown()
```

This method shuts down the custom security provider.

Because they extend `SecurityProvider`, a runtime class that implements any SSPI ending in "Provider" must provide implementations for these inherited methods.

Determine Which "Provider" Interface You Will Implement

Implementations of SSPIs that begin with the prefix "Deployable" and end with the suffix "Provider" (for example, `DeployableCredentialProvider`) expose the services of a custom security provider into the WebLogic Security Framework as explained in . However, implementations of these SSPIs also perform additional tasks. These SSPIs also provide support for security in deployment descriptors, including the servlet deployment descriptors (`web.xml`, `weblogic.xml`), the EJB deployment descriptors (`ejb-jar.xml`, `weblogic-ejb.jar.xml`) and the EAR deployment descriptors (`application.xml`, `weblogic-application.xml`).

Authorization providers, Role Mapping providers, and Credential Mapping providers have deployable versions of their "Provider" SSPIs.

Note: If your security provider database (which stores security policies, security roles, and credentials) is read-only, you can implement the non-deployable version of the SSPI for your Authorization, Role Mapping, and Credential Mapping security providers. However, you will still need to configure deployable versions of these security provider that do handle deployment.

The DeployableAuthorizationProvider SSPI

An Authorization provider that supports deploying security policies on behalf of Web application or Enterprise JavaBean (EJB) deployments needs to implement the `DeployableAuthorizationProvider` SSPI instead of the `AuthorizationProvider` SSPI. (However, because the `DeployableAuthorizationProvider` SSPI extends the `AuthorizationProvider` SSPI, you actually will need to implement the methods from both SSPIs.) This is because Web application and EJB deployment activities require the Authorization provider to perform additional tasks, such as creating and removing security policies.

In a security realm, at least one Authorization provider must support the
`DeployableAuthorizationProvider` SSPI, or else it will be impossible to deploy
Web applications and EJBs.

Note: For more information about security policies, see "Security Policies" in
Securing WebLogic Resources.

The DeployableRoleProvider SSPI

A Role Mapping provider that supports deploying security roles on behalf of Web
application or Enterprise JavaBean (EJB) deployments needs to implement the
`DeployableRoleProvider` SSPI instead of the `RoleProvider` SSPI. (However,
because the `DeployableRoleProvider` SSPI extends the `RoleProvider` SSPI, you
will actually need to implement the methods from both SSPIs.) This is because Web
application and EJB deployment activities require the Role Mapping provider to
perform additional tasks, such as creating and removing security roles. In a security
realm, at least one Role Mapping provider must support this SSPI, or else it will be
impossible to deploy Web applications and EJBs.

Note: For more information about security roles, see "Security Roles" in *Securing
WebLogic Resources*.

The DeployableCredentialProvider SSPI

A Credential Mapping provider that supports deploying security policies on behalf of
Resource Adapter (RA) deployments needs to implement the
`DeployableCredentialProvider` SSPI instead of the `CredentialProvider` SSPI.
(However, because the `DeployableCredentialProvider` SSPI extends the
`CredentialProvider` SSPI, you will actually need to implement the methods from
both SSPIs.) This is because Resource Adapter deployment activities require the
Credential Mapping provider to perform additional tasks, such as creating and
removing credentials and mappings. In a security realm, at least one Credential
Mapping provider must support this SSPI, or else it will be impossible to deploy
Resource Adapters.

Notes: For more information about credentials, see "Credential Mapping Concepts" on page 10-1. For more information about security policies, see "Security Policies" in *Securing WebLogic Resources*.

Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes

Figure 2-3 uses a Credential Mapping provider to illustrate the inheritance hierarchy that is common to all SSPIs, and shows how a runtime class you supply can implement those interfaces. In this example, BEA supplies the SecurityProvider interface, and the CredentialProvider, DeployableCredentialProvider, and CredentialMapper SSPIs. Figure 2-3 shows *a single runtime class* called MyCredentialMapperProviderImpl that implements the DeployableCredentialProvider *and* CredentialMapper SSPIs.

Figure 2-3   Credential Mapping SSPIs and a Single Runtime Class
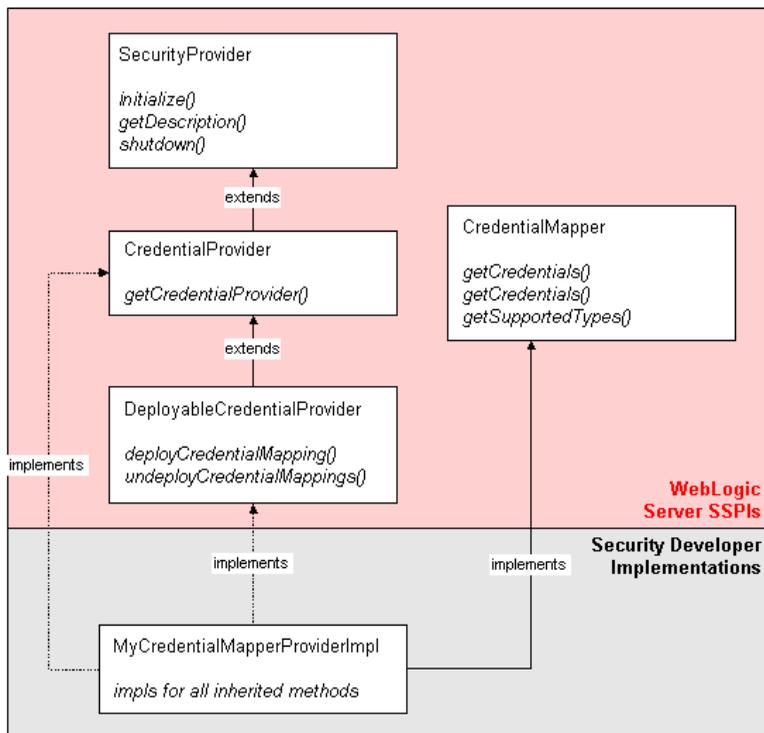
However, Figure 2-3 illustrates only one way you can implement SSPIs: by creating a *single* runtime class. If you prefer, you can have two runtime classes (as shown in Figure 2-4): one for the implementation of the SSPI ending in "Provider" (for example, CredentialProvider or DeployableCredentialProvider), and one for the implementation of the other SSPI (for example, the CredentialMapper SSPI).

When there are separate runtime classes, the class that implements the SSPI ending in "Provider" acts as a factory for generating the runtime class that implements the other SSPI. For example, in Figure 2-4, MyCredentialMapperProviderImpl acts as a factory for generating MyCredentialMapperImpl.

Figure 2-4   Credential Mapping SSPIs and Two Runtime Classes
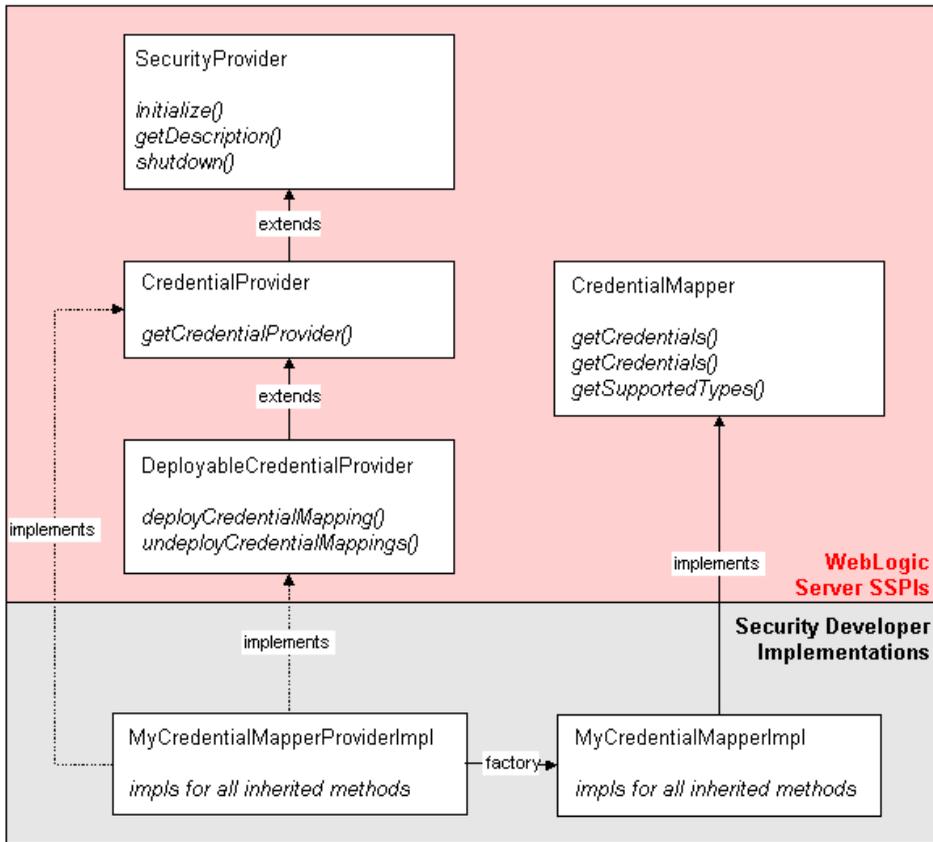
Note: If you decide to have two runtime implementation classes, you need to remember to include *both* runtime implementation classes in the MBean JAR File (MJF) when you generate the security provider's MBean type. For more information, see "Generating an MBean Type to Configure and Manage the Custom Security Provider" on page 1-4.

SSPI Quick Reference

Table 2-1 maps the types of security providers (and their components) with the SSPIs and other interfaces you use to develop them.

Table 2-1 Security Providers, Their Components, and Corresponding SSPIs

Type/Component	SSPIs/Interfaces
Authentication provider	`AuthenticationProvider`
LoginModule (JAAS)	`LoginModule`
Identity Assertion provider	`AuthenticationProvider`
Identity Asserter	`IdentityAsserter`
Principal Validation provider	`PrincipalValidator`
Authorization	`AuthorizationProvider` `DeployableAuthorizationProvider`
Access Decision	`AccessDecision`
Adjudication provider	`AdjudicationProvider`
Adjudicator	`Adjudicator`
Role Mapping provider	`RoleProvider` `DeployableRoleProvider`
Role Mapper	`RoleMapper`
Auditing provider	`AuditProvider`
Audit Channel	`AuditChannel`
Credential Mapping provider	`CredentialProvider` `DeployableCredentialProvider`
Credential Mapper	`CredentialMapper`

Note: The SSPIs you use to create runtime classes for custom security providers are located in the `weblogic.security.spi` package. For more information about this package, see the *WebLogic Server 7.0 API Reference Javadoc*.

Security Service Provider Interface (SSPI) MBeans

As described in "Overview of the Development Process" on page 1-2, the second step in developing a custom security provider is generating an MBean type for the custom security provider. This section helps you:

- Understand Why You Need an MBean Type

- Determine Which SSPI MBeans to Extend and Implement

- Understand the Basic Elements of an MBean Definition File (MDF)

- Understand the SSPI MBean Hierarchy and How It Affects the Administration Console

- Understand What the WebLogic MBeanMaker Provides

Additionally, this section provides an SSPI MBean Quick Reference that indicates which required SSPI MBeans must be extended and which optional SSPI MBeans can be implemented for each type of security provider.

Understand Why You Need an MBean Type

In addition to creating runtime classes for a custom security provider, you must also generate an MBean type. The term **MBean** is short for managed bean, a Java object that represents a Java Management eXtensions (JMX) manageable resource.

Note: JMX is a specification created by Sun Microsystems that defines a standard management architecture, APIs, and management services. For more information, see the *Java Management Extensions White Paper*.

An **MBean type** is a factory for instances of MBeans, the latter of which you or an administrator can create using the WebLogic Server Administration Console. Once they are created, you can configure and manage the custom security provider using the MBean instance, through the Administration Console.

Note: All MBean instances are aware of their parent type, so if you modify the configuration of an MBean type, all instances that you or an administrator may have created using the Administration Console will also update their configurations. (For more information, see "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15.)

Determine Which SSPI MBeans to Extend and Implement

You use MBean interfaces called **SSPI MBeans** to create MBean types. There are two types of SSPI MBeans you can use to create anMBean type for a custom security provider:

- **Required SSPI MBeans**, which you must extend because they define the basic methods that allow a security provider to be configured and managed within the WebLogic Server environment.

- **Optional SSPI MBeans**, which you can implement because they define additional methods for managing security providers. Different types of security providers are able to use different optional SSPI MBeans.

For more information, see "SSPI MBean Quick Reference" on page 2-19.

Understand the Basic Elements of an MBean Definition File (MDF)

An **MBean Definition File (MDF)** is an XML file used by the WebLogic MBeanMaker utility to generate the Java files that comprise an MBean type. All MDFs *must* extend a required SSPI MBean that is specific to the type of the security provider you have created, and *can* implement optional SSPI MBeans.

Listing 2-1 shows a sample MBean Definition File (MDF), and an explanation of its content follows. (Specifically, it is the MDF used to generate an MBean type for the WebLogic Credential Mapping provider.)

Note: A complete reference of MDF element syntax is available in Appendix A, "MBean Definition File (MDF) Element Syntax."

Listing 2-1   DefaultCredentialMapper.xml

```
<?xml version="1.0" ?>
<!DOCTYPE MBeanType SYSTEM "commo.dtd">

<MBeanType
 Name = "DefaultCredentialMapper"
 DisplayName = "DefaultCredentialMapper"
 Package = "weblogic.security.providers.credentials"
 Extends = "weblogic.management.security.credentials.
DeployableCredentialMapper"
 Implements = "weblogic.management.security.credentials.
UserPasswordCredentialMapEditor"
 PersistPolicy = "OnUpdate"
 Description = "This MBean represents configuration attributes for
the WebLogic Credential Mapping provider.&lt;p&gt;"
>

<MBeanAttribute
 Name = "ProviderClassName"
 Type = "java.lang.String"
 Writeable = "false"
 Default = "&quot;weblogic.security.providers.credentials.
DefaultCredentialMapperProviderImpl&quot;"
 Description = "The name of the Java class that loads the WebLogic
Credential Mapping provider."
/>

<MBeanAttribute
 Name = "Description"
 Type = "java.lang.String"
 Writeable = "false"
 Default = "&quot;Provider that performs Default Credential
Mapping&quot;"
 Description = "A short description of the WebLogic Credential
Mapping provider."
/>

<MBeanAttribute
 Name = "Version"
```

```
 Type = "java.lang.String"
 Writeable = "false"
 Default = "&quot;1.0&quot;"
 Description = "The version of the WebLogic Credential Mapping
provider."
/>

</MBeanType>
```

The bold attributes in the `<MBeanType>` tag show that this MDF is named `DefaultCredentialMapper` and that it extends the required SSPI MBean called `DeployableCredentialMapper`. It also includes additional management capabilities by implementing the `UserPasswordCredentialMapEditor` optional SSPI MBean.

The `ProviderClassName`, `Description`, and `Version` attributes defined in the `<MBeanAttribute>` tags are required in any MDF used to generate MBean types for security providers because they define the security provider's basic configuration methods, and are inherited from the base required SSPI MBean called `Provider` (see Figure 2-6). The `ProviderClassName` attribute is especially important. The value for the `ProviderClassName` attribute is the Java filename of the security provider's runtime class (that is, the implementation of the appropriate SSPI ending in "Provider"). The example runtime class shown in Listing 2-1 is `DefaultCredentialMapperProviderImpl.java`.

While not shown in Listing 2-1, you can include additional attributes and operations in an MDF using the `<MBeanAttribute>` and `<MBeanOperation>` tags. Most custom attributes will automatically appear in the Details tab for your custom security provider in the WebLogic Server Administration Console (an example of which is shown in Figure 2-5). To display custom operations, however, you need to write a console extension. (See "Writing Console Extensions" on page 1-5.)

Figure 2-5   Sample Details Tab
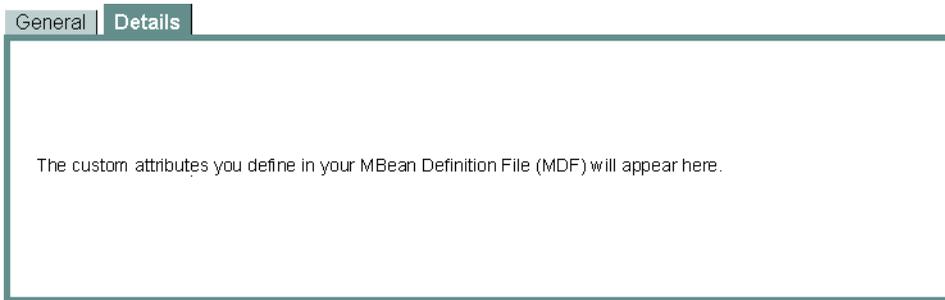
> **Note:**   The Sample Auditing provider (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) provides an example of adding a custom attribute.

Understand the SSPI MBean Hierarchy and How It Affects the Administration Console

All attributes and operations that are specified in the required SSPI MBeans that your MBean Definition File (MDF) extends (all the way up to the `Provider` base SSPI MBean) automatically appear in a WebLogic Server Administration Console page for the associated security provider. You use these attributes and operatations to configure and manage your custom security providers.

> **Note:**   For Authentication security providers only, the attributes and operations that are specified in the optional SSPI MBeans your MDF implements are also automatically supported by the Administration Console. For other types of security providers, you must write a console extension in order to make the attributes and operations inherited from the optional SSPI MBeans available in the Administration Console. For more information, see "Writing Console Extensions" on page 1-5.

Figure 2-6 illustrates the SSPI MBean hierarchy for security providers (using the WebLogic Credential Mapping MDF as an example), and indicates what attributes and operations will appear in the Administration Console for the WebLogic Credential Mapping provider.

Figure 2-6   SSPI MBean Hierarchy for Credential Mapping Providers
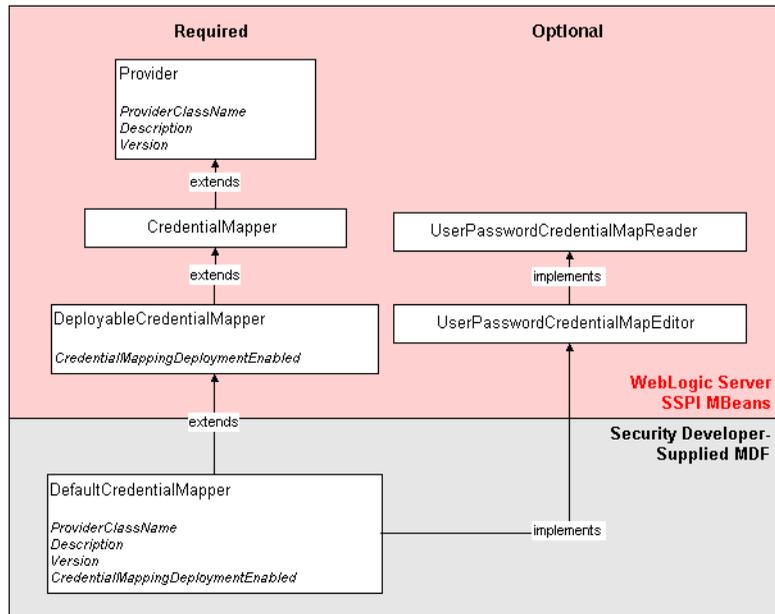
Implementing the hierarchy of SSPI MBeans in the DefaultCredentialMapper MDF (shown in Figure 2-6) produces the page in the Administration Console that is shown in Figure 2-7. (The full listing of the DefaultCredentialMapper MDF is shown in Listing 2-1.)

Figure 2-7   DefaultCredentialMapper Administration Console Page
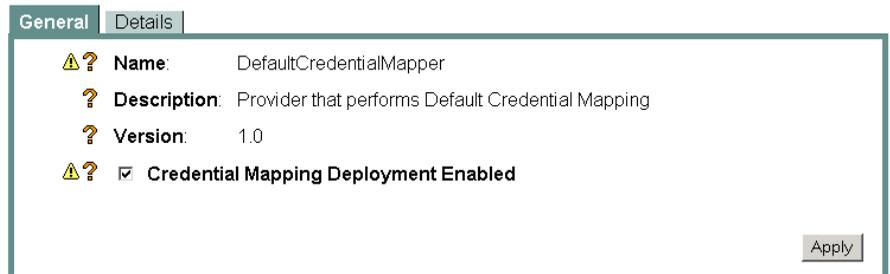
The Name, Description, and Version fields come from attributes with these names inherited from the base required SSPI MBean called `Provider` and specified in the `DefaultCredentialMapper` MDF. Note that the `DisplayName` attribute in the `DefaultCredentialMapper` MDF generates the value for the Name field, and that the `Description` and `Version` attributes generate the values for their respective fields as well. The Credential Mapping Deployment Enabled field is displayed because of the `CredentialMappingDeploymentEnabled` attribute in the `DeployableCredentialMapper` required SSPI MBean, which the `DefaultCredentialMapper` MDF extends. Notice that this Administration Console page does not display a field for the `DefaultCredentialMapper` MDF's implementation of the `UserPasswordCredentialMapEditor` optional SSPI MBean.

Understand What the WebLogic MBeanMaker Provides

The **WebLogic MBeanMaker** is a command-line utility that takes an MBean Definition File (MDF) as input and outputs files for an MBean type. When you run the MDF you created through the WebLogic MBeanMaker, the following occurs:

- Any attributes inherited from required SSPI MBeans—as well as any custom attributes you added to the MDF—cause the WebLogic MBeanMaker to generate *complete getter/setter methods* in the MBean type's information file. (The MBean information file is not shown in Figure 2-8.) For more information about the MBean information file, see "About the MBean Information File" on page 2-19.

  Necessary developer action: None. No further work must be done for these methods.

- Any operations inherited from optional SSPI MBeans cause the MBean implementation file to inherit their methods, whose implementations you must supply from scratch.

  Necessary developer action: Currently, the WebLogic MBeanMaker does not generate method stubs for these inherited methods, so you will need to use the Mapping MDF Operation Declarations to Java Method Signatures Document (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) to supply the appropriate implementations.

- Any custom operations you added to the MDF will cause the WebLogic MBeanMaker to *generate method stubs*.

Necessary developer action: You must provide implementations for these methods. (However, because the WebLogic MBeanMaker generates the stubs, you do not need to look up the Java method signatures.)

This is illustrated in Figure 2-8.

Figure 2-8   What the WebLogic MBeanMaker Provides
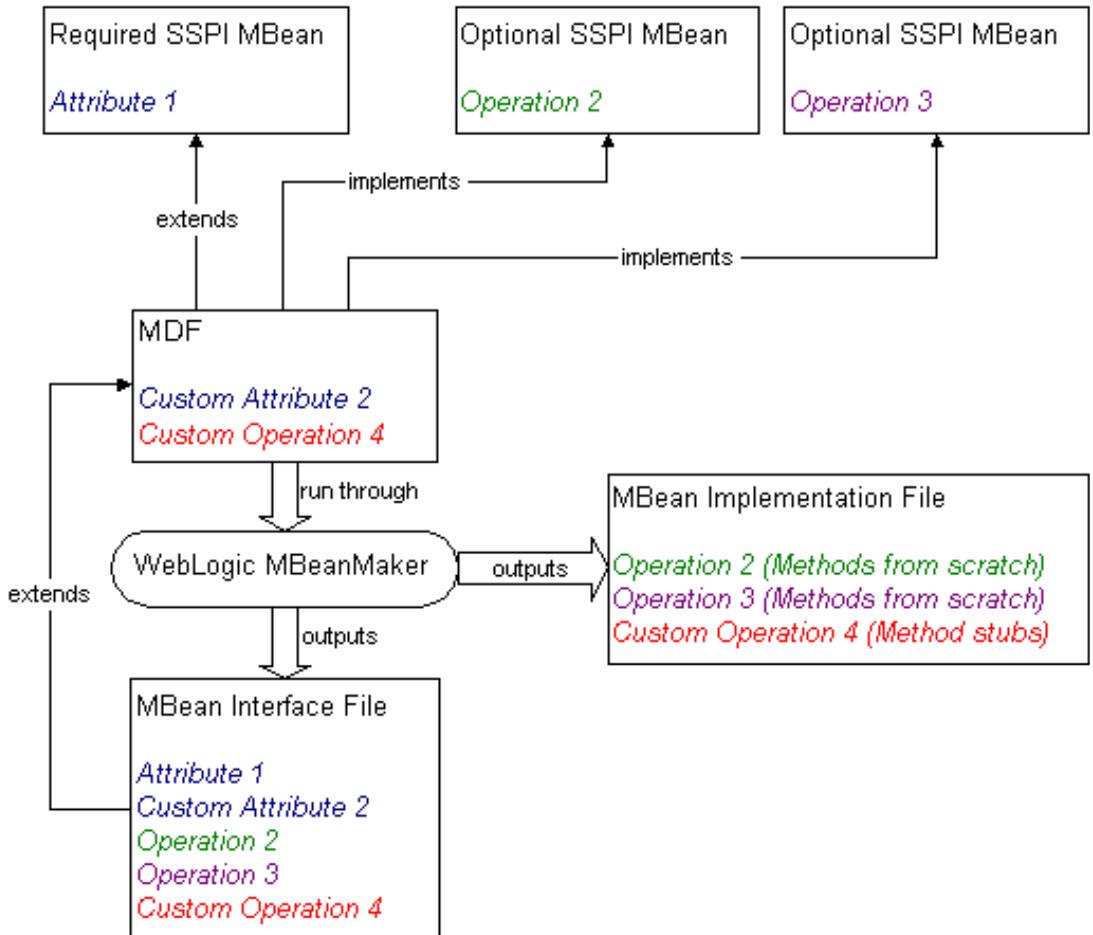
About the MBean Information File

The MBean information file contains a compiled definition of the data in the MBean Definition File in a form that JMX Model MBeans require. The format of this file is a list of attributes, operations, and notifications, each of which also has a set of descriptor tags that describe that entity. In addition, the MBean itself also has a set of descriptor tags. An example of this format is as follows:

```
MBean + tags

attribute1 + tags, attribute2 + tags ...

operation1 + tags, operation2 + tags ...

notification1 + tags, notification2 + tags ...
```

If desired, you can access this information at runtime by calling the standard JMX server `getMBeanInfo` method to obtain the `ModelMBeanInfo`.

Note: Be sure to reference the JMX specification to determine how to interpret the returned structure.

SSPI MBean Quick Reference

Based on the list of SSPIs you need to implement as part of developing your custom security provider, locate the required SSPI MBeans you need to extend in Table 2-2. Using Table 2-3 through Table 2-5, locate any optional SSPI MBeans you also want to implement for managing your security provider.

Table 2-2 Required SSPI MBeans

Type	Package Name	Required SSPI MBean
Authentication provider	authentication	Authenticator
Identity Assertion provider	authentication	IdentityAsserter
Authorization provider	authorization	Authorizer or DeployableAuthorizer
Adjudication provider	authorization	Adjudicator

Table 2-2 Required SSPI MBeans

Type	Package Name	Required SSPI MBean
Role Mapping provider	`authorization`	`RoleMapper` or `DeployableRoleMapper`
Auditing provider	`audit`	`Auditor`
Credential Mapping provider	`credentials`	`CredentialMapper` or `DeployableCredentialMapper`

Note: The required SSPI MBeans shown in Table 2-2 are located in the `weblogic.management.security.<Package_Name>` package.

Table 2-3 Optional Authentication SSPI MBeans

Optional SSPI MBeans	Purpose
`GroupEditor`	Create a group. If the group already exists, an exception is thrown.
`GroupMemberLister`	List a group's members.
`GroupReader`	Read data about groups.
`GroupRemover`	Remove groups.
`MemberGroupLister`	List the groups containing a user or a group.
`UserEditor`	Create, edit and remove users.
`UserPasswordEditor`	Change a user's password.
`UserReader`	Read data about users.
`UserRemover`	Remove users.

Notes: The optional Authentication SSPI MBeans shown in Table 2-3 are located in the `weblogic.management.security.authentication` package. They are also supported in the WebLogic Server Administration Console.

For an example of how to implement the optional Authentication SSPI MBeans shown in Table 2-3, review the code for the Manageable Sample Authentication provider (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*).

Table 2-4 Optional Authorization SSPI MBeans

Optional SSPI MBeans	Purpose
PolicyEditor	Create, edit and remove security policies.
PolicyReader	Read data about security policies.
RoleEditor	Create, edit and remove security roles.
RoleReader	Read data about security roles.

Note: The optional Authorization SSPI MBeans shown in Table 2-4 are located in the `weblogic.management.security.authorization` package.

Table 2-5 Optional Credential Mapping SSPI MBeans

Optional SSPI MBeans	Purpose
UserPasswordCredentialMapEditor	Edit credential maps that map a WebLogic user to a remote username and password.
UserPasswordCredentialMapReader	Read credential maps that map a WebLogic user to a remote username and password.

Note: The optional Credential Mapping SSPI MBeans shown in Table 2-5 are located in the `weblogic.management.security.credentials` package.

Management Utilities Available to Developers of Security Providers

The `weblogic.management.utils` package contains additional management interfaces and exceptions that developers might find useful, particularly when generating MBean types for their custom security providers. Implementation of these interfaces and exceptions is not required to develop a custom security provider (unless you inherit them by implementing optional SSPI MBeans in your custom security provider's MDF).

Note: The interfaces and classes are located in this package (rather than in `weblogic.management.security`) because they are general purpose utilities; in other words, these utilities can also be used for non-security MBeans. The various types of MBeans are described in "WebLogic Server Managed Resources and MBeans" in *Programming WebLogic Management Services with JMX*.

The `weblogic.management.utils` package contains the following utilities:

- Common exceptions.

- Interfaces that provide methods for handling large lists of data.

- An interface containing configuration attributes that are required to communicate with an external LDAP server.

Note: The Manageable Sample Authentication Provider, one of the sample security providers available under "Code Samples: WebLogic Server" on the *dev2dev Web site*, uses the `weblogic.management.utils` package for exceptions as well as to handle lists of data.

For more information, see the *WebLogic Server 7.0 API Reference Javadoc* for the weblogic.management.utils package.

Security Providers and WebLogic Resources

A **WebLogic resource** is a structured object used to represent an underlying WebLogic Server entity that can be protected from unauthorized access. Developers of custom Authorization, Role Mapping, and Credential Mapping providers need to understand how these security providers interact with WebLogic resources and the security policies used to secure those resources.

Note: Security policies replace the access control lists (ACLs) and permissions that were used to protect WebLogic resources in previous releases of WebLogic Server.

The following sections provide information about security providers and WebLogic resources:

- "The Architecture of WebLogic Resources" on page 2-23
- "Types of WebLogic Resources" on page 2-24
- "WebLogic Resource Identifiers" on page 2-25
- "Creating Default Groups for WebLogic Resources" on page 2-27
- "Creating Default Security Roles for WebLogic Resources" on page 2-27
- "Creating Default Security Policies for WebLogic Resources" on page 2-28
- "Single-Parent Resource Hierarchies" on page 2-31
- "ContextHandlers and WebLogic Resources" on page 2-33

Note: For more information, see *Securing WebLogic Resources*.

The Architecture of WebLogic Resources

The `Resource` interface, located in the `weblogic.security.spi` package, provides the definition for an object that represents a WebLogic resource, which can be protected from unauthorized access. The `ResourceBase` class, located in the

weblogic.security.service package, is an abstract base class for more specific WebLogic resource types, and facilitates the model for extending resources. (See Figure 2-9 and "Types of WebLogic Resources" on page 2-24 for more information.)

Figure 2-9   Architecture of WebLogic Resources
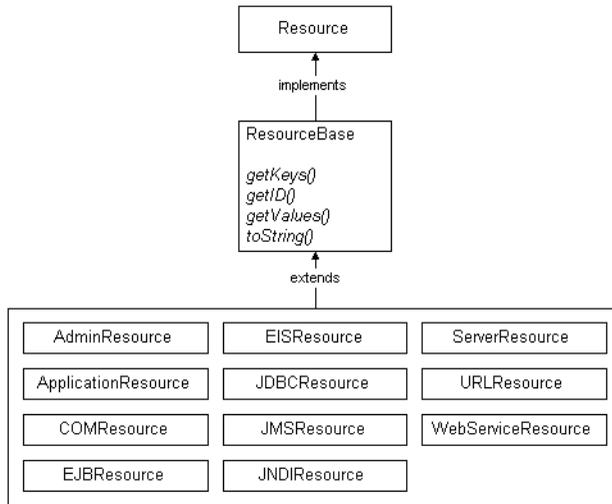
The ResourceBase class includes the BEA-provided implementations of the getID, getKeys, getValues, and toString methods. For more information, see the *WebLogic Server 7.0 API Reference Javadoc* for the ResourceBase class.

This architecture allows you to develop security providers without requiring that they be aware of any particular WebLogic resources. Therefore, when new resource types are added, you should not need to modify the security providers.

Types of WebLogic Resources

As shown in Figure 2-9, certain classes in the weblogic.security.service package extend the ResourceBase class, and therefore provide you with implementations for specific types of WebLogic resources. WebLogic resource implementations are available for:

■ Administrative resources

- Application resources

- COM resources

- EIS resources

- EJB resources

- JDBC resources

- JMS resources

- JNDI resources

- Server resources

- URL resources

- Web Service resources

Notes: For more information about each of these WebLogic resources, see *Securing WebLogic Resources* and the *WebLogic Server 7.0 API Reference Javadoc* for the weblogic.security.service package.

WebLogic Resource Identifiers

Each WebLogic resource (described in "Types of WebLogic Resources" on page 2-24) can identified in two ways: by its toString() representation or by an ID obtained using the getID() method.

The toString() Method

If you use the toString() method of any WebLogic resource implementation, a description of the WebLogic resource will be returned in the form of a String. First, the type of the WebLogic resource is printed in pointy-brackets. Then, each key is printed, in order, along with its value. The keys are comma-separated. Values that are lists are comma-separated and delineated by open and close curly braces. Each value is printed as is, except that commas (,), open braces ({), close braces (}), and back slashes (\) are each escaped with a back slash. For example, the EJB resource:

```
EJBResource ("myApp",
             "MyJarFile",
             "myEJB",
             "myMethod",
             "Home",
             new String[ ] {"argumentType1", "argumentType2"}
            );
```

will produce the following `toString` output:

```
type=<ejb>, app=myApp, module="MyJarFile", ejb=myEJB,
method="myMethod", methodInterface="Home",
methodParams={argumentType1, argumentType2}
```

The format of the WebLogic resource description provided by the `toString()` method is public (that is, you can construct one without using a `Resource` object) and is reversible (meaning that you can convert the `String` form back to the original WebLogic resource).

Note: Listing 2-2 illustrates how to use the `toString()` method to identify a WebLogic resource.

Resource IDs and the getID() Method

The `getID()` method on each of the defined WebLogic resource types returns a 64-bit hashcode that can be used to uniquely identify the WebLogic resource in a security provider. The resource ID can be effectively used for fast runtime caching, using the following algorithm:

1. Obtain a WebLogic resource.

2. Get the resource ID for the WebLogic resource using the `getID` method.

3. Look up the resource ID in the cache.

4. If the resource ID is found, then return the security policy.

5. If the resource ID is not found, then:

   a. Use the `toString()` method to look up the WebLogic resource in the security provider database.

   b. Store the resource ID and the security policy in cache.

   c. Return the security policy.

Note: Listing 2-3 illustrates how to use the `getID()` method to identify a WebLogic resource in Authorization provider, and provides a sample implementation of this algorithm.

Because it is not guaranteed stable across multiple runs, you should not use the resource ID to store information about the WebLogic resource in a security provider database. Instead, BEA recommends that you store any resource-to-security policy and resource-to-security role mappings in their corresponding security provider database using the WebLogic resource's `toString()` method.

Notes: For more information about security provider databases, see "Initializing the Security Provider Database" on page 2-35. For more information about the `toString` method, see "The toString() Method" on page 2-25.

Creating Default Groups for WebLogic Resources

When writing a runtime class for a custom Authentication provider, there are several default groups that you are required to create. Table 2-6 provides information to assist you with this task.

Table 2-6 Default Groups and Group Membership

Group Name	Group Membership
Administrators	Empty, or an administrative user.
Deployers	Empty
Monitors	Empty
Operators	Empty

Creating Default Security Roles for WebLogic Resources

When writing a runtime class for a custom Role Mapping provider, there are several default global roles that you are required to create. Table 2-7 provides information to assist you with this task.

Table 2-7 Default Global Roles and Group Associations

Global Role Name	Group Association
Admin	`Administrators` group
Anonymous	`weblogic.security.WLSPrincipals.getEveryoneGroupname()` group
Deployer	`Deployers` group
Monitor	`Monitors` group
Operator	`Operators` group

> **Note:** For more information about global and scoped security roles, see "Security Roles" in *Securing WebLogic Resources*.

Creating Default Security Policies for WebLogic Resources

When writing a runtime class for a custom Authorization provider, there are several default security policies that you are required to create. These default security policies initially protect the various types of WebLogic resources. Table 2-8 provides information to assist you with this task.

Table 2-8 Default Security Policies for WebLogic Resources

WebLogic Resource Constructor	Security Policy
`new AdminResource(null, null, null)`	`Admin` global role
`new AdminResource("Configuration", null, null)`	`Admin`, `Deployer`, `Monitor`, or `Operator` global roles
`new AdminResource("FileUpload", null, null)`	`Admin` or `Deployer` global role
`new EISResource(null, null, null)`	`weblogic.security.WLSPrincipals. getEveryoneGroupname()` group

Table 2-8 Default Security Policies for WebLogic Resources (Continued)

WebLogic Resource Constructor	Security Policy
`new EJBResource(null, null, null, null, null, null)`	`weblogic.security.WLSPrincipals.` `getEveryoneGroupname()` group
`new JDBCResource(null, null, null, null, null)`	`weblogic.security.WLSPrincipals.` `getEveryoneGroupname()` group
`new JNDIResource(null, null, null)`	`weblogic.security.WLSPrincipals.` `getEveryoneGroupname()` group
`new JMSResource(null, null, null, null)`	`weblogic.security.WLSPrincipals.` `getEveryoneGroupname()` group
`new ServerResource(null, null, null)`	`Admin` or `Operator` global roles
`new URLResource(null, null, null, null, null)`	`weblogic.security.WLSPrincipals.` `getEveryoneGroupname()` group
`new WebServiceResource(null, null, null, null)`	`weblogic.security.WLSPrincipals.` `getEveryoneGroupname()` group

Note: Application and COM resources should not have default security policies (that is, they should not grant permission to anyone by default).

Looking Up WebLogic Resources in a Security Provider's Runtime Class

Listing 2-2 illustrates how to look up a WebLogic resource in the runtime class of an Authorization provider. This algorithm assumes that the security provider database for the Authorization provider contains a mapping of WebLogic resources to security policies. It is not required that you use the algorithm shown in Listing 2-2, or that you utitilize the call to the `getParentResource` method. (For more information about the `getParentResource` method, see "Single-Parent Resource Hierarchies" on page 2-31.)

Listing 2-2 How to Look Up a WebLogic Resource in an Authorization Provider:

Using the toString Method

```
Policy findPolicy(Resource resource) {
   Resource myResource = resource;
   while (myResource != null) {
      String resourceText = myResource.toString();
      Policy policy = lookupInDB(resourceText);
      if (policy != null) return policy;
      myResource = myResource.getParentResource();
   }
   return null;
}
```

You can optimize the algorithm for looking up a WebLogic resource by using the getID method for the resource. (Use of the toString method alone, as shown in Listing 2-2, may impact performance due to the frequency of string concatenations.) The getID method may be quicker and more efficient because it is a hash operation that is calculated and cached within the WebLogic resource itself. Therefore, when the getID method is used, the toString value only needs to be calculated once per resource (as shown in Listing 2-3).

Listing 2-3 How to Look Up a WebLogic Resource in an Authorization Provider: Using the getID Method

```
Policy findPolicy(Resource resource) {
   Resource myResource = resource;
   while (myResource != null) {
      long id = myResource.getID();
      Policy policy = lookupInCache(id);
      if (policy != null) return policy;
      String resourceText = myResource.toString();
      Policy policy = lookupInDB(resourceText);
      if (policy != null) {
         addToCache(id, policy);
         return policy;
      }
      myResource = myResource.getParentResource();
   }
   return null;
}
```

Note: The getID method is not guaranteed between service packs or future WebLogic Server releases. Therefore, you should not store getID values in your security provider database.

Single-Parent Resource Hierarchies

The level of granularity for WebLogic resources is up to you. For example, you can consider an entire Web application, a particular Enterprise JavaBean (EJB) within that Web application, or a single method within that EJB to be a WebLogic resource.

WebLogic resources are arranged in a hierarchical structure ranging from most specific to least specific. You can use the getParentResource method for each of the WebLogic resource types if you like, but it is not required.

The WebLogic security providers use the single-parent resource hierarchy as follows: If a WebLogic security provider attempts to access a specific WebLogic resource and that resource cannot be located, the WebLogic security provider will call the getParentResource method of that resource. The parent of the current WebLogic resource is returned, and allows the WebLogic security provider to move up the resource hierarchy to protect the next (less-specific) resource. For example, if a caller attempts to access the following URL resource:

```
type=<url>, application=myApp, contextPath="/mywebapp",
uri=foo/bar/my.jsp
```

and that exact URL resource cannot be located, the WebLogic security provider will progressively attempt to locate and protect the following resources (in order):

```
type=<url>, application=myApp, contextPath="/mywebapp", uri=/foo/bar/*
type=<url>, application=myApp, contextPath="/mywebapp", uri=/foo/*
type=<url>, application=myApp, contextPath="/mywebapp", uri=*.jsp
type=<url>, application=myApp, contextPath="/mywebapp", uri=/*
type=<url>, application=myApp, contextPath="/mywebapp"
type=<url>, application=myApp
type=<app>, application=myApp
type=<url>
```

Note: For more information about the getParentResource method, see the *WebLogic Server 7.0 API Reference Javadoc* for any of the predefined WebLogic resource types or the Resource interface.

Pattern Matching for URL Resources

Sections SRV.11.1 and SRV.11.2 of the Java Servlet 2.3 Specification describe the servlet container's pattern matching rules. These rules are used for URL resources as well. The following examples illustrate some important concepts with regard to URL resource pattern matching.

Example 1

For the URL resource `type=<url>, application=myApp,`
`contextPath=/mywebapp, uri=/foo/my.jsp, httpMethod=GET,` the resource hierarchy used is as follows. (Note lines 3 and 4, which contain URL patterns that may be different from what is expected.)

1. `type=<url>, application=myApp, contextPath=/mywebapp,`
   `uri=/foo/my.jsp, httpMethod=GET`

2. `type=<url>, application=myApp, contextPath=/mywebapp,`
   `uri=/foo/my.jsp`

3. `type=<url>, application=myApp, contextPath=/mywebapp,`
   `uri=/foo/my.jsp/*, httpMethod=GET`

4. `type=<url>, application=myApp, contextPath=/mywebapp,`
   `uri=/foo/my.jsp/*`

5. `type=<url>, application=myApp, contextPath=/mywebapp,`
   `uri=/foo/*, httpMethod=GET`

6. `type=<url>, application=myApp, contextPath=/mywebapp,`
   `uri=/foo/*`

7. `type=<url>, application=myApp, contextPath=/mywebapp,`
   `uri=*.jsp, httpMethod=GET`

8. `type=<url>, application=myApp, contextPath=/mywebapp, uri=*.jsp`

9. `type=<url>, application=myApp, contextPath=/mywebapp, uri=/*,`
   `httpMethod=GET`

10. `type=<url>, application=myApp, contextPath=/mywebapp, uri=/*`

11. `type=<url>, application=myApp,`
    `contextPath=/mywebapptype=<url>, application=myApp`

12. `type=<app>, application=myApp`

13. `type=<url>`

Example 2

For the URL resource `type=<url>`, `application=myApp`, `contextPath=/mywebapp`, `uri=/foo`, the resource hierarchy used is as follows. (Note line 2, which contains a URL pattern that may be different from what is expected.)

1. `type=<url>, application=myApp, contextPath=/mywebapp, uri=/foo`

2. `type=<url>, application=myApp, contextPath=/mywebapp, uri=/foo/*`

3. `type=<url>, application=myApp, contextPath=/mywebapp, uri=/*`

4. `type=<url>, application=myApp, contextPath=/mywebapp`

5. `type=<url>, application=myApp`

6. `type=<app>, application=myApp`

7. `type=<url>`

ContextHandlers and WebLogic Resources

A **ContextHandler** is a high-performing WebLogic class that obtains additional context and container-specific information from the resource container, and provides that information to security providers making access or role mapping decisions. The `ContextHandler` interface provides a way for an internal WebLogic resource container to pass additional information to a WebLogic Security Framework call, so that a security provider can obtain contextual information beyond what is provided by the arguments to a particular method. A ContextHandler is essentially a name/value list and as such, it requires that a security provider know what names to look for. (In other words, use of a ContextHandler requires close cooperation between the WebLogic resource container and the security provider.) Each name/value pair in a ContextHandler is known as a **context element**, and is represented by a `ContextElement` object.

Note: For more information about the `ContextHandler` interface and `ContextElement` class, see the *WebLogic Server 7.0 API Reference Javadoc* for the weblogic.security.service package.

Currently, two types of WebLogic resource containers pass ContextHandlers to the WebLogic Security Framework: the Servlet and EJB containers. Thus, URL (Web) and EJB resource types have different context elements whose values you can inspect as part of developing custom Authorization provider (or custom Role Mapping provider). Table 2-9 and Table 2-10 list each context element for the URL and EJB resource ContextHandlers.

Table 2-9 ContextHandler for URL (Web) Resources

Context Element Name	Context Element Value
HttpServletRequest	javax.servlet.http.HttpServletRequest
HttpServletResponse	javax.servlet.http.HttpServletResponse

Table 2-10 ContextHandler for Enterprise JavaBean (EJB) Resources

Context Element Name	Context Element Value
Parameter1	Determine the object type and semantics of each parameter via the <method-param> elements of the ejb-jar.xml deployment descriptor for the EJB.
Parameter2 ...	
ParameterN	

Listing 2-4 illustrates how you can access HttpServletRequest and HttpServletResponse context element objects via a URL (Web) resource's ContextHandler. For example, you might use this code in the isAccessAllowed() method of your AccessDecision SSPI implementation. (For more information, see "Implement the AccessDecision SSPI" on page 6-8.)

Listing 2-4 Example: Accessing Context Elements in the URL Resource ContextHandler

```
static final String SERVLETREQUESTNAME = "HttpServletRequest";

if (resource instanceof URLResource) {
   HttpServletRequest req =
      (HttpServletRequest)handler.getValue(SERVLETREQUESTNAME);
}
```

Note: You might also want to access these context elements in the `getRoles()` method of the `RoleMapper` SSPI implementation or the `getContext()` method of the `AuditContext` interface implementation. (For more information, see "Implement the RoleMapper SSPI" on page 8-10 and "Audit Context" on page 11-9, respectively.)

Initializing the Security Provider Database

Note: Prior to reviewing this section, be sure you have read "Security Provider Databases" in the *Introduction to WebLogic Security*.

At minimum, you must initialize security providers' databases with the default users, groups, security policies, security roles, or credentials that your Authentication, Authorization, Role Mapping, and Credential Mapping providers expect. You will need to initialize a given security provider's database *before* the security provider can be used, and should think about how this will work as you are writing the runtime classes for your custom security providers. The method you use to initialize a security provider's database depends upon many factors, including whether or not an externally administered database will be used to store the user, group, security policy, security role, or credential information, and whether or not the database already exists or needs to be created.

The following sections explain some best practices for initializing a security provider database:

■ Best Practice: Create a Simple Database If None Exists

■ Best Practice: Configure an Existing Database

■ Best Practice: Delegate Database Initialization

Best Practice: Create a Simple Database If None Exists

The first time an Authentication, Authorization, Role Mapping, or Credential Mapping provider is used, it attempts to locate a database with the information it needs to provide its security service. If the security provider fails to locate the database, you can

have it create one and automatically populate it with the default users, groups, security policies, security roles, and credentials. This option may be useful for development and testing purposes.

Both the WebLogic security providers and the sample security providers follow this practice. The WebLogic Authentication, Authorization, Role Mapping, and Credential Mapping providers store the user, group, security policy, security role, and credential information in the embedded LDAP server. If you want to use any of these WebLogic security providers, you will need to follow the "Configuring the Embedded LDAP Server" instructions in *Managing WebLogic Security*.

Note: The sample security providers, available under "Code Samples: WebLogic Server" on the *dev2dev Web site*, simply create and use a properties file as their database. For example, the sample Authentication provider creates a file called `SampleAuthenticatorDatabase.java` that contains the necessary information about users and groups.

Best Practice: Configure an Existing Database

If you already have a database (such as an external LDAP server), you can populate that database with the users, groups, security policies, security roles, and credentials that your Authentication, Authorization, Role Mapping, and Credential Mapping providers require. (Populating an existing database is accomplished using whatever tools you already have in place for performing these tasks.)

Once your database contains the necessary information, you must configure the security providers to look in that database. You accomplish this by adding custom attributes in your security provider's MBean Definition File (MDF). Some examples of custom attributes are the database's host, port, password, and so on. After you run the MDF through the WebLogic MBeanMaker and complete a few other steps to generate the MBean type for your custom security provider, you or an administrator use the WebLogic Server Administration Console to set these attributes to point to the database.

Note: For more information about MDFs, MBean types, and the WebLogic MBeanMaker, see "Generating an MBean Type to Configure and Manage the Custom Security Provider" on page 1-4.

As an example, Listing 2-5 shows some custom attributes that are part of the WebLogic LDAP Authentication provider's MDF. These attributes enable an administrator to specify information about the WebLogic LDAP Authentication provider's database (an external LDAP server), so it can locate information about users and groups.

Listing 2-5   LDAPAuthenticator.xml

```
...
<MBeanAttribute
 Name = "UserObjectClass"
 Type = "java.lang.String"
 Default = "&quot;person&quot;"
 Description = "The LDAP object class that stores users."
/>

<MBeanAttribute
 Name = "UserNameAttribute"
 Type = "java.lang.String"
 Default = "&quot;uid&quot;"
 Description = "The attribute of an LDAP user object that specifies the name of
    the user."
/>

<MBeanAttribute
 Name = "UserDynamicGroupDNAttribute"
 Type = "java.lang.String"
 Description = "The attribute of an LDAP user object that specifies the
    distinguished names (DNs) of dynamic groups to which this user belongs.
    If such an attribute does not exist, WebLogic Server determines if a
    user is a member of a group by evaluating the URLs on the dynamic group.
    If a group contains other groups, WebLogic Server evaluates the URLs on
    any of the descendents of the group."
/>

<MBeanAttribute
 Name = "UserBaseDN"
 Type = "java.lang.String"
 Default = "&quot;ou=people, o=example.com&quot;"
 Description = "The base distinguished name (DN) of the tree in the LDAP directory
    that contains users."
/>

<MBeanAttribute
 Name = "UserSearchScope"
 Type = "java.lang.String"
```

```
Default = "&quot;subtree&quot;"
LegalValues = "subtree,onelevel"
Description = "Specifies how deep in the LDAP directory tree to search for Users.
  Valid values are &lt;code&gt;subtree&lt;/code&gt;
  and &lt;code&gt;onelevel&lt;/code&gt;."
/>

...
```

Best Practice: Delegate Database Initialization

If possible, initialization calls between a security provider and the security provider's database should be done by an intermediary class, referred to as a **database delegator**. The database delegator should interact with the runtime class and the MBean type for the security provider, as shown in Figure 2-10.

Figure 2-10   Positioning of the Database Delegator Class
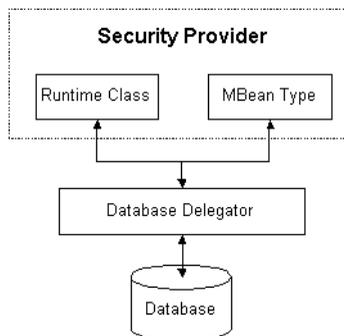
A database delegator is used by the WebLogic Authentication and Credential Mapping providers. The WebLogic Authentication provider, for example, calls into a database delegator to initialize the embedded LDAP server with default users and groups, which it requires to provide authentication services for the default security realm.

Use of a database delegator is suggested as a convenience to application developers and security vendors who are developing custom security providers, because it hides the security provider's database and centralizes calls into the database.

3 Authentication Providers

Authentication is the mechanism by which callers prove that they are acting on behalf of specific users or systems. Authentication answers the question, "Who are you?" using credentials such as username/password combinations.

In WebLogic Server, Authentication providers are used to prove the identity of users or system processes. Authentication providers also remember, transport, and make that identity information available to various components of a system (via subjects) when needed. During the authentication process, a Principal Validation provider provides additional security protections for the principals (users and groups) contained within the subject by signing and verifying the authenticity of those principals. (For more information, see Chapter 5, "Principal Validation Providers.")

The following sections describe Authentication provider concepts and functionality, and provide step-by-step instructions for developing a custom Authentication provider:

■ "Authentication Concepts" on page 3-2

■ "The Authentication Process" on page 3-11

■ "Do You Need to Develop a Custom Authentication Provider?" on page 3-12

■ "How to Develop a Custom Authentication Provider" on page 3-12

Note: An Identity Assertion provider is a specific form of Authentication provider that allows users or system processes to assert their identity using tokens. For more information, see Chapter 4, "Identity Assertion Providers."

Authentication Concepts

Before delving into the specifics of developing custom Authentication providers, it is important to understand the following concepts:

■ "Users and Groups, Principals and Subjects" on page 3-2

■ "LoginModules" on page 3-3

■ "Java Authentication and Authorization Service (JAAS)" on page 3-6

Users and Groups, Principals and Subjects

A **user** is similar to an operating system user in that it represents a person. A **group** is a category of users, classified by common traits such as job title. Categorizing users into groups makes it easier to control the access permissions for large numbers of users. For more information about users and groups, see "Users and Groups" in *Securing WebLogic Resources*.

Both users and groups can be used as principals by application servers like WebLogic Server. A **principal** is an identity assigned to a user or group as a result of authentication. The Java Authentication and Authorization Service (JAAS) requires that **subjects** be used as containers for authentication information, including principals. Each principal stored in the same subject represents a separate aspect of the same user's identity, much like cards in a person's wallet. (For example, an ATM card identifies someone to their bank, while a membership card identifies them to a professional organization to which they belong.) For more information about JAAS, see "Java Authentication and Authorization Service (JAAS)" on page 3-6.

Note: Subjects replace WebLogic Server 6.x users.

Figure 3-1 illustrates the relationships among users, groups, principals, and subjects.

Figure 3-1   Relationships Among Users, Groups, Principals and Subjects
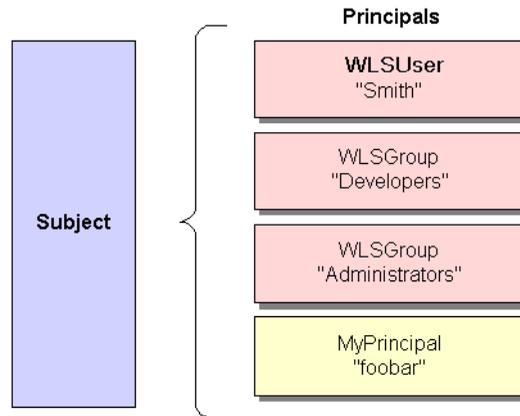
As part of a successful authentication, principals are signed and stored in a subject for future use. A Principal Validation provider signs principals, and an Authentication provider's LoginModule actually stores the principals in the subject. Later, when a caller attempts to access a principal stored within a subject, a Principal Validation provider verifies that the principal has not been altered since it was signed, and the principal is returned to the caller (assuming all other security conditions are met).

Note: For more information about Principal Validation providers and LoginModules, see Chapter 5, "Principal Validation Providers" and "LoginModules" on page 3-3, respectively.

Any principal that is going to represent a WebLogic Server user or group needs to implement the `WLSUser` and `WLSGroup` interfaces, which are available in the `weblogic.security.spi` package.

LoginModules

A LoginModule is a required component of an Authentication provider, and can be a component of an Identity Assertion provider if you want to develop a separate LoginModule for perimeter authentication.

LoginModules are the work-horses of authentication: all LoginModules are responsible for authenticating users within the security realm and for populating a subject with the necessary principals (users/groups). LoginModules that are *not* used for perimeter authentication also verify the proof material submitted (for example, a user's password).

Note: For more information about Identity Assertion providers and perimeter authentication, see Chapter 4, "Identity Assertion Providers."

If there are multiple Authentication providers configured in a security realm, each of the Authentication providers' LoginModules will store principals within the same subject. Therefore, if a principal that represents a WebLogic Server user (that is, an implementation of the `WLSUser` interface) named "Joe" is added to the subject by one Authentication provider's LoginModule, any other Authentication provider in the security realm should be referring to the same person when they encounter "Joe". In other words, the other Authentication providers' LoginModules should not attempt to add another principal to the subject that represents a WebLogic Server user (for example, named "Joseph") to refer to the same person. However, it is acceptable for a another Authentication provider's LoginModule to add a principal of a type other than `WLSUser` with the name "Joseph".

The LoginModule Interface

LoginModules can be written to handle a variety of authentication mechanisms, including username/password combinations, smart cards, biometric devices, and so on. You develop LoginModules by implementing the `javax.security.auth.spi.LoginModule` interface, which is based on the Java Authentication and Authorization Service (JAAS) and uses a subject as a container for authentication information. The `LoginModule` interface enables you to plug in different kinds of authentication technologies for use with a single application, and the WebLogic Security Framework is designed to support multiple `LoginModule` implementations for multipart authentication. You can also have dependencies across LoginModule instances or share credentials across those instances. However, the relationship between LoginModules and Authentication providers is one-to-one. In other words, to have a LoginModule that handles retina scan authentication and a LoginModule that interfaces to a hardware device like a smart card, you must develop and configure two Authentication providers, each of which include an implementation of the `LoginModule` interface. For more information, see "Implement the JAAS LoginModule Interface" on page 3-15.

Note: You can also obtain LoginModules from third-party security vendors instead of developing your own.

LoginModules and Multipart Authentication

The way you configure multiple Authentication providers (and thus, multiple LoginModules) can affect the overall outcome of the authentication process, which is especially important for multipart authentication. First, because LoginModules are components of Authentication providers, they are called in the order in which the Authentication providers are configured. Generally, you configure Authentication providers using the WebLogic Server Administration Console. (For more information, see "Configure the Custom Authentication Provider Using the Administration Console" on page 3-32.) Second, the way each LoginModule's control flag is set specifies how a failure during the authentication process should be handled. Figure 3-2 illustrates a sample flow involving three different LoginModules (that are part of three Authentication providers), and illustrates what happens to the subject for different authentication outcomes.

Figure 3-2   Sample LoginModule Flow

	User Authenticated?	Principal Created?	Control Flag Setting	Subject
WebLogic Authentication Provider — LoginModule	Yes	Yes, p1	Required	p1
Custom Authentication Provider #1 — LoginModule	No	No	Optional	N/A
Custom Authentication Provider #2 — LoginModule	Yes	Yes, p2	Required	p2

If the control flag for Custom Authentication Provider #1 had been set to Required, the authentication failure in its User Authentication step would have caused the entire authentication process to have failed. Also, if the user had not been authenticated by the WebLogic Authentication provider (or custom Authentication provider #2), the

entire authentication process would have failed. If the authentication process had failed in any of these ways, all three LoginModules would have been rolled back and the subject would not contain any principals.

Note: For more information about the LoginModule control flag setting and the LoginModule interface, see the *Java Authentication and Authorization Service (JAAS) 1.0 LoginModule Developer's Guide* and the *Java 2 Enterprise Edition, v1.3.1 API Specification Javadoc* for the LoginModule interface, respectively.

Java Authentication and Authorization Service (JAAS)

Whether the client is an application, applet, Enterprise JavaBean (EJB), or servlet that requires authentication, WebLogic Server uses the Java Authentication and Authorization Service (JAAS) classes to reliably and securely authenticate to the client. JAAS implements a Java version of the Pluggable Authentication Module (PAM) framework, which permits applications to remain independent from underlying authentication technologies. Therefore, the PAM framework allows the use of new or updated authentication technologies without requiring modifications to your application.

WebLogic Server uses JAAS for remote fat-client authentication, and internally for authentication. Therefore, only developers of custom Authentication providers and developers of remote fat client applications need to be involved with JAAS directly. Users of thin clients or developers of within-container fat client applications (for example, those calling an Enterprise JavaBean (EJB) from a servlet) do not require the direct use or knowledge of JAAS.

How JAAS Works With the WebLogic Security Framework

Generically, authentication using the JAAS classes and WebLogic Security Framework is performed in the following manner:

1. A client-side application obtains authentication information from a user or system process. The mechanism by which this occurs is different for each type of client.

2. The client-side application can optionally create a `CallbackHandler` containing the authentication information.

a. The client-side application passes the `CallbackHandler` to a local (client-side) LoginModule using the `LoginContext` class. (The local LoginModule could be `UsernamePasswordLoginModule`, which is provided as part of WebLogic Server.)

b. The local LoginModule passes the `CallbackHandler` containing the authentication information to the appropriate WebLogic Server container (for example, RMI, EJB, servlet, or IIOP).

Notes: A `CallbackHandler` is a highly-flexible JAAS standard that allows a variable number of arguments to be passed as complex objects to a method. There are three types of `CallbackHandler`s: `NameCallback`, `PasswordCallback`, and `TextInputCallback`, all of which reside in the `javax.security.auth.callback` package. The `NameCallback` and `PasswordCallback` return the username and password, respectively. `TextInputCallback` can be used to access the data users enter into any additional fields on a login form (that is, fields other than those for obtaining the username and password). When used, there should be one `TextInputCallback` per additional form field, and the prompt string of each `TextInputCallback` must match the field name in the form. WebLogic Server only uses the `TextInputCallback` for form-based Web application login. For more information about `CallbackHandler`s, see the *Java 2 Enterprise Edition, v1.4.0 API Specification Javadoc* for the CallbackHandler interface.

For more information about the `LoginContext` class, see the *Java 2 Enterprise Edition v1.3.1 Specification* Javadoc for the LoginContext class.

For more information about the `UsernamePasswordLoginModule`, see the *WebLogic Server 7.0 API Reference Javadoc* for the UsernamePasswordLoginModule class.

If you do not want to use a client-side LoginModule, you can specify the username and password in other ways: for example, as part of the initial JNDI lookup.

3. The WebLogic Server container calls into the WebLogic Security Framework. If there is a client-side `CallbackHandler` containing authentication information, this is passed into the WebLogic Security Framework.

4. For each of the configured Authentication providers, the WebLogic Security Framework creates a `CallbackHandler` using the authentication information that was passed in. (These are internal `CallbackHandler`s created on the server-side by the WebLogic Security Framework, and are not related to the client's `CallbackHandler`.)

5. The WebLogic Security Framework calls the LoginModule associated with the Authentication provider (that is, the LoginModule that is specifically designed to handle the authentication information).

   Note: For more information about LoginModules, see "LoginModules" on page 3-3.

   The LoginModule attempts to authenticate the client using the authentication information.

6. If the authentication is successful, the following occurs:

   a. Principals (users and groups) are signed by a Principal Validation provider to ensure their authenticity between programmatic server invocations. For more information about Principal Validation providers, see Chapter 5, "Principal Validation Providers."

   b. The LoginModule associates the signed principals with a subject, which represents the user or system process being authenticated. For more information about subjects and principals, see "Users and Groups, Principals and Subjects" on page 3-2.

Note: For authentication performed entirely on the server-side, the process would begin at step 3, and the WebLogic Server container would call the `weblogic.security.services.authentication.login` method prior to step 4. (The `weblogic.security.services.authentication.login` method is only available in WebLogic Server 7.0 SP01.)

Example: Standalone T3 Application

Figure 3-3 illustrates how the JAAS classes work with the WebLogic Security Framework for a standalone, T3 application, and an explanation follows.

Figure 3-3   Authentication Using JAAS Classes and WebLogic Server
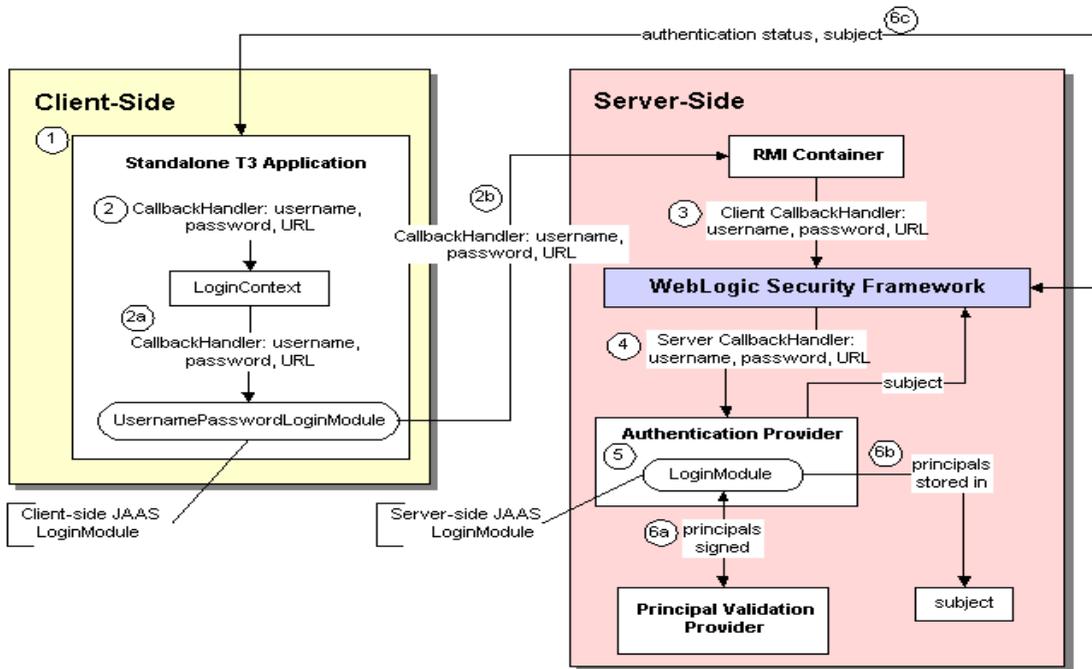
For this example, authentication using the JAAS classes and WebLogic Security Framework is performed in the following manner:

1. The T3 application obtains authentication information (username, password, and URL) from a user or system process.

2. The T3 application creates a `CallbackHandler` containing the authentication information.

   a. The T3 application passes the `CallbackHandler` to the `UsernamePasswordLoginModule` using the `LoginContext` class.

      Note: The
              `weblogic.security.auth.login.UsernamePasswordLoginModu`
              `le` implements the standard JAAS
              `javax.security.auth.spi.LoginModule` interface and uses
              client-side APIs to authenticate a WebLogic client to a WebLogic
              Server instance. It can be used for both T3 and IIOP clients. Callers of

this LoginModule must implement a `CallbackHandler` to pass the username (`NameCallback`), password (`PasswordCallback`), and a URL (`URLCallback`).

   b. The `UsernamePasswordLoginModule` passes the `CallbackHandler` containing the authentication information (that is, username, password, and URL) to the WebLogic Server RMI container.

3. The WebLogic Server RMI container calls into the WebLogic Security Framework. The client-side `CallbackHandler` containing authentication information is passed into the WebLogic Security Framework.

4. For each of the configured Authentication providers, the WebLogic Security Framework creates a `CallbackHandler` containing the username, password, and URL that was passed in. (These are internal `CallbackHandlers` created on the server-side by the WebLogic Security Framework, and are not related to the client's `CallbackHandler`.)

5. The WebLogic Security Framework calls the LoginModule associated with the Authentication provider (that is, the LoginModule that is specifically designed to handle the authentication information).

   The LoginModule attempts to authenticate the client using the authentication information.

6. If the authentication is successful, the following occurs:

   a. Principals (users and groups) are signed by a Principal Validation provider to ensure their authenticity between programmatic server invocations.

   b. The LoginModule associates the signed principals with a subject, which represents the user or system being authenticated.

   c. The WebLogic Security Framework returns the authentication status to the T3 client application, and the T3 client application retrieves the authenticated subject from the WebLogic Security Framework.

The Authentication Process

Figure 3-4 shows a behind-the-scenes look of the authentication process for a fat-client login. JAAS runs on the server to perform the login. Even in the case of a thin-client login (that is, a browser client) JAAS is still run on the server.

Figure 3-4   The Authentication Process
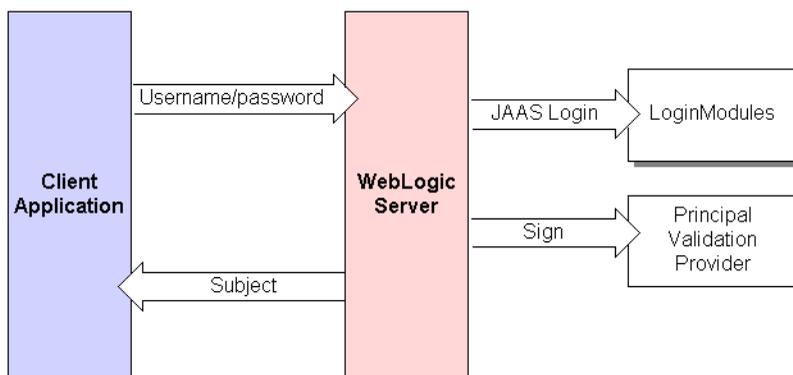
Notes: Only developers of custom Authentication providers will be involved with this JAAS process directly. The client application could either use JNDI initial context creation or JAAS to initiate the passing of the username and password.

When a user attempts to log into a system using a username/password combination, WebLogic Server establishes trust by validating that user's username and password, and returns a subject that is populated with principals per JAAS requirements. As Figure 3-4 also shows, this process requires the use of a LoginModule and a Principal Validation provider, which are discussed in detail in "LoginModules" on page 3-3 and Chapter 5, "Principal Validation Providers," respectively.

After successfully proving a caller's identity, an authentication context is established, which allows an identified user or system to be authenticated to other entities. Authentication contexts may also be delegated to an application component, allowing that component to call another application component while impersonating the original caller.

Do You Need to Develop a Custom Authentication Provider?

The default (that is, active) security realm for WebLogic Server includes a WebLogic Authentication provider.

Note: In conjunction with the WebLogic Authorization provider, the WebLogic Authentication provider replaces the functionality of the File realm that was available in 6.x releases of WebLogic Server.

The WebLogic Authentication provider supports delegated username/password authentication, and utilizes an embedded LDAP server to store user and group information. The WebLogic Authentication provider allows you to edit, list, and manage users and group membership. If you want to perform additional authentication tasks, then you need to develop a custom Authentication provider.

Note: If you want to perform perimeter authentication using X509 certificates or CORBA Common Secure Interoperability version 2 (CSIv2), you might need to develop a custom Identity Assertion provider. For more information, see Chapter 4, "Identity Assertion Providers."

How to Develop a Custom Authentication Provider

If the WebLogic Authentication provider does not meet your needs, you can develop a custom Authentication provider by following these steps:

1. "Create Runtime Classes Using the Appropriate SSPIs" on page 3-13

2. "Generate an MBean Type Using the WebLogic MBeanMaker" on page 3-25

3. "Configure the Custom Authentication Provider Using the Administration Console" on page 3-32

Create Runtime Classes Using the Appropriate SSPIs

Before you start creating runtime classes, you should first:

■ "Understand the Purpose of the "Provider" SSPIs" on page 2-3

■ "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes" on page 2-7

When you understand this information and have made your design decisions, create the runtime classes for your custom Authentication provider by following these steps:

■ "Implement the AuthenticationProvider SSPI" on page 3-13

■ "Implement the JAAS LoginModule Interface" on page 3-15

For an example of how to create a runtime class for a custom Authentication provider, see "Example: Creating the Runtime Classes for the Sample Authentication Provider" on page 3-18.

Implement the AuthenticationProvider SSPI

To implement the `AuthenticationProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3 *and* the following methods:

getLoginModuleConfiguration

```
public AppConfigurationEntry getLoginModuleConfiguration()
```

The `getLoginModuleConfiguration` method obtains information about the Authentication provider's associated LoginModule, which is returned as an `AppConfigurationEntry`. The `AppConfigurationEntry` is a Java Authentication and Authorization Service (JAAS) class that contains the classname of the LoginModule; the LoginModule's control flag (which was passed in via the Authentication provider's associated MBean); and a configuration options map for the LoginModule (which allows other configuration information to be passed into the LoginModule).

For more information about the `AppConfigurationEntry` class (located in the `javax.security.auth.login` package) and the control flag options for LoginModules, see the *Java 2 Enterprise Edition, v1.3.1 API Specification Javadoc* for the AppConfigurationEntry class and the Configuration class. For

more information about LoginModules, see "LoginModules" on page 3-3. For more information about security providers and MBeans, see "Understand Why You Need an MBean Type" on page 2-11.

getAssertionModuleConfiguration

```
public AppConfigurationEntry
getAssertionModuleConfiguration()
```

The `getAssertionModuleConfiguration` method obtains information about an Identity Assertion provider's associated LoginModule, which is returned as an `AppConfigurationEntry`. The `AppConfigurationEntry` is a JAAS class that contains the classname of the LoginModule; the LoginModule's control flag (which was passed in via the Identity Assertion provider's associated MBean); and a configuration options map for the LoginModule (which allows other configuration information to be passed into the LoginModule).

Note: The implementation of the `getAssertionModuleConfiguration` method can be to return `null`, if you want the Identity Assertion provider to use the same LoginModule as the Authentication provider.

getPrincipalValidator

```
public PrincipalValidator getPrincipalValidator()
```

The `getPrincipalValidator` method obtains a reference to the Principal Validation provider's runtime class (that is, the `PrincipalValidator` SSPI implementation). In most cases, the WebLogic Principal Validation provider can be used (see Listing 3-1 for an example of how to return the WebLogic Principal Validation provider). For more information about Principal Validation providers, see Chapter 5, "Principal Validation Providers."

getIdentityAsserter

```
public IdentityAsserter getIdentityAsserter()
```

The `getIdentityAsserter` method obtains a reference to the Identity Assertion provider's runtime class (that is, the `IdentityAsserter` SSPI implementation). In most cases, the return value for this method will be `null` (see Listing 3-1 for an example). For more information about Identity Assertion providers, see Chapter 4, "Identity Assertion Providers."

For more information about the `AuthenticationProvider` SSPI and the methods described above, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the JAAS LoginModule Interface

To implement the JAAS `javax.security.auth.spi.LoginModule` interface, provide implementations for the following methods:

initialize

```
public void initialize (Subject subject, CallbackHandler
callbackHandler, Map sharedState, Map options)
```

The `initialize` method initializes the LoginModule. It takes as arguments a subject in which to store the resulting principals, a `CallbackHandler` that the Authentication provider will use to call back to the container for authentication information, a map of any shared state information, and a map of configuration options (that is, any additional information you want to pass to the LoginModule).

A `CallbackHandler` is a highly-flexible JAAS standard that allows a variable number of arguments to be passed as complex objects to a method. For more information about `CallbackHandler`s, see the *Java 2 Enterprise Edition, v1.3.1 API Specification Javadoc* for the CallbackHandler interface.

login

```
public boolean login() throws LoginException
```

The `login` method attempts to authenticate the user and create principals for the user by calling back to the container for authentication information. If multiple LoginModules are configured (as part of multiple Authentication providers), this method is called for each LoginModule in the order that they are configured. Information about whether the login was successful (that is, whether principals were created) is stored for each LoginModule.

commit

```
public boolean commit() throws LoginException
```

The `commit` method attempts to add the principals created in the `login` method to the subject. This method is also called for each configured LoginModule (as part of the configured Authentication providers), and executed in order. Information about whether the commit was successful is stored for each LoginModule.

abort

```
public boolean abort() throws LoginException
```

The abort method is called for each configured LoginModule (as part of the configured Authentication providers) if any commits for the LoginModules failed (in other words, the relevant REQUIRED, REQUISITE, SUFFICIENT and OPTIONAL LoginModules did not succeed). The abort method will remove that LoginModule's principals from the subject, effectively rolling back the actions performed. For more information about the available control flag settings, see the *Java 2 Enterprise Edition, v1.3.1 API Specification Javadoc* for the LoginModule interface.

logout

```
public boolean logout() throws LoginException
```

The logout method attempts to log the user out of the system. It also resets the subject so that its associated principals are no longer stored.

Note: The LoginModule.logout method is never called for the WebLogic Authentication providers or custom Authentication providers. This is simply because once the principals are created and placed into a subject, the WebLogic Security Framework no longer controls the lifecycle of the subject. Therefore, the developer-written, user code that creates the JAAS LoginContext to login and obtain the subject should also call the LoginContext.logout method. When the user code runs in a Java client that uses JAAS directly, that code has the option of calling the LoginContext.logout method, which clears the subject. When the user code runs in a servlet, the servlet has the ability to logout a user from a servlet session, which clears the subject.

For more information about the JAAS LoginModule interface and the methods described above, see the *Java Authentication and Authorization Service (JAAS) 1.0 Developer's Guide*, and the *Java 2 Enterprise Edition, v1.3.1 API Specification Javadoc* for the LoginModule interface.

Throwing Custom Exceptions from LoginModules

You may want to throw a custom exception from a LoginModule you write. The custom exception can then be caught by your application and appropriate action taken. For example, if a PasswordChangeRequiredException is thrown from your LoginModule, you can catch that exception within your application, and use it to forward users to a page that allows them to change their password.

When you throw a custom exception from a LoginModule and want to catch it within your application, you must ensure that:

1. The application catching the exception is running on the server. (Fat clients cannot catch custom exceptions.)

2. Your servlet has access to the custom exception class at both compile time and deploy time. You can do this using either of the following methods, depending on your preference:

   - "Method 1: Make Custom Exceptions Available via the System and Compiler Classpath" on page 3-17

   - "Method 2: Make Custom Exceptions Available via the Application Classpath" on page 3-17

Method 1: Make Custom Exceptions Available via the System and Compiler Classpath

1. Write an exception class that extends `LoginException`.

2. Use the custom exception class in your classes that implement the `LoginModule` and `AuthenticationProvider` interfaces.

3. Put the custom exception class in both the system and compiler classpath when compiling the security provider's runtime class.

4. "Generate an MBean Type Using the WebLogic MBeanMaker."

Method 2: Make Custom Exceptions Available via the Application Classpath

1. Write an exception class that extends `LoginException`.

2. Use the custom exception class in your classes that implement the `LoginModule` and `AuthenticationProvider` interfaces.

3. Put the custom exception's source in the classpath of the application's build, and include it in the classpath of the application's JAR/WAR file.

4. "Generate an MBean Type Using the WebLogic MBeanMaker."

5. Add the custom exception class to the MJF (MBean JAR File) generated by the WebLogic MBeanMaker.

6. Include the MJF when compiling your application.

Example: Creating the Runtime Classes for the Sample Authentication Provider

Listing 3-1 shows the `SampleAuthenticationProviderImpl.java` class, which is one of two runtime classes for the sample Authentication provider. This runtime class includes implementations for:

- The three methods inherited from the `SecurityProvider` interface: `initialize`, `getDescription` and `shutdown` (as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.)

- The four methods in the `AuthenticationProvider` SSPI: the `getLoginModuleConfiguration`, `getAssertionModuleConfiguration`, `getPrincipalValidator`, and `getIdentityAsserter` methods (as described in "Implement the AuthenticationProvider SSPI" on page 3-13).

Note: The bold face code in Listing 3-1 highlights the class declaration and the method signatures.

Listing 3-1   SampleAuthenticationProviderImpl.java

```
package examples.security.providers.authentication;

import java.util.HashMap;
import javax.security.auth.login.AppConfigurationEntry;
import javax.security.auth.login.AppConfigurationEntry.LoginModuleControlFlag;
import weblogic.management.security.ProviderMBean;
import weblogic.security.provider.PrincipalValidatorImpl;
import weblogic.security.spi.AuthenticationProvider;
import weblogic.security.spi.IdentityAsserter;
import weblogic.security.spi.PrincipalValidator;
import weblogic.security.spi.SecurityServices;

public final class SampleAuthenticationProviderImpl implements
AuthenticationProvider
{
   private String description;
   private SampleAuthenticatorDatabase database;
   private LoginModuleControlFlag controlFlag;

   public void initialize(ProviderMBean mbean, SecurityServices services)
   {
      System.out.println("SampleAuthenticationProviderImpl.initialize");
      SampleAuthenticatorMBean myMBean = (SampleAuthenticatorMBean)mbean;
      description = myMBean.getDescription() + "\n" + myMBean.getVersion();
      database = new SampleAuthenticatorDatabase(myMBean);
```

```
   String flag = myMBean.getControlFlag();
   if (flag.equalsIgnoreCase("REQUIRED")) {
     controlFlag = LoginModuleControlFlag.REQUIRED;
   } else if (flag.equalsIgnoreCase("OPTIONAL")) {
     controlFlag = LoginModuleControlFlag.OPTIONAL;
   } else if (flag.equalsIgnoreCase("REQUISITE")) {
     controlFlag = LoginModuleControlFlag.REQUISITE;
   } else if (flag.equalsIgnoreCase("SUFFICIENT")) {
     controlFlag = LoginModuleControlFlag.SUFFICIENT;
   } else {
     throw new IllegalArgumentException("invalid flag value" + flag);
   }
}

public String getDescription()
{
   return description;
}

public void shutdown()
{
   System.out.println("SampleAuthenticationProviderImpl.shutdown");
}

private AppConfigurationEntry getConfiguration(HashMap options)
{
   options.put("database", database);
   return new
     AppConfigurationEntry(
       "examples.security.providers.authentication.SampleLoginModuleImpl",
       controlFlag,
       options
     );
}

public AppConfigurationEntry getLoginModuleConfiguration()
{
   HashMap options = new HashMap();
   return getConfiguration(options);
}

public AppConfigurationEntry getAssertionModuleConfiguration()
{
   HashMap options = new HashMap();
   options.put("IdentityAssertion","true");
   return getConfiguration(options);
}

public PrincipalValidator getPrincipalValidator()
{
```

```
      return new PrincipalValidatorImpl();
   }

   public IdentityAsserter getIdentityAsserter()
   {
      return null;
   }

}
```

Listing 3-2 shows the `SampleLoginModuleImpl.java` class, which is one of two runtime classes for the sample Authentication provider. This runtime class implements the JAAS LoginModule interface (as described in "Implement the JAAS LoginModule Interface" on page 3-15), and therefore includes implementations for its `initialize`, `login`, `commit`, `abort`, and `logout` methods.

Note: The bold face code in Listing 3-2 highlights the class declaration and the method signatures.

Listing 3-2   SampleLoginModuleImpl.java

```
package examples.security.providers.authentication;

import java.io.IOException;
import java.util.Enumeration;
import java.util.Map;
import java.util.Vector;
import javax.security.auth.Subject;
import javax.security.auth.callback.Callback;
import javax.security.auth.callback.CallbackHandler;
import javax.security.auth.callback.NameCallback;
import javax.security.auth.callback.PasswordCallback;
import javax.security.auth.callback.UnsupportedCallbackException;
import javax.security.auth.login.LoginException;
import javax.security.auth.login.FailedLoginException;
import javax.security.auth.spi.LoginModule;
import weblogic.management.utils.NotFoundException;
import weblogic.security.spi.WLSGroup;
import weblogic.security.spi.WLSUser;
import weblogic.security.principal.WLSGroupImpl;
import weblogic.security.principal.WLSUserImpl;

final public class SampleLoginModuleImpl implements LoginModule
{
```

```
private Subject subject;
private CallbackHandler callbackHandler;
private SampleAuthenticatorDatabase database;

// Determine whether this is a login or assert identity
private boolean isIdentityAssertion;

// Authentication status
private boolean loginSucceeded;
private boolean principalsInSubject;
private Vector principalsForSubject = new Vector();
```

public void initialize(Subject subject, CallbackHandler callbackHandler, Map sharedState, Map options)

```
{
   // only called (once!) after the constructor and before login

   System.out.println("SampleLoginModuleImpl.initialize");
   this.subject = subject;
   this.callbackHandler = callbackHandler;

   // Check for Identity Assertion option
   isIdentityAssertion =
      "true".equalsIgnoreCase((String)options.get("IdentityAssertion"));

   database = (SampleAuthenticatorDatabase)options.get("database");
}
```

public boolean login() throws LoginException

```
{
   // only called (once!) after initialize

   System.out.println("SampleLoginModuleImpl.login");

   // loginSucceeded        should be false
   // principalsInSubject   should be false
   // user                  should be null
   // group                 should be null

   Callback[] callbacks = getCallbacks();

   String userName = getUserName(callbacks);

   if (userName.length() > 0) {
      if (!database.userExists(userName)) {
         throwFailedLoginException("Authentication Failed: User " + userName
         + " doesn't exist.");
      }
    if (!isIdentityAssertion) {
      String passwordWant = null;
      try {
```

```
            passwordWant = database.getUserPassword(userName);
        } catch (NotFoundException shouldNotHappen) {}
            String passwordHave = getPasswordHave(userName, callbacks);
            if (passwordWant == null || !passwordWant.equals(passwordHave)) {
               throwFailedLoginException(
                 "Authentication Failed: User " + userName + " bad password. " +
                 "Have " + passwordHave + ".  Want " + passwordWant + "."
               );
            }
        }
        } else {
         // anonymous login - let it through?
        System.out.println("\tempty userName");
        }

        loginSucceeded = true;
        principalsForSubject.add(new WLSUserImpl(userName));
        addGroupsForSubject(userName);

        return loginSucceeded;
   }

   public boolean commit() throws LoginException
   {
      // only called (once!) after login

      // loginSucceeded      should be true or false
      // principalsInSubject should be false
      // user       should be null if !loginSucceeded, null or not-null otherwise
      // group      should be null if user == null, null or not-null otherwise

      System.out.println("SampleLoginModule.commit");
      if (loginSucceeded) {
         subject.getPrincipals().addAll(principalsForSubject);
         principalsInSubject = true;
         return true;
      } else {
         return false;
      }
   }

   public boolean abort() throws LoginException
   {
      // The abort method is called to abort the authentication process. This is
      // phase 2 of authentication when phase 1 fails. It is called if the
      // LoginContext's overall authentication failed.

      // loginSucceeded      should be true or false
      // user       should be null if !loginSucceeded, otherwise null or not-null
      // group      should be null if user == null, otherwise null or not-null
```

```
   // principalsInSubject        should be false if user is null, otherwise true
   //                            or false

   System.out.println("SampleLoginModule.abort");
   if (principalsInSubject) {
      subject.getPrincipals().removeAll(principalsForSubject);
      principalsInSubject = false;
   }

   return true;
}

public boolean logout() throws LoginException
{
   // should never be called
   System.out.println("SampleLoginModule.logout");
   return true;
}

private void throwLoginException(String msg) throws LoginException
{
   System.out.println("Throwing LoginException(" + msg + ")");
   throw new LoginException(msg);
}

private void throwFailedLoginException(String msg) throws FailedLoginException
{
   System.out.println("Throwing FailedLoginException(" + msg + ")");
   throw new FailedLoginException(msg);
}

private Callback[] getCallbacks() throws LoginException
{
   if (callbackHandler == null) {
      throwLoginException("No CallbackHandler Specified");
   }

   if (database == null) {
      throwLoginException("database not specified");
   }

   Callback[] callbacks;
   if (isIdentityAssertion) {
      callbacks = new Callback[1];
   } else {
      callbacks = new Callback[2];
      callbacks[1] = new PasswordCallback("password: ",false);
   }
   callbacks[0] = new NameCallback("username: ");
```

```
      try {
          callbackHandler.handle(callbacks);
      } catch (IOException e) {
        throw new LoginException(e.toString());
      } catch (UnsupportedCallbackException e) {
        throwLoginException(e.toString() + " " + e.getCallback().toString());
      }

      return callbacks;
   }

   private String getUserName(Callback[] callbacks) throws LoginException
   {
      String userName = ((NameCallback)callbacks[0]).getName();
      if (userName == null) {
         throwLoginException("Username not supplied.");
      }
      System.out.println("\tuserName\t= " + userName);
      return userName;
   }

   private void addGroupsForSubject(String userName)
   {
      for (Enumeration e = database.getUserGroups(userName);
         e.hasMoreElements();) {
            String groupName = (String)e.nextElement();
            System.out.println("\tgroupName\t= " + groupName);
            principalsForSubject.add(new WLSGroupImpl(groupName));
      }
   }

   private String getPasswordHave(String userName, Callback[] callbacks) throws
   LoginException
   {
      PasswordCallback passwordCallback = (PasswordCallback)callbacks[1];
      char[] password = passwordCallback.getPassword();
      passwordCallback.clearPassword();
      if (password == null || password.length < 1) {
         throwLoginException("Authentication Failed: User " + userName + ".
            Password not supplied");
      }
      String passwd = new String(password);
      System.out.println("\tpasswordHave\t= " + passwd);
      return passwd;
   }

}
```

Generate an MBean Type Using the WebLogic MBeanMaker

Before you start generating an MBean type for your custom security provider, you should first:

- "Understand Why You Need an MBean Type" on page 2-11

- "Determine Which SSPI MBeans to Extend and Implement" on page 2-12

- "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12

- "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15

- "Understand What the WebLogic MBeanMaker Provides" on page 2-17

When you understand this information and have made your design decisions, create the MBean type for your custom Authentication provider by following these steps:

1. "Create an MBean Definition File (MDF)" on page 3-25

2. "Use the WebLogic MBeanMaker to Generate the MBean Type" on page 3-26

3. "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 3-30

4. "Install the MBean Type Into the WebLogic Server Environment" on page 3-31

Notes: Several sample security providers (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) illustrate how to perform these steps.

All instructions provided in this section assume that you are working in a Windows environment.

Create an MBean Definition File (MDF)

To create an MBean Definition File (MDF), follow these steps:

1. Copy the MDF for the sample Authentication provider to a text file.

> **Note:** The MDF for the sample Authentication provider is called
> `SampleAuthenticator.xml`.

2. Modify the content of the `<MBeanType>` and `<MBeanAttribute>` elements in
   your MDF so that they are appropriate for your custom Authentication provider.

3. Add any custom attributes and operations (that is, additional `<MBeanAttribute>`
   and `<MBeanOperation>` elements) to your MDF.

4. Save the file.

Note: A complete reference of MDF element syntax is available in Appendix A,
"MBean Definition File (MDF) Element Syntax."

Use the WebLogic MBeanMaker to Generate the MBean Type

Once you create your MDF, you are ready to run it through the WebLogic
MBeanMaker. The WebLogic MBeanMaker is currently a command-line utility that
takes as its input an MDF, and outputs some intermediate Java files, including an
MBean interface, an MBean implementation, and an associated MBean information
file. Together, these intermediate files form the **MBean type** for your custom security
provider.

The instructions for generating an MBean type differ based on the design of your
custom Authentication provider. Follow the instructions that are appropriate to your
situation:

- "No Optional SSPI MBeans and No Custom Operations" on page 3-26

- "Optional SSPI MBeans or Custom Operations" on page 3-27

No Optional SSPI MBeans and No Custom Operations

If the MDF for your custom Authentication provider does not implement any optional
SSPI MBeans *and* does not include any custom operations, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Authentication providers).

3. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 3-30.

Optional SSPI MBeans or Custom Operations

If the MDF for your custom Authentication provider does implement some optional SSPI MBeans *or* does include custom operations, consider the following:

■ Are you creating an MBean type for the first time? If so, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Authentication providers).

3. If you implemented optional SSPI MBeans in your MDF, follow these steps:

   a. Locate the MBean implementation file.

      The MBean implementation file generated by the WebLogic MBeanMaker is named *MBeanName*Impl.java. For example, for the MDF named SampleAuthenticator, the MBean implementation file to be edited is named SampleAuthenticatorImpl.java.

   b. For each optional SSPI MBean that you implemented in your MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

4. If you included any custom attributes/operations in your MDF, implement the methods using the method stubs.

5. Save the file.

6. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 3-30.

- Are you updating an existing MBean type? If so, follow these steps:

1. Copy your existing MBean implementation file to a temporary directory so that your current method implementations are not overwritten by the WebLogic MBeanMaker.

2. Create a new DOS shell.

3. Type the following command:

   ```
   java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir`, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Authentication providers).

4. If you implemented optional SSPI MBeans in your MDF, follow these steps:

a. Locate and open the MBean implementation file.

The MBean implementation file generated by the WebLogic MBeanMaker is named `<MBeanName>Impl.java`. For example, for the MDF named `SampleAuthenticator`, the MBean implementation file to be edited is named `SampleAuthenticatorImpl.java`.

b. Open your existing MBean implementation file (which you saved to a temporary directory in step 1).

c. Synchronize the existing MBean implementation file with the MBean implementation file generated by the WebLogic MBeanMaker.

Accomplishing this task may include, but is not limited to: copying the method implementations from your existing MBean implementation file into the newly-generated MBean implementation file (or, alternatively, adding the new methods from the newly-generated MBean implementation file to your existing MBean implementation file), and verifying that any changes to method signatures are reflected in the version of the MBean implementation file that you are going to use (for methods that exist in both MBean implementation files).

d. If you modified the MDF to implement optional SSPI MBeans that were not in the original MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

5. If you modified the MDF to include any custom operations that were not in the original MDF, implement the methods using the method stubs.

6. Save the version of the MBean implementation file that is complete (that is, has all methods implemented).

7. Copy this MBean implementation file into the directory where the WebLogic MBeanMaker placed the intermediate files for the MBean type. You specified this as *filesdir* in step 3. (You will be overriding the MBean implementation file generated by the WebLogic MBeanMaker as a result of step 3.)

8. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 3-30.

About the Generated MBean Interface File

The **MBean interface file** is the client-side API to the MBean that your runtime class or your MBean implementation will use to obtain configuration data. It is typically used in the initialize method as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

Because the WebLogic MBeanMaker generates MBean types from the MDF you created, the generated MBean interface file will have the name of the MDF, plus the text "MBean" appended to it. For example, the result of running the SampleAuthenticator MDF through the WebLogic MBeanMaker will yield an MBean interface file called SampleAuthenticatorMBean.java.

Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)

Once your have run your MDF through the WebLogic MBeanMaker to generate your intermediate files, and you have edited the MBean implementation file to supply implementations for the appropriate methods within it, you need to package the MBean files *and the runtime classes* for the custom Authentication provider into an MBean JAR File (MJF). The WebLogic MBeanMaker also automates this process.

To create an MJF for your custom Authentication provider, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMJF=jarfile -Dfiles=filesdir
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMJF flag indicates that the WebLogic MBeanMaker should build a JAR file containing the new MBean types, *jarfile* is the name for the MJF and

filesdir is the location where the WebLogic MBeanMaker looks for the files to JAR into the MJF.

Compilation occurs at this point, so errors are possible. If *jarfile* is provided, and no errors occur, an MJF is created with the specified name.

Notes: If you want to update an existing MJF, simply delete the MJF and regenerate it. The WebLogic MBeanMaker also has a -DIncludeSource option, which controls whether source files are included into the resulting MJF. Source files include both the generated source and the MDF itself. The default is false. This option is ignored when -DMJF is not used.

The resulting MJF can be installed into your WebLogic Server environment, or distributed to your customers for installation into their WebLogic Server environments.

Install the MBean Type Into the WebLogic Server Environment

To install an MBean type into the WebLogic Server environment, copy the MJF into the *WL_HOME*\server\lib\mbeantypes directory, where *WL_HOME* is the top-level installation directory for WebLogic Server. This "deploys" your custom Authentication provider—that is, it makes the custom Authentication provider manageable from the WebLogic Server Administration Console.

Notes: *WL_HOME*\server\lib\mbeantypes is the default directory for installing MBean types. However, if you want WebLogic Server to look for MBean types in *additional* directories, use the -Dweblogic.alternateTypesDirectory=*<dir>* command-line flag when starting your server, where *<dir>* is a comma-separated list of directory names. When you use this flag, WebLogic Server will always load MBean types from *WL_HOME*\server\lib\mbeantypes first, then will look in the additional directories and load all valid archives present in those directories (regardless of their extension). For example, if -Dweblogic.alternateTypesDirectory = dirX,dirY, WebLogic Server will first load MBean types from *WL_HOME*\server\lib\mbeantypes, then any valid archives present in dirX and dirY.

If you instruct WebLogic Server to look in additional directories for MBean types and are using the Java Security Manager, you must also update the weblogic.policy file to grant appropriate permissions for the MBean type

(and thus, the custom security provider). For more information, see "Using the Java Security Manager to Protect WebLogic Resources" in *Programming WebLogic Security*.

It is advisable to keep non-security provider JARs, including backup files, out of the *WL_HOME*\server\lib\mbeantypes directory.

You can create instances of the MBean type by configuring your custom Authentication provider (see "Configure the Custom Authentication Provider Using the Administration Console" on page 3-32), and then use those MBean instances from a GUI, from other Java code, or from APIs. For example, you can use the WebLogic Server Administration Console to get and set attributes and invoke operations, or you can develop other Java objects that instantiate MBeans and automatically respond to information that the MBeans supply. We recommend that you back up these MBean instances. For more information, see "Backing Up Security Configuration Data" under "Recovering Failed Servers" in *Creating and Configuring WebLogic Server Domains*.

Configure the Custom Authentication Provider Using the Administration Console

Configuring a custom Authentication provider means that you are adding the custom Authentication provider to your security realm, where it can be accessed by applications requiring authentication services.

Configuring custom security providers is an administrative task, but it is a task that may also be performed by developers of custom security providers. This section contains information that is important for the person configuring your custom Authentication providers:

- "Managing User Lockouts" on page 3-32

Note: The steps for configuring a custom Authentication provider using the WebLogic Server Administration Console are described in "Configuring a Custom Security Provider" in *Managing WebLogic Security*.

Managing User Lockouts

As part of using a custom Authentication provider, you need to consider how you will configure and manage user lockouts. You have two choices for doing this:

- "Rely on the Realm-Wide User Lockout Manager" on page 3-33

- "Implement Your Own User Lockout Manager" on page 3-33

Rely on the Realm-Wide User Lockout Manager

The WebLogic Security Framework provides a realm-wide User Lockout Manager that works directly with the WebLogic Security Framework to manage user lockouts.

Note: Both the realm-wide User Lockout Manager *and* a WebLogic Server 6.1 PasswordPolicyMBean (at the Realm Adapter level) may be active. For more information, see the *WebLogic Server 6.1API Reference Javadoc* for the PasswordPolicyMBean interface.

If you decide to rely on the realm-wide User Lockout Manager, then all you must do to make it work with your custom Authentication provider is use the WebLogic Server Administration Console to:

1. Ensure that User Lockout is enabled. (It should be enabled by default.)

2. Modify any parameters for User Lockout (as necessary).

Notes: Changes to the User Lockout Manager do not take effect until you reboot the server. Instructions for using the Administration Console to perform these tasks are described in "Protecting User Accounts" in *Managing WebLogic Security*.

Implement Your Own User Lockout Manager

If you decide to implement your own User Lockout Manager as part of your custom Authentication provider, then you must:

1. Disable the realm-wide User Lockout Manager to prevent double lockouts from occurring. (When you create a new security realm using the WebLogic Server Administration Console, a User Lockout Manager is always created.) Instructions for performing this task are provided in "Protecting User Accounts" in *Managing WebLogic Security*.

2. Because you cannot borrow anything from the WebLogic Security Framework's realm-wide implementation, you must also perform the following tasks:

a. Provide the implementation for your User Lockout Manager. Note that there is no security service provider interface (SSPI) provided for User Lockout Managers.

b. Create an MBean by which the User Lockout Manager can be managed.

c. Create a new JavaServer Page (JSP) for configuring the User Lockout Manager, and incorporate it into the Administration Console using console extensions. For more information, see *Extending the Administration Console* and Chapter 12, "Writing Console Extensions for Custom Security Providers."

4 Identity Assertion Providers

An Identity Assertion provider is a specific form of Authentication provider that allows users or system processes to assert their identity using tokens (in other words, perimeter authentication). You can use an Identity Assertion provider in place of an Authentication provider if you create a LoginModule for the Identity Assertion provider, or in addition to an Authentication provider if you want to use the Authentication provider's LoginModule. Identity Assertion providers enable perimeter authentication and support single sign-on.

The following sections describe Identity Assertion provider concepts and functionality, and provide step-by-step instructions for developing a custom Identity Assertion provider:

- "Identity Assertion Concepts" on page 4-1

- "The Identity Assertion Process" on page 4-7

- "Do You Need to Develop a Custom Identity Assertion Provider?" on page 4-8

- "How to Develop a Custom Identity Assertion Provider" on page 4-10

Identity Assertion Concepts

Before you develop an Identity Assertion provider, you need to understand the following concepts:

- "Identity Assertion Providers and LoginModules" on page 4-2

Identity Assertion Providers and LoginModules

When used with a LoginModule, Identity Assertion providers support single sign-on. For example, an Identity Assertion provider can generate a token from a digital certificate, and that token can be passed around the system so that users are not asked to sign on more than once.

The LoginModule that an Identity Assertion provider uses can be:

- Part of a custom Authentication provider you develop. For more information, see Chapter 3, "Authentication Providers."

- Part of the WebLogic Authentication provider BEA developed and packaged with WebLogic Server. For more information, see "Do You Need to Develop a Custom Authentication Provider?" on page 3-12.

- Part of a third-party security vendor's Authentication provider.

Unlike in a simple authentication situation (described in "The Authentication Process" on page 3-11), the LoginModules that Identity Assertion providers use *do not* verify proof material such as usernames and passwords; they simply verify that the user exists.

Note: For more information about LoginModules, see "LoginModules" on page 3-3.

Identity Assertion and Tokens

You develop Identity Assertion providers to support the specific types of tokens that you will be using to assert the identities of users or system processes. You can develop an Identity Assertion provider to support multiple token types, but you or an administrator configure the Identity Assertion provider so that it validates only one

"active" token type. While you can have multiple Identity Assertion providers in a security realm with *the ability* to validate the same token type, only one Identity Assertion provider can actually perform this validation.

Note: "Supporting" token types means that the Identity Assertion provider's runtime class (that is, the `IdentityAsserter` SSPI implementation) can validate the token type its `assertIdentity` method. For more information, see "Implement the IdentityAsserter SSPI" on page 4-12.

The following sections will help you work with new token types:

- "How to Create New Token Types" on page 4-3

- "How to Make New Token Types Available for Identity Assertion Provider Configurations" on page 4-4

How to Create New Token Types

If you develop a custom Identity Assertion provider, you can also create new token types. A **token type** is simply a piece of data represented as a string. The token types you create and use are completely up to you. As examples, the following token types are currently defined for the WebLogic Identity Assertion provider: `X.509`, `CSI.PrincipalName`, `CSI.ITTAnonymous`, `CSI.X509CertChain`, and `CSI.DistinguishedName`.

To create new token types, you create a new Java file and declare any new token types as variables of type `String.`, as shown in Listing 4-1. The `PerimeterIdentityAsserterTokenTypes.java` file defines the names of the token types `Test 1`, `Test 2`, and `Test 3` as strings.

Listing 4-1   PerimeterIdentityAsserterTokenTypes.java

```
package sample.security.providers.authentication.perimeterATN;

public class PerimeterIdentityAsserterTokenTypes
{

   public final static String TEST1_TYPE = "Test 1";
   public final static String TEST2_TYPE = "Test 2";
   public final static String TEST3_TYPE = "Test 3";
}
```

Note: If you are defining only one new token type, you can also do it right in the Identity Assertion provider's runtime class, as shown in Listing 4-4, "SampleIdentityAsserterProviderImpl.java," on page 4-14.

How to Make New Token Types Available for Identity Assertion Provider Configurations

When you or an administrator configure a custom Identity Assertion provider (see "Configure the Custom Identity Assertion Provider Using the Administration Console" on page 4-24), the Supported Types field displays a list of the token types that the Identity Assertion provider supports. You enter one of the supported types in the Active Types field, as shown in Figure 4-1.

Figure 4-1   Configuring the Sample Identity Assertion Provider

The content for the Supported Types field is obtained from the SupportedTypes attribute of the MBean Definition File (MDF), which you use to generate your custom Identity Assertion provider's MBean type. An example from the sample Identity Assertion provider is shown in Listing 4-2. (For more information about MDFs and MBean types, see "Generate an MBean Type Using the WebLogic MBeanMaker" on page 4-17.)

Listing 4-2   SampleIdentityAsserter MDF: SupportedTypes Attribute

```
<MBeanType>
```

```
...
   <MBeanAttribute
    Name = "SupportedTypes"
    Type = "java.lang.String[]"
    Writeable = "false"
    Default = "new String[] {&quot;SamplePerimeterAtnToken&quot;}"
   />

...

</MBeanType>
```

Similarly, the content for the Active Types field is obtained from the `ActiveTypes` attribute of the MBean Definition File (MDF). You or an administrator can default the `ActiveTypes` attribute in the MDF so that it does not have to be set manually with the WebLogic Server Administration Console. An example from the sample Identity Assertion provider is shown in Listing 4-3.

Listing 4-3   SampleIdentityAsserter MDF: ActiveTypes Attribute with Default

```
<MBeanAttribute
 Name= "ActiveTypes"
 Type= "java.lang.String[]"
 Default = "new String[] { &quot;SamplePerimeterAtnToken&quot; }"
/>
```

While defaulting the `ActiveTypes` attribute is convenient, you should only do this if no other Identity Assertion provider will ever validate that token type. Otherwise, it would be easy to configure an invalid security realm (where more than one Identity Assertion provider attempts to validate the same token type). Best practice dictates that all MDFs for Identity Assertion providers turn off the token type by default; then an administrator can manually make the token type active by configuring the Identity Assertion provider that validates it.

Note: If an Identity Assertion provider is not developed *and* configured to validate and accept a token type, the authentication process will fail. For more information about configuring an Identity Assertion provider, see "Configure the Custom Identity Assertion Provider Using the Administration Console" on page 4-24.

Passing Tokens for Perimeter Authentication

An Identity Assertion providers can pass tokens from Java clients to servlets for the purpose of perimeter authentication. Tokens can be passed using HTTP headers, cookies, SSL certificates, or other mechanisms. For example, a string that is base 64-encoded (which enables the sending of binary data) can be sent to a servlet through an HTTP header. The value of this string can be a username, or some other string representation of a user's identity. The Identity Assertion provider used for perimeter authentication can then take that string and extract the username.

If the token is passed through HTTP headers or cookies, the token is equal to the header or cookie name, and the resource container passes the token to the part of the WebLogic Security Framework that handles authentication. The WebLogic Security Framework then passes the token to the Identity Assertion provider, unchanged.

Common Secure Interoperability Version 2 (CSIv2)

WebLogic Server provides support for an Enterprise JavaBean (EJB) interoperability protocol based on Internet Inter-ORB (IIOP) (GIOP version 1.2) and the CORBA Common Secure Interoperability version 2 (CSIv2) specification. CSIv2 support in WebLogic Server:

- Interoperates with the Java 2 Enterprise Edition (J2EE) version 1.3 reference implementation.

- Allows WebLogic Server IIOP clients to specify a username and password in the same manner as T3 clients.

- Supports Generic Security Services Application Programming Interface (GSSAPI) initial context tokens. For this release, only usernames and passwords and GSSUP (Generic Security Services Username Password) tokens are supported.

Note: The CSIv2 implementation in WebLogic Server passed Java 2 Enterprise Edition (J2EE) Compatibility Test Suite (CTS) conformance testing.

The external interface to the CSIv2 implementation is a JAAS LoginModule that retrieves the username and password of the CORBA object. The JAAS LoginModule can be used in a WebLogic Java client or in a WebLogic Server instance that acts as a client to another J2EE application server. The JAAS LoginModule for the CSIv2 support is called `UsernamePasswordLoginModule`, and is located in the `weblogic.security.auth.login` package.

CSIv2 works in the following manner:

1. When creating a Security Extensions to Interoperable Object Reference (IOR), WebLogic Server adds a tagged component identifying the security mechanisms that the CORBA object supports. This tagged component includes transport information, client authentication information, and identity token/authorization token information.

2. The client evaluates the security mechanisms in the IOR and selects the mechanism that supports the options required by the server.

3. The client uses the SAS protocol to establish a security context with WebLogic Server. The SAS protocol defines messages contained within the service context of requests and replies. A context can be stateful or stateless.

For information about using CSIv2, see "Common Secure Interoperability Version 2" in *Introduction to WebLogic Security*. For more information about JAAS LoginModules, see "LoginModules" on page 3-3.

The Identity Assertion Process

In **perimeter authentication**, a system *outside* of WebLogic Server establishes trust via tokens (as opposed to the type of authentication described in "The Authentication Process" on page 3-11, where WebLogic Server establishes trust via usernames and passwords). Identity Assertion providers are used as part of perimeter authentication process, which works as follows (see Figure 4-2):

1. A token from outside of WebLogic Server is passed to an Identity Assertion provider that is responsible for validating tokens of that type and that is configured as "active".

2. If the token is successfully validated, the Identity Assertion provider maps the token to a WebLogic Server username, and sends that username back to WebLogic Server, which then continues the authentication process as described in "The Authentication Process" on page 3-11. Specifically, the username is sent via a Java Authentication and Authorization Service (JAAS) `CallbackHandler` and passed to each configured Authentication provider's LoginModule, so that the LoginModule can populate the subject with the appropriate principals.

Figure 4-2   Perimeter Authentication
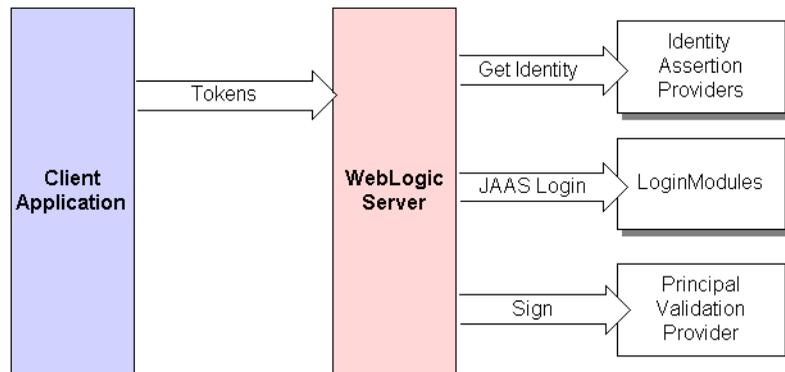
As Figure 4-2 also shows, perimeter authentication requires the same components as the authentication process described in "The Authentication Process" on page 3-11, but also adds an Identity Assertion provider.

Do You Need to Develop a Custom Identity Assertion Provider?

The WebLogic Identity Assertion provider supports certificate authentication using X509 certificates and CORBA Common Secure Interoperability version 2 (CSIv2) identity assertion.

The WebLogic Identity Assertion provider validates the token type, then maps X509 digital certificates and X501 distinguished names to WebLogic usernames. It also specifies a list of trusted client principals to use for CSIv2 identity assertion. The wildcard character (*) can be used to specify that all principals are trusted. If a client is not listed as a trusted client principal, the CSIv2 identity assertion fails and the invoke is rejected.

Note: To use the WebLogic Identity Assertion provider for X.501 and X.509 certificates, you must provide an implementation of the `weblogic.security.providers.authentication.UserNameMapper` interface. This interface maps a X.509 certificate to a WebLogic Server user name according to whatever scheme is appropriate for your needs. You can also use this interface to map from an X.501 distinguished name to a user name. You specify your implementation of this interface when you use the Administration Console to configure an Identity Assertion provider. For more information, see "Using a User Name Mapper with the WebLogic Identity Assertion Provider" in *Managing WebLogic Security*.

The WebLogic Identity Assertion provider supports the following token types:

- `AU_TYPE`—for a WebLogic `AuthenticatedUser` used as a token.

- `X509_TYPE`—for an X509 client certificate used as a token.

- `CSI_PRINCIPAL_TYPE`—for a CSIv2 principal name identity used as a token.

- `CSI_ANONYMOUS_TYPE`—for a CSIv2 anonymous identity used as a token.

- `CSI_X509_CERTCHAIN_TYPE`—for a CSIv2 X509 certificate chain identity used as a token.

- `CSI_DISTINGUISHED_NAME_TYPE`—for a CSIv2 distinguished name identity used as a token.

If you want to perform additional identity assertion tasks or create new token types, then you need to develop a custom Identity Assertion provider.

How to Develop a Custom Identity Assertion Provider

If the WebLogic Identity Assertion provider does not meet your needs, you can develop a custom Identity Assertion provider by following these steps:

Create Runtime Classes Using the Appropriate SSPIs

Before you start creating runtime classes, you should first:

When you understand this information and have made your design decisions, create the runtime classes for your custom Identity Assertion provider by following these steps:

Note: If you want to create a separate LoginModule for your custom Identity Assertion provider (that is, not use the LoginModule from your Authentication provider), you also need to implement the JAAS `LoginModule` interface, as described in

For an example of how to create a runtime class for a custom Identity Assertion provider, see

Implement the AuthenticationProvider SSPI

To implement the `AuthenticationProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3 *and* the following methods:

getLoginModuleConfiguration

```
public AppConfigurationEntry getLoginModuleConfiguration()
```

The `getLoginModuleConfiguration` method obtains information about the Authentication provider's associated LoginModule, which is returned as an `AppConfigurationEntry`. The `AppConfigurationEntry` is a Java Authentication and Authorization Service (JAAS) class that contains the classname of the LoginModule; the LoginModule's control flag (which was passed in via the Authentication provider's associated MBean); and a configuration options map for the LoginModule (which allows other configuration information to be passed into the LoginModule).

For more information about the `AppConfigurationEntry` class (located in the `javax.security.auth.login` package) and the control flag options for LoginModules, see the *Java 2 Enterprise Edition, v1.3.1 API Specification Javadoc* for the AppConfigurationEntry class and the Configuration class. For more information about LoginModules, see "LoginModules" on page 3-3. For more information about security providers and MBeans, see "Understand Why You Need an MBean Type" on page 2-11.

getAssertionModuleConfiguration

```
public AppConfigurationEntry
getAssertionModuleConfiguration()
```

The `getAssertionModuleConfiguration` method obtains information about an Identity Assertion provider's associated LoginModule, which is returned as an `AppConfigurationEntry`. The `AppConfigurationEntry` is a JAAS class that contains the classname of the LoginModule; the LoginModule's control flag (which was passed in via the Identity Assertion provider's associated MBean); and a configuration options map for the LoginModule (which allows other configuration information to be passed into the LoginModule).

Notes: The `assertIdentity()` method of an Identity Assertion provider is called every time identity assertion occurs, but the LoginModules may not be called if the Subject is cached. The `-Dweblogic.security.identityAssertionTTL` flag can be used

to affect this behavior (for example, to modify the default TTL of 5 minutes or to disable the cache by setting the flag to -1).

It is the responsibility of the Identity Assertion provider to ensure not just that the token is valid, but also that the user is still valid (for example, the user has not been deleted).

getPrincipalValidator

```
public PrincipalValidator getPrincipalValidator()
```

The getPrincipalValidator method obtains a reference to the Principal Validation provider's runtime class (that is, the PrincipalValidator SSPI implementation). For more information, see Chapter 5, "Principal Validation Providers."

getIdentityAsserter

```
public IdentityAsserter getIdentityAsserter()
```

The getIdentityAsserter method obtains a reference to the Identity Assertion provider's runtime class (that is, the IdentityAsserter SSPI implementation). For more information, see "Implement the IdentityAsserter SSPI" on page 4-12.

Note: When the LoginModule used for the Identity Assertion provider is the same as that used for an existing Authentication provider, implementations for the methods in the AuthenticationProvider SSPI (excluding the getIdentityAsserter method) for Identity Assertion providers can just return null. An example of this is shown in Listing 4-4, "SampleIdentityAsserterProviderImpl.java," on page 4-14.

For more information about the AuthenticationProvider SSPI and the methods described above, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the IdentityAsserter SSPI

To implement the IdentityAsserter SSPI, provide implementations for the following method:

assertIdentity

```
public CallbackHandler assertIdentity(String type, Object
token) throws IdentityAssertionException;
```

The `assertIdentity` method asserts an identity based on the token identity information that is supplied. In other words, the purpose of this method is to validate any tokens that are not currently trusted against trusted client principals. The `type` parameter represents the token type to be used for the identity assertion. Note that identity assertion types are case *insensitive*. The `token` parameter contains the actual identity information. The `CallbackHandler` returned from the `assertIdentity` method is passed to all configured Authentication providers' LoginModules to perform principal mapping, and should contain the asserted username. If the `CallbackHandler` is `null`, this signifies that the anonymous user should be used.

A `CallbackHandler` is a highly-flexible JAAS standard that allows a variable number of arguments to be passed as complex objects to a method. For more information about `CallbackHandler`s, see the *Java 2 Enterprise Edition, v1.3.1 API Specification Javadoc* for the CallbackHandler interface.

For more information about the `IdentityAsserter` SSPI and the method described above, see the *WebLogic Server 7.0 API Reference Javadoc*.

Example: Creating the Runtime Class for the Sample Identity Assertion Provider

Listing Note: shows the `SampleIdentityAsserterProviderImpl.java` class, which is the runtime class for the sample Identity Assertion provider. This runtime class includes implementations for:

- The three methods inherited from the `SecurityProvider` interface: `initialize`, `getDescription`, and `shutdown` (as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.)

- The four methods in the `AuthenticationProvider` SSPI: the `getLoginModuleConfiguration`, `getAssertionModuleConfiguration`, `getPrincipalValidator`, and `getIdentityAsserter` methods (as described in "Implement the AuthenticationProvider SSPI" on page 4-11).

- The method in the `IdentityAsserter` SSPI: the `assertIdentity` method (described in "Implement the IdentityAsserter SSPI" on page 4-12).

Note: The bold face code in Listing 4-4 highlights the class declaration and the method signatures.

<hr/>

Listing 4-4   SampleIdentityAsserterProviderImpl.java

<hr/>

```
package examples.security.providers.identityassertion;

import javax.security.auth.callback.CallbackHandler;
import javax.security.auth.login.AppConfigurationEntry;
import weblogic.management.security.ProviderMBean;
import weblogic.security.spi.AuthenticationProvider;
import weblogic.security.spi.IdentityAsserter;
import weblogic.security.spi.IdentityAssertionException;
import weblogic.security.spi.PrincipalValidator;
import weblogic.security.spi.SecurityServices;

public final class SampleIdentityAsserterProviderImpl implements
AuthenticationProvider, IdentityAsserter
{
   final static private String TOKEN_TYPE   = "SamplePerimeterAtnToken";
   final static private String TOKEN_PREFIX = "username=";

   private String description;

   public void initialize(ProviderMBean mbean, SecurityServices services)
   {
      System.out.println("SampleIdentityAsserterProviderImpl.initialize");
      SampleIdentityAsserterMBean myMBean = (SampleIdentityAsserterMBean)mbean;
      description = myMBean.getDescription() + "\n" + myMBean.getVersion();
   }

   public String getDescription()
   {
      return description;
   }

   public void shutdown()
   {
      System.out.println("SampleIdentityAsserterProviderImpl.shutdown");
   }

   public AppConfigurationEntry getLoginModuleConfiguration()
   {
      return null;
   }

   public AppConfigurationEntry getAssertionModuleConfiguration()
   {
      return null;
   }

   public PrincipalValidator getPrincipalValidator()
   {
```

```
      return null;
   }

   public IdentityAsserter getIdentityAsserter()
   {
      return this;
   }

   public CallbackHandler assertIdentity(String type, Object token) throws
   IdentityAssertionException
   {
      System.out.println("SampleIdentityAsserterProviderImpl.assertIdentity");
      System.out.println("\tType\t\t= "  + type);
      System.out.println("\tToken\t\t= " + token);

      if (!(TOKEN_TYPE.equals(type))) {
         String error = "SampleIdentityAsserter received unknown token type \""
            + type + "\"." + " Expected " + TOKEN_TYPE;
         System.out.println("\tError: " + error);
         throw new IdentityAssertionException(error);
      }

      if (!(token instanceof byte[])) {
         String error = "SampleIdentityAsserter received unknown token class \""
            + token.getClass() + "\"." + " Expected a byte[].";
         System.out.println("\tError: " + error);
         throw new IdentityAssertionException(error);
      }

      byte[] tokenBytes = (byte[])token;
      if (tokenBytes == null || tokenBytes.length < 1) {
         String error = "SampleIdentityAsserter received empty token byte array";
         System.out.println("\tError: " + error);
         throw new IdentityAssertionException(error);
      }

      String tokenStr = new String(tokenBytes);

      if (!(tokenStr.startsWith(TOKEN_PREFIX))) {
         String error = "SampleIdentityAsserter received unknown token string \""
            + type + "\"." + " Expected " + TOKEN_PREFIX + "username";
         System.out.println("\tError: " + error);
         throw new IdentityAssertionException(error);
      }

      String userName = tokenStr.substring(TOKEN_PREFIX.length());
      System.out.println("\tuserName\t= " + userName);
      return new SampleCallbackHandlerImpl(userName);
   }

}
```

Listing 4-5 shows the sample `CallbackHandler` implementation that is used along with the `SampleIdentityAsserterProviderImpl.java` runtime class. This `CallbackHandler` implementation is used to send the username back to an Authentication provider's LoginModule.

Listing 4-5   SampleCallbackHandlerImpl.java

```
package examples.security.providers.identityassertion;

import javax.security.auth.callback.Callback;
import javax.security.auth.callback.NameCallback;
import javax.security.auth.callback.CallbackHandler;
import javax.security.auth.callback.UnsupportedCallbackException;

/*package*/ class SampleCallbackHandler implements CallbackHandler
{
   private String userName;

   /*package*/ SampleCallbackHandlerImpl(String user)
   {
      userName = user;
   }

   public void handle(Callback[] callbacks) throws UnsupportedCallbackException
   {
      for (int i = 0; i < callbacks.length; i++) {

           Callback callback = callbacks[i];

           if (!(callback instanceof NameCallback)) {
              throw new UnsupportedCallbackException(callback, "Unrecognized
                 Callback");
           }

           NameCallback nameCallback = (NameCallback)callback;
           nameCallback.setName(userName);
      }
   }
}
```

Generate an MBean Type Using the WebLogic MBeanMaker

Before you start generating an MBean type for your custom security provider, you should first:

- "Understand Why You Need an MBean Type" on page 2-11

- "Determine Which SSPI MBeans to Extend and Implement" on page 2-12

- "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12

- "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15

- "Understand What the WebLogic MBeanMaker Provides" on page 2-17

When you understand this information and have made your design decisions, create the MBean type for your custom Identity Assertion provider by following these steps:

1. "Create an MBean Definition File (MDF)" on page 4-17

2. "Use the WebLogic MBeanMaker to Generate the MBean Type" on page 4-18

3. "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 4-22

4. "Install the MBean Type Into the WebLogic Server Environment" on page 4-23

Notes: Several sample security providers (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) illustrate how to perform these steps.

All instructions provided in this section assume that you are working in a Windows environment.

Create an MBean Definition File (MDF)

To create an MBean Definition File (MDF), follow these steps:

1. Copy the MDF for the sample Identity Assertion provider to a text file.

Note: The MDF for the sample Identity Assertion provider is called
SampleIdentityAsserter.xml.

2. Modify the content of the <MBeanType> and <MBeanAttribute> elements in
your MDF so that they are appropriate for your custom Identity Assertion
provider.

3. Add any custom attributes and operations (that is, additional <MBeanAttribute>
and <MBeanOperation> elements) to your MDF.

4. Save the file.

Note: A complete reference of MDF element syntax is available in Appendix A,
"MBean Definition File (MDF) Element Syntax."

Use the WebLogic MBeanMaker to Generate the MBean Type

Once you create your MDF, you are ready to run it through the WebLogic
MBeanMaker. The WebLogic MBeanMaker is currently a command-line utility that
takes as its input an MDF, and outputs some intermediate Java files, including an
MBean interface, an MBean implementation, and an associated MBean information
file. Together, these intermediate files form the **MBean type** for your custom security
provider.

The instructions for generating an MBean type differ based on the design of your
custom Identity Assertion provider. Follow the instructions that are appropriate to your
situation:

- "No Optional SSPI MBeans and No Custom Operations" on page 4-18

- "Optional SSPI MBeans or Custom Operations" on page 4-19

No Optional SSPI MBeans and No Custom Operations

If the MDF for your custom Identity Assertion provider does not implement any
optional SSPI MBeans *and* does not include any custom operations, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Identity Assertion providers).

3. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 4-22.

Optional SSPI MBeans or Custom Operations

If the MDF for your custom Identity Assertion provider does implement some optional SSPI MBeans *or* does include custom operations, consider the following:

■ Are you creating an MBean type for the first time? If so, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Identity Assertion providers).

3. If you implemented optional SSPI MBeans in your MDF, follow these steps:

   a. Locate the MBean implementation file.

      The MBean implementation file generated by the WebLogic MBeanMaker is named `MBeanNameImpl.java`. For example, for the MDF named `SampleIdentityAsserter`, the MBean implementation file to be edited is named `SampleIdentityAsserterImpl.java`.

   b. For each optional SSPI MBean that you implemented in your MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

4. If you included any custom operations in your MDF, implement the methods using the method stubs.

5. Save the file.

6. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 4-22.

■ Are you updating an existing MBean type? If so, follow these steps:

1. Copy your existing MBean implementation file to a temporary directory so that your current method implementations are not overwritten by the WebLogic MBeanMaker.

2. Create a new DOS shell.

3. Type the following command:

   ```
   java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, `xmlFile` is the MDF (the XML MBean Description File) and `filesdir` is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir`, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Identity Assertion providers).

4. If you implemented optional SSPI MBeans in your MDF, follow these steps:

   a. Locate and open the MBean implementation file.

   The MBean implementation file generated by the WebLogic MBeanMaker is named *MBeanName*`Impl.java`. For example, for the MDF named `SampleIdentityAsserter`, the MBean implementation file to be edited is named `SampleIdentityAsserterImpl.java`.

   b. Open your existing MBean implementation file (which you saved to a temporary directory in step 1).

   c. Synchronize the existing MBean implementation file with the MBean implementation file generated by the WebLogic MBeanMaker.

   Accomplishing this task may include, but is not limited to: copying the method implementations from your existing MBean implementation file into the newly-generated MBean implementation file (or, alternatively, adding the new methods from the newly-generated MBean implementation file to your existing MBean implementation file), and verifying that any changes to method signatures are reflected in the version of the MBean implementation file that you are going to use (for methods that exist in both MBean implementation files).

   d. If you modified the MDF to implement optional SSPI MBeans that were not in the original MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

5. If you modified the MDF to include any custom operations that were not in the original MDF, implement the methods using the method stubs.

6. Save the version of the MBean implementation file that is complete (that is, has all methods implemented).

7. Copy this MBean implementation file into the directory where the WebLogic MBeanMaker placed the intermediate files for the MBean type. You specified this as *filesdir* in step 3. (You will be overriding the MBean implementation file generated by the WebLogic MBeanMaker as a result of step 3.)

8. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 4-22.

About the Generated MBean Interface File

The MBean interface file is the client-side API to the MBean that your runtime class or your MBean implementation will use to obtain configuration data. It is typically used in the initialize method as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

Because the WebLogic MBeanMaker generates MBean types from the MDF you created, the generated MBean interface file will have the name of the MDF, plus the text "MBean" appended to it. For example, the result of running the SampleIdentityAsserter MDF through the WebLogic MBeanMaker will yield an MBean interface file called SampleIdentityAsserterMBean.java.

Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)

Once your have run your MDF through the WebLogic MBeanMaker to generate your intermediate files, and you have edited the MBean implementation file to supply implementations for the appropriate methods within it, you need to package the MBean files *and the runtime classes* for the custom Identity Assertion provider into an MBean JAR File (MJF). The WebLogic MBeanMaker also automates this process.

To create an MJF for your custom Identity Assertion provider, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMJF=jarfile -Dfiles=filesdir
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMJF flag indicates that the WebLogic MBeanMaker should build a JAR file containing the new MBean types, *jarfile* is the name for the MJF and

filesdir is the location where the WebLogic MBeanMaker looks for the files to JAR into the MJF.

Compilation occurs at this point, so errors are possible. If *jarfile* is provided, and no errors occur, an MJF is created with the specified name.

Notes: If you want to update an existing MJF, simply delete the MJF and regenerate it. The WebLogic MBeanMaker also has a -DIncludeSource option, which controls whether source files are included into the resulting MJF. Source files include both the generated source and the MDF itself. The default is false. This option is ignored when -DMJF is not used.

The resulting MJF can be installed into your WebLogic Server environment, or distributed to your customers for installation into their WebLogic Server environments.

Install the MBean Type Into the WebLogic Server Environment

To install an MBean type into the WebLogic Server environment, copy the MJF into the *WL_HOME*\server\lib\mbeantypes directory, where *WL_HOME* is the top-level installation directory for WebLogic Server. This "deploys" your custom Identity Assertion provider—that is, it makes the custom Identity Assertion provider manageable from the WebLogic Server Administration Console.

Notes: *WL_HOME*\server\lib\mbeantypes is the default directory for installing MBean types. However, if you want WebLogic Server to look for MBean types in *additional* directories, use the -Dweblogic.alternateTypesDirectory=*<dir>* command-line flag when starting your server, where *<dir>* is a comma-separated list of directory names. When you use this flag, WebLogic Server will always load MBean types from *WL_HOME*\server\lib\mbeantypes first, then will look in the additional directories and load all valid archives present in those directories (regardless of their extension). For example, if -Dweblogic.alternateTypesDirectory = dirX,dirY, WebLogic Server will first load MBean types from *WL_HOME*\server\lib\mbeantypes, then any valid archives present in dirX and dirY.

If you instruct WebLogic Server to look in additional directories for MBean types and are using the Java Security Manager, you must also update the weblogic.policy file to grant appropriate permissions for the MBean type

(and thus, the custom security provider). For more information, see "Using the Java Security Manager to Protect WebLogic Resources" in *Programming WebLogic Security*.

It is advisable to keep non-security provider JARs, including backup files, out of the `WL_HOME`\server\lib\mbeantypes directory.

You can create instances of the MBean type by configuring your custom Identity Assertion provider (see "Configure the Custom Identity Assertion Provider Using the Administration Console" on page 4-24), and then use those MBean instances from a GUI, from other Java code, or from APIs. For example, you can use the WebLogic Server Administration Console to get and set attributes and invoke operations, or you can develop other Java objects that instantiate MBeans and automatically respond to information that the MBeans supply. We recommend that you back up these MBean instances. For more information, see "Backing Up Security Configuration Data" under "Recovering Failed Servers" in *Creating and Configuring WebLogic Server Domains*.

Configure the Custom Identity Assertion Provider Using the Administration Console

Configuring a custom Identity Assertion provider means that you are adding the custom Identity Assertion provider to your security realm, where it can be accessed by applications requiring identity assertion services.

Configuring custom security providers is an administrative task, but it is a task that may also be performed by developers of custom security providers.

Note: The steps for configuring a custom Identity Assertion provider using the WebLogic Server Administration Console are described under "Configuring a Custom Security Provider" in *Managing WebLogic Security*.

5 Principal Validation Providers

Authentication providers rely on Principal Validation providers to sign and verify the authenticity of principals (users and groups) contained within a subject. Such verification provides an additional level of trust and may reduce the likelihood of malicious principal tampering. Verification of the subject's principals takes place during the WebLogic Server's demarshalling of RMI client requests for each invocation. The authenticity of the subject's principals is also verified when making authorization decisions.

The following sections describe Principal Validation provider concepts and functionality, and provide step-by-step instructions for developing a custom Principal Validation provider:

- "Principal Validation Concepts" on page 5-1
- "The Principal Validation Process" on page 5-3
- "Do You Need to Develop a Custom Principal Validation Provider?" on page 5-4
- "How to Develop a Custom Principal Validation Provider" on page 5-6

Principal Validation Concepts

Before you develop a Principal Validation provider, you need to understand the following concepts:

- "Principal Validation and Principal Types" on page 5-2

Principal Validation and Principal Types

Like Identity Assertion providers support specific types of tokens, Principal Validation providers support specific types of principals. For example, the WebLogic Principal Validation provider (described in "Do You Need to Develop a Custom Principal Validation Provider?" on page 5-4) signs and verifies the authenticity of WebLogic Server principals.

The Principal Validation provider that is associated with the configured Authentication provider (as described in "How Principal Validation Providers Differ From Other Types of Security Providers" on page 5-2) will sign and verify all the principals stored in the subject that are of the type the Principal Validation provider is designed to support.

How Principal Validation Providers Differ From Other Types of Security Providers

A Principal Validation provider is a special type of security provider that primarily acts as a "helper" to an Authentication provider. The main function of a Principal Validation provider is to prevent malicious individuals from tampering with the principals stored in a subject.

The AuthenticationProvider SSPI (as described in "Implement the AuthenticationProvider SSPI" on page 3-13) includes a method called getPrincipalValidator. In this method, you specify the Principal Validation provider's runtime class to be used with the Authentication provider. The Principal Validation provider's runtime class can be the one BEA provides (called the WebLogic Principal Validation provider) or one you develop (called a custom Principal Validation provider). An example of using the WebLogic Principal Validation provider in an Authentication provider's getPrincipalValidator method is shown in Listing 3-1, "SampleAuthenticationProviderImpl.java," on page 3-18.

Because you generate MBean types for Authentication providers and configure Authentication providers using the WebLogic Server Administration Console, you do <u>not</u> have to perform these steps for a Principal Validation provider.

Security Exceptions Resulting from Invalid Principals

When the WebLogic Security Framework attempts an authentication (or authorization) operation, it checks the subject's principals to see if they are valid. If a principal is not valid, the WebLogic Security Framework throws a security exception with text indicating that the subject is invalid. A subject may be invalid because:

■ A principal in the subject does not have a corresponding Principal Validation provider configured (which means there is no way for the WebLogic Security Framework to validate the subject).

   Note: Because you can have multiple principals in a subject, each stored by the LoginModule of a different Authentication provider, the principals can have different Principal Validation providers.

■ A principal was signed in another WebLogic Server security domain (with a different credential from this security domain) and the caller is trying to use it in the current domain.

■ A principal with an invalid signature was created as part of an attempt to compromise security.

■ A subject never had its principals signed.

The Principal Validation Process

As shown in Figure 5-1, a user attempts to log into a system using a username/password combination. WebLogic Server establishes trust by calling the configured Authentication provider's LoginModule, which validates the user's username and password and returns a subject that is populated with principals per Java Authentication and Authorization Service (JAAS) requirements.

Figure 5-1   The Principal Validation Process
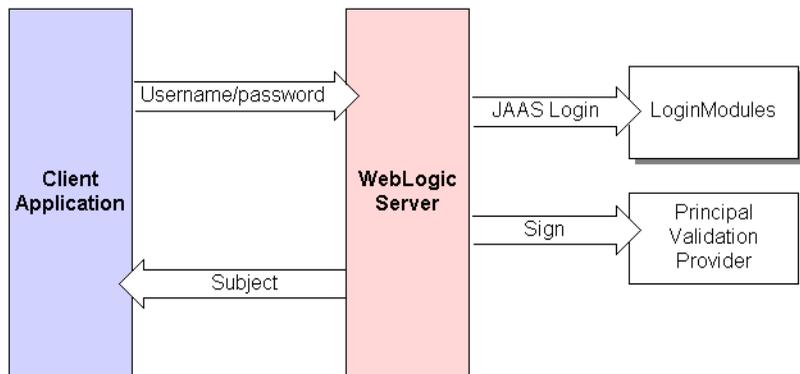
WebLogic Server passes the subject to the specified Principal Validation provider, which signs the principals and then returns them to the client application via WebLogic Server. Whenever the principals stored within the subject are required for other security operations, the same Principal Validation provider will verify that the principals stored within the subject have not been modified since they were signed.

Do You Need to Develop a Custom Principal Validation Provider?

The default (that is, active) security realm for WebLogic Server includes a WebLogic Principal Validation provider. Much like an Identity Assertion provider supports a specific type of token, a Principal Validation provider signs and verifies the authenticity of a specific type of principal. The WebLogic Principal Validation provider signs and verifies WebLogic Server principals. In other words, it signs and verifies principals that represent WebLogic Server users or WebLogic Server groups.

Notes: You can use the `WLSPrincipals` class (located in the `weblogic.security` package) to determine whether a principal (user or group) has special meaning to WebLogic Server. (That is, whether it is a predefined WebLogic Server user or WebLogic Server group.) Furthermore, any principal that is going to

represent a WebLogic Server user or group needs to implement the `WLSUser` and `WLSGroup` interfaces (available in the `weblogic.security.spi` package).

The WebLogic Principal Validation provider includes implementations of the `WLSUser` and `WLSGroup` interfaces, named `WLSUserImpl` and `WLSGroupImpl`. These are located in the `weblogic.security.principal` package. It also includes an implementation of the `PrincipalValidator` SSPI called `PrincipalValidatorImpl` (located in the `weblogic.security.provider` package). The `sign()` method in the `PrincipalValidatorImpl` class generates a random seed and computes a digest based on that random seed. (For more information about the `PrincipalValidator` SSPI, see "Implement the PrincipalValidator SSPI" on page 5-6.)

How to Use the WebLogic Principal Validation Provider

If you have simple user and group principals (that is, they only have a name), and you want to use the WebLogic Principal Validation provider:

- Use the `weblogic.security.principal.WLSUserImpl` and `weblogic.security.principal.WLSGroupImpl` classes.

- Use the `weblogic.security.provider.PrincipalValidatorImpl` class.

If you have user or group principals with extra data members (that is, in addition to a name), and you want to use the WebLogic Principal Validation provider:

- Write your own `UserImpl` and `GroupImpl` classes.

- Extend the `weblogic.security.principal.WLSAbstractPrincipal` class.

- Implement the `weblogic.security.spi.WLSUser` and `weblogic.security.spi.WLSGroup` interfaces.

- Implement the `equals()` method to include your extra data members. Your implementation should call the `super.equals()` method when complete so the `WLSAbstractPrincipal` can validate the remaining data.

  Note: By default, only the user or group name will be validated. If you want to validate your extra data members as well, then implement the `getSignedData()` method.

■ Use the `weblogic.security.provider.PrincipalValidatorImpl` class.

If you have your own validation scheme and do not want to use the WebLogic Principal Validation provider, or if you want to provide validation for principals other than WebLogic Server principals, then you need to develop a custom Principal Validation provider.

How to Develop a Custom Principal Validation Provider

To develop a custom Principal Validation provider:

■ Write your own `UserImpl` and `GroupImpl` classes by:

- Implementing the `weblogic.security.spi.WLSUser` and `weblogic.security.spi.WLSGroup` interfaces.

- Implementing the `java.io.Serializable` interfaces.

■ Write your own `PrincipalValidationImpl` class by implementing the `weblogic.security.spi.PrincipalValidator` SSPI. (See "Implement the PrincipalValidator SSPI" on page 5-6.)

Implement the PrincipalValidator SSPI

To implement the `PrincipalValidator` SSPI, provide implementations for the following methods:

validate

```
public boolean validate(Principal principal) throws
SecurityException;
```

The `validate` method takes a principal as an argument and attempts to validate it. In other words, this method verifies that the principal was not altered since it was signed.

sign

```
public boolean sign(Principal principal);
```

The `sign` method takes a principal as an argument and signs it to assure trust. This allows the principal to later be verified using the `validate` method.

Your implementation of the `sign` method should be a secret algorithm that malicious individuals cannot easily recreate. You can include that algorithm within the `sign` method itself, have the `sign` method call out to a server for a token it should use to sign the principal, or implement some other way of signing the principal.

getPrincipalBaseClass

```
public Class getPrincipalBaseClass();
```

The `getPrincipalBaseClass` method returns the base class of principals that this Principal Validation provider knows how to validate and sign.

For more information about the `PrincipalValidator` SSPI and the methods described above, see the *WebLogic Server 7.0 API Reference Javadoc*.

6 Authorization Providers

Authorization is the process whereby the interactions between users and WebLogic resources are controlled, based on user identity or other information. In other words, authorization answers the question, "What can you access?" In WebLogic Server, an Authorization provider is used to limit the interactions between users and WebLogic resources to ensure integrity, confidentiality, and availability.

The following sections describe Authorization provider concepts and functionality, and provide step-by-step instructions for developing a custom Authorization provider:

- "Authorization Concepts" on page 6-1

- "The Authorization Process" on page 6-2

- "Do You Need to Develop a Custom Authorization Provider?" on page 6-5

- "How to Develop a Custom Authorization Provider" on page 6-6

Authorization Concepts

Before you develop an Authorization provider, you need to understand the following concepts:

- "Access Decisions" on page 6-2

- "Security Providers and WebLogic Resources" on page 2-23

Access Decisions

Like LoginModules for Authentication providers, an **Access Decision** is the component of an Authorization provider that actually answers the "is access allowed?" question. Specifically, an Access Decision is asked whether a subject has permission to perform a given operation on a WebLogic resource, with specific parameters in an application. Given this information, the Access Decision responds with a result of `PERMIT`, `DENY`, or `ABSTAIN`.

Note: For more information about Access Decisions, see "Implement the AccessDecision SSPI" on page 6-8.

The Authorization Process

Figure 6-1 illustrates how Authorization providers (and the associated Adjudication and Role Mapping providers) interact with the WebLogic Security Framework during the authorization process, and an explanation follows.

Figure 6-1   Authorization Providers and the Authorization Process
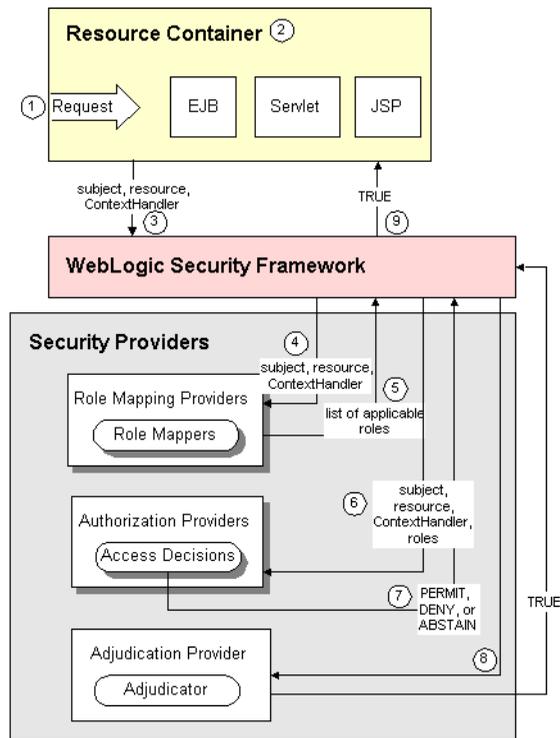
Generally, authorization is performed in the following manner:

1. A user or system process requests a WebLogic resource on which it will attempt to perform a given operation.

2. The resource container that handles the type of WebLogic resource being requested receives the request (for example, the EJB container receives the request for an EJB resource).

   Note: The resource container could be the container that handles any one of the WebLogic Resources described in "Security Providers and WebLogic Resources" on page 2-23.

3. The resource container constructs a `ContextHandler` object that may be used by the configured Role Mapping providers and the configured Authorization providers' Access Decisions to obtain information associated with the context of the request.

   Note: For more information about ContextHandlers, see "ContextHandlers and WebLogic Resources" on page 2-33. For more information about Access Decisions, see "Access Decisions" on page 6-2. For more information about Role Mapping providers, see Chapter 8, "Role Mapping Providers."

   The resource container calls the WebLogic Security Framework, passing in the subject, the WebLogic resource, and optionally, the `ContextHandler` object (to provide additional input for the decision).

4. The WebLogic Security Framework calls the configured Role Mapping providers.

5. The Role Mapping providers use the `ContextHandler` to request various pieces of information about the request. They construct a set of `Callback` objects that represent the type of information being requested. This set of `Callback` objects is then passed as an array to the `ContextHandler` using the `handle` method.

   The Role Mapping providers use the values contained in the `Callback` objects, the subject, and the resource to compute a list of roles to which the subject making the request is entitled, and pass the list of applicable roles back to the WebLogic Security Framework.

6. The WebLogic Security Framework delegates the actual decision about whether the subject is entitled to perform the requested action on the WebLogic resource to the configured Authorization providers.

   The Authorization providers' Access Decisions also use the `ContextHandler` to request various pieces of information about the request. They too construct a set of `Callback` objects that represent the type of information being requested. This set of `Callback` objects is then passed as an array to the `ContextHandler` using the `handle` method. (The process is the same as described for Role Mapping providers in Step 5.)

7. The `isAccessAllowed` method of each configured Authorization provider's Access Decision is called to determine if the subject is authorized to perform the requested access, based on the `ContextHandler`, subject, resource, and roles. Each `isAccessAllowed` method can return one of three values:

   - `PERMIT`—Indicates that the requested access is permitted.

- DENY—Indicates that the requested access is explicitly denied.

- ABSTAIN—Indicates that the Access Decision was unable to render an explicit decision.

This process continues until all Access Decisions are used.

8. The WebLogic Security Framework delegates the job of reconciling any discrepancies among the results rendered by the configured Authorization providers' Access Decisions to the Adjudication provider. The Adjudication provider determines the ultimate outcome of the authorization decision.

   Note: For more information about the Adjudication provider, see Chapter 7, "Adjudication Providers."

9. The Adjudication provider returns either a TRUE or FALSE verdict, which is forwarded to the resource container through the WebLogic Security Framework.

   - If the decision is TRUE, the resource container dispatches the request to the protected WebLogic resource.

   - If the decision is FALSE, the resource container throws a security exception that indicates that the requestor was not authorized to perform the requested access on the protected WebLogic resource.

Do You Need to Develop a Custom Authorization Provider?

The default (that is, active) security realm for WebLogic Server includes a WebLogic Authorization provider. The WebLogic Authorization provider supplies the default enforcement of authorization for this version of WebLogic Server. The WebLogic Authorization provider returns an access decision using a policy-based authorization engine to determine if a particular user is allowed access to a protected WebLogic resource. The WebLogic Authorization provider also supports the deployment and undeployment of security policies within the system. If you want to use an authorization mechanism that already exists within your organization, you could create a custom Authorization provider to tie into that system.

How to Develop a Custom Authorization Provider

If the WebLogic Authorization provider does not meet your needs, you can develop a custom Authorization provider by following these steps:

1. "Create Runtime Classes Using the Appropriate SSPIs" on page 6-6

2. "Generate an MBean Type Using the WebLogic MBeanMaker" on page 6-13

3. "Configure the Custom Authorization Provider Using the Administration Console" on page 6-21

4. "Provide a Mechanism for Security Policy Management" on page 6-25

Create Runtime Classes Using the Appropriate SSPIs

Before you start creating runtime classes, you should first:

- "Understand the Purpose of the "Provider" SSPIs" on page 2-3

- "Determine Which "Provider" Interface You Will Implement" on page 2-5

- "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes" on page 2-7

When you understand this information and have made your design decisions, create the runtime classes for your custom Authorization provider by following these steps:

- "Implement the AuthorizationProvider SSPI" on page 6-7 *or* "Implement the DeployableAuthorizationProvider SSPI" on page 6-7

- "Implement the AccessDecision SSPI" on page 6-8

Note: At least one Authorization provider in a security realm must implement the `DeployableAuthorizationProvider` SSPI, or else it will be impossible to deploy Web applications and EJBs.

For an example of how to create a runtime class for a custom Authorization provider, see "Example: Creating the Runtime Class for the Sample Authorization Provider" on page 6-10.

Implement the AuthorizationProvider SSPI

To implement the `AuthorizationProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3 *and* the following method:

getAccessDecision

```
public AccessDecision getAccessDecision();
```

The `getAccessDecision` method obtains the implementation of the `AccessDecision` SSPI. For a single runtime class called `MyAuthorizationProviderImpl.java`, the implementation of the `getAccessDecision` method would be:

```
return this;
```

If there are two runtime classes, then the implementation of the `getAccessDecision` method could be:

```
return new MyAccessDecisionImpl;
```

This is because the runtime class that implements the `AuthorizationProvider` SSPI is used as a factory to obtain classes that implement the `AccessDecision` SSPI.

For more information about the `AuthorizationProvider` SSPI and the `getAccessDecision` method, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the DeployableAuthorizationProvider SSPI

To implement the `DeployableAuthorizationProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3, "Implement the AuthorizationProvider SSPI" on page 6-7, *and* the following methods:

deployPolicy

```
public void deployPolicy(Resource resource,
java.lang.String[] roleNames) throws
ResourceCreationException
```

The deployPolicy method creates a policy on behalf of a deployed Web application or EJB, based on the WebLogic resource to which the policy should apply and the role names that are in the policy.

undeployPolicy

```
public void undeployPolicy(Resource resource) throws
ResourceRemovalException
```

The undeployPolicy method deletes a policy on behalf of an undeployed Web application or EJB, based on the WebLogic resource to which the policy applied.

For more information about the DeployableAuthorizationProvider SSPI and the deployPolicy and undeployPolicy methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the AccessDecision SSPI

When you implement the AccessDecision SSPI, you must provide implementations for the following methods:

isAccessAllowed

```
public Result isAccessAllowed(Subject subject, Map roles,
Resource resource, ContextHandler handler, Direction
direction) throws InvalidPrincipalException
```

The isAccessAllowed method utilizes information contained within the subject to determine if the requestor should be allowed to access a protected method. The isAccessAllowed method may be called prior to or after a request, and returns values of PERMIT, DENY, or ABSTAIN. If multiple Access Decisions are configured and return conflicting values, an Adjudication provider will be needed to determine a final result. For more information, see Chapter 7, "Adjudication Providers."

isProtectedResource

```
public boolean isProtectedResource(Subject subject, Resource
resource) throws InvalidPrincipalException
```

The isProtectedResource method is used to determine whether the specified WebLogic resource is protected, without incurring the cost of an actual access check. It is only a lightweight mechanism because it does not compute a set of roles that may be granted to the caller's subject.

For more information about the `AccessDecision` SSPI and the `isAccessAllowed` and `isProtectedResource` methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Developing Custom Authorization Providers That Are Compatible With the Realm Adapter Authentication Provider

An Authentication provider is the security provider responsible for populating a subject with users and groups, which are then extracted from the subject by other types of security providers, including Authorization providers. If the Authentication provider configured in your security realm is a Realm Adapter Authentication provider, the user and group information will be stored in the subject in a way that is slightly different from other Authentication providers. Therefore, this user and group information must also be extracted in a slightly different way.

Listing 6-1 provides code that can be used by custom Authorization providers to check whether a subject matches a user or group name when a Realm Adapter Authentication provider was used to populate the subject. This code belongs in both the `isAccessAllowed` and `isProtectedResource` methods.

Listing 6-1   Sample Code to Check if a Subject Matches a User or Group Name

```
/**
 * Determines if the Subject matches a user/group name.
 *
 * @param principalWant A String containing the name of a principal in this role
 * (that is, the role definition).
 *
 * @param subject A Subject that contains the Principals that identify the user
 * who is trying to access the resource as well as the user's groups.
 *
 * @return A boolean. true if the current subject matches the name of the
 * principal in the role, false otherwise.
 */
private boolean subjectMatches(String principalWant, Subject subject)
{
   // first, see if it's a group name match
   if (SubjectUtils.isUserInGroup(subject, principalWant)) {
      return true;
   }
   // second, see if it's a user name match
   if (principalWant.equals(SubjectUtils.getUsername(subject))) {
      return true;
```

```
    }
    // didn't match
    return false;
}
```

Example: Creating the Runtime Class for the Sample Authorization Provider

Listing 6-2 shows the `SampleAuthorizationProviderImpl.java` class, which is the runtime class for the sample Authorization provider. This runtime class includes implementations for:

- The three methods inherited from the `SecurityProvider` interface: `initialize`, `getDescription` and `shutdown` (as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3).

- The method inherited from the `AuthorizationProvider` SSPI: the `getAccessDecision` method (as described in "Implement the AuthorizationProvider SSPI" on page 6-7).

- The two methods in the `DeployableAuthorizationProvider` SSPI: the `deployPolicy` and `undeployPolicy` methods (as described in "Implement the DeployableAuthorizationProvider SSPI" on page 6-7).

- The two methods in the `AccessDecision` SSPI: the `isAccessAllowed` and `isProtectedResource` methods (as described in "Implement the AccessDecision SSPI" on page 6-8).

Note: The bold face code in Listing 6-2 highlights the class declaration and the method signatures.

Listing 6-2 SampleAuthorizationProviderImpl.java

```
package examples.security.providers.authorization;

import java.security.Principal;
import java.util.Enumeration;
import java.util.Iterator;
import java.util.Map;
import java.util.Set;
import javax.security.auth.Subject;
import weblogic.management.security.ProviderMBean;
import weblogic.security.WLSPrincipals;
```

```
import weblogic.security.service.ContextHandler;
import weblogic.security.spi.AccessDecision;
import weblogic.security.spi.DeployableAuthorizationProvider;
import weblogic.security.spi.Direction;
import weblogic.security.spi.InvalidPrincipalException;
import weblogic.security.spi.Resource;
import weblogic.security.spi.ResourceCreationException;
import weblogic.security.spi.ResourceRemovalException;
import weblogic.security.spi.Result;
import weblogic.security.spi.SecurityServices;

public final class SampleAuthorizationProviderImpl implements
DeployableAuthorizationProvider, AccessDecision
{
   private String description;
   private SampleAuthorizerDatabase database;

   public void initialize(ProviderMBean mbean, SecurityServices services)
   {
      System.out.println("SampleAuthorizationProviderImpl.initialize");
      SampleAuthorizerMBean myMBean = (SampleAuthorizerMBean)mbean;
      description = myMBean.getDescription() + "\n" + myMBean.getVersion();
      database = new SampleAuthorizerDatabase(myMBean);
   }

   public String getDescription()
   {
      return description;
   }

   public void shutdown()
   {
      System.out.println("SampleAuthorizationProviderImpl.shutdown");
   }

   public AccessDecision getAccessDecision()
   {
      return this;
   }

   public Result isAccessAllowed(Subject subject, Map roles, Resource resource,
   ContextHandler handler, Direction direction) throws InvalidPrincipalException
   {
      System.out.println("SampleAuthorizationProviderImpl.isAccessAllowed");
      System.out.println("\tsubject\t= " + subject);
      System.out.println("\troles\t= " + roles);
      System.out.println("\tresource\t= " + resource);
      System.out.println("\tdirection\t= " + direction);

      Set principals = subject.getPrincipals();
```

```
   for (Resource res = resource; res != null; res = res.getParentResource()) {
      if (database.policyExists(res)) {
         return isAccessAllowed(res, principals, roles);
      }
   }
   return Result.ABSTAIN;
}

public boolean isProtectedResource(Subject subject, Resource resource) throws
InvalidPrincipalException
{
   System.out.println("SampleAuthorizationProviderImpl.
     isProtectedResource");
   System.out.println("\tsubject\t= " + subject);
   System.out.println("\tresource\t= " + resource);

   for (Resource res = resource; res != null; res = res.getParentResource()) {
      if (database.policyExists(res)) {
         return true;
      }
   }
   return false;
}

public void deployPolicy(Resource resource, String[] roleNamesAllowed)
throws ResourceCreationException
{
   System.out.println("SampleAuthorizationProviderImpl.deployPolicy");
   System.out.println("\tresource\t= " + resource);

   for (int i = 0; roleNamesAllowed != null && i < roleNamesAllowed.length;
    i++) {
      System.out.println("\troleNamesAllowed[" + i + "]\t= " +
      roleNamesAllowed[i]);
   }
   database.setPolicy(resource, roleNamesAllowed);
}

public void undeployPolicy(Resource resource) throws ResourceRemovalException
{
   System.out.println("SampleAuthorizationProviderImpl.undeployPolicy");
   System.out.println("\tresource\t= " + resource);

   database.removePolicy(resource);
}

private boolean principalsOrRolesContain(Set principals, Map roles, String
principalOrRoleNameWant)
{
   if (roles.containsKey(principalOrRoleNameWant)) {
```

```
      return true;
   }
   {
      for (Iterator i = principals.iterator(); i.hasNext();) {
         Principal principal = (Principal)i.next();
         String principalNameHave = principal.getName();
         if (principalOrRoleNameWant.equals(principalNameHave)) {
            return true;
         }
      }
   }
   return false;
}

private Result isAccessAllowed(Resource resource, Set principals, Map roles)
{
   for (Enumeration e = database.getPolicy(resource); e.hasMoreElements();)
   {
    String principalOrRoleNameAllowed = (String)e.nextElement();
    if (WLSPrincipals.getEveryoneGroupname().
      equals(principalOrRoleNameAllowed) ||
      (WLSPrincipals.getUsersGroupname().equals(principalOrRoleNameAllowed)
      && !principals.isEmpty()) || principalsOrRolesContain(principals,
      roles, principalOrRoleNameAllowed))
      {
         return Result.PERMIT;
      }
   }
   return Result.DENY;
}
}
```

Generate an MBean Type Using the WebLogic MBeanMaker

Before you start generating an MBean type for your custom security provider, you should first:

- "Understand Why You Need an MBean Type" on page 2-11

- "Determine Which SSPI MBeans to Extend and Implement" on page 2-12

- "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12

- "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15

- "Understand What the WebLogic MBeanMaker Provides" on page 2-17

When you understand this information and have made your design decisions, create the MBean type for your custom Authorization provider by following these steps:

1. "Create an MBean Definition File (MDF)" on page 6-14

2. "Use the WebLogic MBeanMaker to Generate the MBean Type" on page 6-15

3. "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 6-19

4. "Install the MBean Type Into the WebLogic Server Environment" on page 6-20

Notes: Several sample security providers (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) illustrate how to perform these steps.

All instructions provided in this section assume that you are working in a Windows environment.

Create an MBean Definition File (MDF)

To create an MBean Definition File (MDF), follow these steps:

1. Copy the MDF for the sample Authorization provider to a text file.

   Note: The MDF for the sample Authorization provider is called `SampleAuthorizer.xml`.

2. Modify the content of the `<MBeanType>` and `<MBeanAttribute>` elements in your MDF so that they are appropriate for your custom Authorization provider.

3. Add any custom attributes and operations (that is, additional `<MBeanAttribute>` and `<MBeanOperation>` elements) to your MDF.

4. Save the file.

   Note: A complete reference of MDF element syntax is available in Appendix A, "MBean Definition File (MDF) Element Syntax."

Use the WebLogic MBeanMaker to Generate the MBean Type

Once you create your MDF, you are ready to run it through the WebLogic MBeanMaker. The WebLogic MBeanMaker is currently a command-line utility that takes as its input an MDF, and outputs some intermediate Java files, including an MBean interface, an MBean implementation, and an associated MBean information file. Together, these intermediate files form the **MBean type** for your custom security provider.

The instructions for generating an MBean type differ based on the design of your custom Authorization provider. Follow the instructions that are appropriate to your situation:

- "No Optional SSPI MBeans and No Custom Operations" on page 6-15

- "Optional SSPI MBeans or Custom Operations" on page 6-16

No Optional SSPI MBeans and No Custom Operations

If the MDF for your custom Authorization provider does not implement any optional SSPI MBeans *and* does not include any custom operations, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, `xmlFile` is the MDF (the XML MBean Description File) and `filesdir` is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

   Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir`, you are informed that the existing files will be overwritten and are asked to confirm.

   Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

   Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Authorization providers).

3. Proceed to .

Optional SSPI MBeans or Custom Operations

If the MDF for your custom Authorization provider does implement some optional SSPI MBeans *or* does include custom operations, consider the following:

■ Are you creating an MBean type for the first time? If so, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Authorization providers).

3. If you implemented optional SSPI MBeans in your MDF, follow these steps:

a. Locate the MBean implementation file.

The MBean implementation file generated by the WebLogic MBeanMaker is named *MBeanName*Impl.java. For example, for the MDF named SampleAuthorizer, the MBean implementation file to be edited is named SampleAuthorizerImpl.java.

b. For each optional SSPI MBean that you implemented in your MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

4. If you included any custom operations in your MDF, implement the methods using the method stubs.

5. Save the file.

6. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 6-19.

■ Are you updating an existing MBean type? If so, follow these steps:

1. Copy your existing MBean implementation file to a temporary directory so that your current method implementations are not overwritten by the WebLogic MBeanMaker.

2. Create a new DOS shell.

3. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, `xmlFile` is the MDF (the XML MBean Description File) and `filesdir` is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir`, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Authorization providers).

4. If you implemented optional SSPI MBeans in your MDF, follow these steps:

a. Locate the MBean implementation file.

The MBean implementation file generated by the WebLogic MBeanMaker is named *MBeanName*Impl.java. For example, for the MDF named SampleAuthorizer, the MBean implementation file to be edited is named SampleAuthorizerImpl.java.

b. Open your existing MBean implementation file (which you saved to a temporary directory in step 1).

c. Synchronize the existing MBean implementation file with the MBean implementation file generated by the WebLogic MBeanMaker.

Accomplishing this task may include, but is not limited to: copying the method implementations from your existing MBean implementation file into the newly-generated MBean implementation file (or, alternatively, adding the new methods from the newly-generated MBean implementation file to your existing MBean implementation file), and verifying that any changes to method signatures are reflected in the version of the MBean implementation file that you are going to use (for methods that exist in both MBean implementation files).

d. If you modified the MDF to implement optional SSPI MBeans that were not in the original MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

5. If you modified the MDF to include any custom operations that were not in the original MDF, implement the methods using the method stubs.

6. Save the version of the MBean implementation file that is complete (that is, has all methods implemented).

7. Copy this MBean implementation file into the directory where the WebLogic MBeanMaker placed the intermediate files for the MBean type. You specified this as *filesdir* in step 3. (You will be overriding the MBean implementation file generated by the WebLogic MBeanMaker as a result of step 3.)

8. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 6-19.

About the Generated MBean Interface File

The MBean interface file is the client-side API to the MBean that your runtime class or your MBean implementation will use to obtain configuration data. It is typically used in the initialize method as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

Because the WebLogic MBeanMaker generates MBean types from the MDF you created, the generated MBean interface file will have the name of the MDF, plus the text "MBean" appended to it. For example, the result of running the `SampleAuthorizer` MDF through the WebLogic MBeanMaker will yield an MBean interface file called `SampleAuthorizerMBean.java`.

Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)

Once your have run your MDF through the WebLogic MBeanMaker to generate your intermediate files, and you have edited the MBean implementation file to supply implementations for the appropriate methods within it, you need to package the MBean files *and the runtime classes* for the custom Authorization provider into an MBean JAR File (MJF). The WebLogic MBeanMaker also automates this process.

To create an MJF for your custom Authorization provider, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMJF=jarfile -Dfiles=filesdir
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMJF` flag indicates that the WebLogic MBeanMaker should build a JAR file containing the new MBean types, `jarfile` is the name for the MJF and `filesdir` is the location where the WebLogic MBeanMaker looks for the files to JAR into the MJF.

   Compilation occurs at this point, so errors are possible. If `jarfile` is provided, and no errors occur, an MJF is created with the specified name.

Notes: If you want to update an existing MJF, simply delete the MJF and regenerate it. The WebLogic MBeanMaker also has a -DIncludeSource option, which controls whether source files are included into the resulting MJF. Source files include both the generated source and the MDF itself. The default is false. This option is ignored when -DMJF is not used.

The resulting MJF can be installed into your WebLogic Server environment, or distributed to your customers for installation into their WebLogic Server environments.

Install the MBean Type Into the WebLogic Server Environment

To install an MBean type into the WebLogic Server environment, copy the MJF into the *WL_HOME*\server\lib\mbeantypes directory, where *WL_HOME* is the top-level installation directory for WebLogic Server. This "deploys" your custom Authorization provider—that is, it makes the custom Authorization provider manageable from the WebLogic Server Administration Console.

Notes: *WL_HOME*\server\lib\mbeantypes is the default directory for installing MBean types. However, if you want WebLogic Server to look for MBean types in *additional* directories, use the -Dweblogic.alternateTypesDirectory=*<dir>* command-line flag when starting your server, where *<dir>* is a comma-separated list of directory names. When you use this flag, WebLogic Server will always load MBean types from *WL_HOME*\server\lib\mbeantypes first, then will look in the additional directories and load all valid archives present in those directories (regardless of their extension). For example, if -Dweblogic.alternateTypesDirectory = dirX,dirY, WebLogic Server will first load MBean types from *WL_HOME*\server\lib\mbeantypes, then any valid archives present in dirX and dirY.

If you instruct WebLogic Server to look in additional directories for MBean types and are using the Java Security Manager, you must also update the weblogic.policy file to grant appropriate permissions for the MBean type (and thus, the custom security provider). For more information, see "Using the Java Security Manager to Protect WebLogic Resources" in *Programming WebLogic Security*.

It is advisable to keep non-security provider JARs, including backup files, out of the *WL_HOME*\server\lib\mbeantypes directory.

You can create instances of the MBean type by configuring your custom Authorization provider (see "Configure the Custom Authorization Provider Using the Administration Console" on page 6-21), and then use those MBean instances from a GUI, from other Java code, or from APIs. For example, you can use the WebLogic Server Administration Console to get and set attributes and invoke operations, or you can develop other Java objects that instantiate MBeans and automatically respond to information that the MBeans supply. We recommend that you back up these MBean instances. For more information, see "Backing Up Security Configuration Data" under "Recovering Failed Servers" in *Creating and Configuring WebLogic Server Domains*.

Configure the Custom Authorization Provider Using the Administration Console

Configuring a custom Authorization provider means that you are adding the custom Authorization provider to your security realm, where it can be accessed by applications requiring authorization services.

Configuring custom security providers is an administrative task, but it is a task that may also be performed by developers of custom security providers. This section contains information that is important for the person configuring your custom Authorization providers:

- "Managing Authorization Providers and Deployment Descriptors" on page 6-21
- "Enabling Security Policy Deployment" on page 6-24

Note: The steps for configuring a custom Authorization provider using the WebLogic Server Administration Console are described under "Configuring a Custom Security Provider" in *Managing WebLogic Security*.

Managing Authorization Providers and Deployment Descriptors

Some application components, such as Enterprise JavaBeans (EJBs) and Web applications, store relevant deployment information in Java 2 Enterprise Edition (J2EE) and WebLogic Server deployment descriptors. For Web applications, the deployment descriptor files (called `web.xml` and `weblogic.xml`) contain information for implementing the J2EE security model, including declarations of security policies. Typically, you will want to include this information when first configuring your Authorization providers in the WebLogic Server Administration Console.

The Administration Console provides an Ignore Security Data in Deployment Descriptors check box for this purpose, which you or an administrator should be sure is unchecked the first time a custom Authorization provider is configured.

Notes: The Ignore Security Data in Deployment Descriptors check box is unchecked by default. To locate this check box, click Security →Realms →*realm* in the left pane of the Administration Console, where *realm* is the name of your security realm. Then select the General tab.

When this box is unchecked and a Web application is deployed, WebLogic Server reads security policy information from the web.xml and weblogic.xml deployment descriptor files (examples of web.xml and weblogic.xml files are shown in Listing 6-3 and Listing 6-4). This information is then copied into the security provider database for the Authorization provider.

Listing 6-3   Sample web.xml File

```
<web-app>

   <welcome-file-list>
      <welcome-file>welcome.jsp</welcome-file>
   </welcome-file-list>

   <security-constraint>
      <web-resource-collection>
         <web-resource-name>Success</web-resource-name>
         <url-pattern>/welcome.jsp</url-pattern>
         <http-method>GET</http-method>
         <http-method>POST</http-method>
      </web-resource-collection>
      <auth-constraint>
         <role-name>developers</role-name>
      </auth-constraint>
   </security-constraint>

   <login-config>
      <auth-method>BASIC</auth-method>
      <realm-name>default</realm-name>
   </login-config>

   <security-role>
      <role-name>developers</role-name>
   </security-role>

</web-app>
```

Listing 6-4   Sample weblogic.xml File

```
<weblogic-web-app>
   <security-role-assignment>
      <role-name>developers</role-name>
      <principal-name>myGroup</principal-name>
   </security-role-assignment>
</weblogic-web-app>
```

While you can set additional security policies in the `web.xml/weblogic.xml` deployment descriptors *and* in the Administration Console, BEA recommends that you copy the security policies defined in the Web application deployment descriptors once, then use the Administration Console to define subsequent security policies. This is because any changes made to the security policies through the Administration Console during configuration of an Authorization provider will **not** be persisted to the `web.xml` and `weblogic.xml` files. Before you deploy the Web application again (which will happen if you redeploy it through the Administration Console, modify it on disk, or restart WebLogic Server), you should check the Ignore Security Data in Deployment Descriptors box. If you do not, the security policies defined using the Administration Console will be overwritten by those defined in the deployment descriptors. For more information, see "Using the Combined Technique to Secure Your URL (Web) and Enterprise JavaBean (EJB) Resources" in *Securing WebLogic Resources*.

Notes: The same process applies to EJBs, but with the `ejb-jar.xml/weblogic-ejb-jar.xml` deployment descriptors.

The Ignore Security Data in Deployment Descriptors check box also affects Role Mapping providers and Credential Mapping providers. For more information, see "Managing Role Mapping Providers and Deployment Descriptors" on page 8-24 and "Managing Credential Mapping Providers, Resource Adapters, and Deployment Descriptors" on page 10-16, respectively.

Enabling Security Policy Deployment

If you implemented the DeployableAuthorizationProvider SSPI and want to support deployable security policies with your custom Authorization provider, the person configuring the custom Authorization provider (that is, you or an administrator) must be sure that the Policy Deployment Enabled check box in the WebLogic Server Administration Console is checked. Otherwise, deployment for the Authorization provider is considered "turned off." Therefore, if multiple Authorization providers are configured, the Policy Deployment Enabled check box can be used to control which Authorization provider is used for security policy deployment.

Note: The Ignore Security Data in Deployment Descriptors check box (specified at the security realm level and described in "Managing Authorization Providers and Deployment Descriptors" on page 6-21) determines whether you want security policies to be copied into the security databases for the configured Authorization providers. The Policy Deployment Enabled check box (specified for each configured Authorization provider) determines whether or not the Authorization provider is the one that stores the deployed security policy.

Provide a Mechanism for Security Policy Management

While configuring a custom Authorization provider via the WebLogic Server Administration Console makes it accessible by applications requiring authorization services, you also need to supply administrators with a way to manage this security provider's associated security policies. The WebLogic Authorization provider, for example, supplies administrators with a Policy Editor page (see Figure 6-2) that allows them to add, modify, or remove security policies for various WebLogic resources by right-clicking on the resource and selecting the Define Policy... option.

Figure 6-2   WebLogic Authorization Provider's Policy Editor Page

Neither the Policy Editor page nor the right-click access to it is available to administrators when you develop a custom Authorization provider. Therefore, you must provide your own mechanism for security policy management. This mechanism must read and write security policy data (that is, expressions) to and from the custom Authorization provider's database.

You can accomplish this task in one of three ways:

- "Option 1: Create Your Own "Policy Editor" Page Using Console Extensions" on page 6-26

- "Option 2: Develop a Stand-Alone Tool for Security Policy Management" on page 6-27

- "Option 3: Integrate an Existing Security Policy Management Tool into the Administration Console" on page 6-28

Option 1: Create Your Own "Policy Editor" Page Using Console Extensions

The main benefit of creating console extensions for your custom Authorization provider is that the console extension provides you with the ID for the WebLogic resource and therefore, the WebLogic resource's location in the resource hierarchy. (This information is required to read and write expressions to and from the Authorization provider's database.) An additional benefit is that your page can be integrated into the existing WebLogic Server Administration Console GUI, like the Policy Editor page provided with the WebLogic Authorization provider.

If you selected this option, you need to:

1. Implement the `getExtensionForPolicy()` method of the `weblogic.management.console.extensibility.SecurityExtension` interface, and have this method return your Policy Editor page.

   Note: For more information, see Chapter 12, "Writing Console Extensions for Custom Security Providers."

2. In addition, you must do *one* of the following:

   a. Implement the `PolicyEditor` and `PolicyReader` optional Authorization SSPI MBeans to develop a management MBean that will act as an intermediary between your Policy Editor page and the Authorization provider's database.

For more information, see "Determine Which SSPI MBeans to Extend and Implement" on page 2-12 and Table 2-4, "Optional Authorization SSPI MBeans," on page 2-21.

In this case, you also need to develop a syntax for the expressions that make up a security policy that can be represented as a string. (For example, `Role=Admin` or `Group=Administrators`.)

Note: This syntax can be different for different Authorization providers. For more information about expressions, see "Components of a Security Policy: Policy Conditions, Expressions, and Policy Statements" in *Securing WebLogic Resources*.

b. Develop your own MBean APIs for managing security policies, and implement those interfaces to develop a management MBean that will act as an intermediary between your Policy Editor page and the Authorization provider's database.

c. Have your page read and write the expressions from and to the custom Authorization provider's database directly, without delegating to an MBean.

Option 2: Develop a Stand-Alone Tool for Security Policy Management

You would typically select this option if you want to develop a tool that is entirely separate from the WebLogic Server Administration Console.

For this option, you do not need to write any console extensions for your custom Authorization provider, nor do you need to develop any management MBeans as described in "Option 1: Create Your Own "Policy Editor" Page Using Console Extensions" on page 6-26. However, your tool needs to:

1. Determine the WebLogic resource's ID, since it is not automatically provided to you by the console extension. For more information, see "WebLogic Resource Identifiers" on page 2-25.

2. Determine how to represent the expressions that make up a security policy. (This representation is entirely up to you and need not be a string as in "Option 1: Create Your Own "Policy Editor" Page Using Console Extensions" on page 6-26)

3. Read and write the expressions from and to the custom Authorization provider's database.

Option 3: Integrate an Existing Security Policy Management Tool into the Administration Console

You would typically select this option if you have a tool that is separate from the WebLogic Server Administration Console, but you want to launch that tool from the Administration Console.

For this option, your tool needs to:

1. Determine the WebLogic resource's ID, since it is not automatically provided to you by the console extension. For more information, see "WebLogic Resource Identifiers" on page 2-25.

2. Determine how to represent the expressions that make up a security policy. (This representation is entirely up to you and need not be a string as in "Option 1: Create Your Own "Policy Editor" Page Using Console Extensions" on page 6-26)

3. Read and write the expressions from and to the custom Authorization provider's database.

4. Link into the Administration Console using basic console extension techniques, as described in *Extending the Administration Console*.

7 **Adjudication Providers**

Adjudication involves resolving any authorization conflicts that may occur when more than one Authorization provider is configured, by weighing the result of each Authorization provider's Access Decision. In WebLogic Server, an Adjudication provider is used to tally the results that multiple Access Decisions return, and determines the final PERMIT or DENY decision. An Adjudication provider may also specify what should be done when an answer of ABSTAIN is returned from a single Authorization provider's Access Decision.

The following sections describe Adjudication provider concepts and functionality, and provide step-by-step instructions for developing a custom Adjudication provider:

- "The Adjudication Process" on page 7-1
- "Do You Need to Develop a Custom Adjudication Provider?" on page 7-2
- "How to Develop a Custom Adjudication Provider" on page 7-3

The Adjudication Process

The use of Adjudication providers is part of the authorization process, and is described in "The Authorization Process" on page 6-2.

Do You Need to Develop a Custom Adjudication Provider?

The default (that is, active) security realm for WebLogic Server includes a WebLogic Adjudication provider. The WebLogic Adjudication provider is responsible for adjudicating between potentially differing results rendered by multiple Authorization providers' Access Decisions, and rendering a final verdict on whether or not access will be granted to a WebLogic resource.

The WebLogic Adjudication provider has an attribute called Require Unanimous Permit that governs its behavior. By default, the Require Unanimous Permit attribute is set to `TRUE`, which causes the WebLogic Adjudication provider to act as follows:

- If all the Authorization providers' Access Decisions return `PERMIT`, then return a final verdict of `TRUE` (that is, permit access to the WebLogic resource).

- If some Authorization providers' Access Decisions return `PERMIT` and others return `ABSTAIN`, then return a final verdict of `FALSE` (that is, deny access to the WebLogic resource).

- If any of the Authorization providers' Access Decisions return `ABSTAIN` or `DENY`, then return a final verdict of `FALSE` (that is, deny access to the WebLogic resource).

If you change the Require Unanimous Permit attribute to `FALSE`, the WebLogic Adjudication provider acts as follows:

- If all the Authorization providers' Access Decisions return `PERMIT`, then return a final verdict of `TRUE` (that is, permit access to the WebLogic resource).

- If some Authorization providers' Access Decisions return `PERMIT` and others return `ABSTAIN`, then return a final verdict of `TRUE` (that is, permit access to the WebLogic resource).

- If any of the Authorization providers' Access Decisions return `DENY`, then return a final verdict of `FALSE` (that is, deny access to the WebLogic resource).

Note: You set the Require Unanimous Permit attributes when you configure the WebLogic Adjudication provider. For more information about configuring the WebLogic Adjudication provider, see "Configuring a WebLogic Adjudication Provider" in *Managing WebLogic Security*.

If you want an Adjudication provider that behaves in a way that is different from what is described above, then you need to develop a custom Adjudication provider. (Keep in mind that an Adjudication provider may also specify what should be done when an answer of ABSTAIN is returned from a single Authorization provider's Access Decision, based on your specific security requirements.)

How to Develop a Custom Adjudication Provider

If the WebLogic Adjudication provider does not meet your needs, you can develop a custom Adjudication provider by following these steps:

1. "Create Runtime Classes Using the Appropriate SSPIs" on page 7-3

2. "Generate an MBean Type Using the WebLogic MBeanMaker" on page 7-5

3. "Configure the Custom Adjudication Provider Using the Administration Console" on page 7-11

Create Runtime Classes Using the Appropriate SSPIs

Before you start creating runtime classes, you should first:

■   "Understand the Purpose of the "Provider" SSPIs" on page 2-3

■   "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes" on page 2-7

When you understand this information and have made your design decisions, create the runtime classes for your custom Adjudication provider by following these steps:

- "Implement the AdjudicationProvider SSPI" on page 7-4

- "Implement the Adjudicator SSPI" on page 7-4

Implement the AdjudicationProvider SSPI

To implement the `AdjudicationProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3 *and* the following method:

getAdjudicator

```
public Adjudicator getAdjudicator()
```

The `getAdjudicator` method obtains the implementation of the `Adjudicator` SSPI. For a single runtime class called `MyAdjudicationProviderImpl.java`, the implementation of the `getAdjudicator` method would be:

```
return this;
```

If there are two runtime classes, then the implementation of the `getAdjudicator` method could be:

```
return new MyAdjudicatorImpl;
```

This is because the runtime class that implements the `AdjudicationProvider` SSPI is used as a factory to obtain classes that implement the `Adjudicator` SSPI.

For more information about the `AdjudicationProvider` SSPI and the `getAdjudicator` method, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the Adjudicator SSPI

To implement the `Adjudicator` SSPI, provide implementations for the following methods:

initialize

```
public void initialize(String[] accessDecisionClassNames)
```

The `initialize` method initializes the names of all the configured Authorization providers' Access Decisions that will be called to supply a result for the "is access allowed?" question. The `accessDecisionClassNames` parameter may also be used by an Adjudication provider in its `adjudicate`

method to favor a result from a particular Access Decision. For more information about Authorization providers and Access Decisions, see Chapter 6, "Authorization Providers."

adjudicate

```
public boolean adjudicate(Result[] results)
```

The `adjudicate` method determines the answer to the "is access allowed?" question, given all the results from the configured Authorization providers' Access Decisions.

For more information about the `Adjudicator` SSPI and the `initialize` and `adjudicate` methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Generate an MBean Type Using the WebLogic MBeanMaker

Before you start generating an MBean type for your custom security provider, you should first:

- "Understand Why You Need an MBean Type" on page 2-11

- "Determine Which SSPI MBeans to Extend and Implement" on page 2-12

- "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12

- "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15

- "Understand What the WebLogic MBeanMaker Provides" on page 2-17

When you understand this information and have made your design decisions, create the MBean type for your custom Adjudication provider by following these steps:

1. "Create an MBean Definition File (MDF)" on page 7-6

2. "Use the WebLogic MBeanMaker to Generate the MBean Type" on page 7-6

3. "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 7-9

Notes: Several sample security providers (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) illustrate how to perform these steps.

All instructions provided in this section assume that you are working in a Windows environment.

Create an MBean Definition File (MDF)

To create an MBean Definition File (MDF), follow these steps:

1. Copy the MDF for the sample Authentication provider to a text file.

   Note: The MDF for the sample Authentication provider is called `SampleAuthenticator.xml.` (There is currently no sample Adjudication provider.)

2. Modify the content of the `<MBeanType>` and `<MBeanAttribute>` elements in your MDF so that they are appropriate for your custom Adjudication provider.

3. Add any custom attributes and operations (that is, additional `<MBeanAttribute>` and `<MBeanOperation>` elements) to your MDF.

4. Save the file.

   Note: A complete reference of MDF element syntax is available in Appendix A, "MBean Definition File (MDF) Element Syntax."

Use the WebLogic MBeanMaker to Generate the MBean Type

Once you create your MDF, you are ready to run it through the WebLogic MBeanMaker. The WebLogic MBeanMaker is currently a command-line utility that takes as its input an MDF, and outputs some intermediate Java files, including an MBean interface, an MBean implementation, and an associated MBean information file. Together, these intermediate files form the **MBean type** for your custom security provider.

The instructions for generating an MBean type differ based on the design of your custom Adjudication provider. Follow the instructions that are appropriate to your situation:

■ "No Custom Operations" on page 7-7

■ "Custom Operations" on page 7-7

No Custom Operations

If the MDF for your custom Adjudication provider does not include any custom operations, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, `xmlFile` is the MDF (the XML MBean Description File) and `filesdir` is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir`, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Adjudication providers).

3. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 7-9.

Custom Operations

If the MDF for your custom Adjudication provider does include custom operations, consider the following:

■ Are you creating an MBean type for the first time? If so, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Adjudication providers).

3. For any custom operations in your MDF, implement the methods using the method stubs.

4. Save the file.

5. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 7-9.

- Are you updating an existing MBean type? If so, follow these steps:

1. Copy your existing MBean implementation file to a temporary directory so that your current method implementations are not overwritten by the WebLogic MBeanMaker.

2. Create a new DOS shell.

3. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Adjudication providers).

4. If you modified the MDF to include any custom operations that were not in the original MDF, implement the methods using the method stubs.

5. Save the version of the MBean implementation file that is complete (that is, has all methods implemented).

6. Copy this MBean implementation file into the directory where the WebLogic MBeanMaker placed the intermediate files for the MBean type. You specified this as *filesdir* in step 3. (You will be overriding the MBean implementation file generated by the WebLogic MBeanMaker as a result of step 3.)

7. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 7-9.

About the Generated MBean Interface File

The MBean interface file is the client-side API to the MBean that your runtime class or your MBean implementation will use to obtain configuration data. It is typically used in the initialize method as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

Because the WebLogic MBeanMaker generates MBean types from the MDF you created, the generated MBean interface file will have the name of the MDF, plus the text "MBean" appended to it. For example, the result of running the `MyAdjudicator` MDF through the WebLogic MBeanMaker will yield an MBean interface file called `MyAdjudicatorMBean.java`.

Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)

Once your have run your MDF through the WebLogic MBeanMaker to generate your intermediate files, and you have edited the MBean implementation file to supply implementations for the appropriate methods within it, you need to package the MBean files *and the runtime classes* for the custom Adjudication provider into an MBean JAR File (MJF). The WebLogic MBeanMaker also automates this process.

To create an MJF for your custom Adjudication provider, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMJF=jarfile -Dfiles=filesdir
weblogic.management.commo.WebLogicMBeanMaker
```

   where the -DMJF flag indicates that the WebLogic MBeanMaker should build a JAR file containing the new MBean types, *jarfile* is the name for the MJF and *filesdir* is the location where the WebLogic MBeanMaker looks for the files to JAR into the MJF.

   Compilation occurs at this point, so errors are possible. If *jarfile* is provided, and no errors occur, an MJF is created with the specified name.

Notes: If you want to update an existing MJF, simply delete the MJF and regenerate it. The WebLogic MBeanMaker also has a -DIncludeSource option, which controls whether source files are included into the resulting MJF. Source files include both the generated source and the MDF itself. The default is false. This option is ignored when -DMJF is not used.

The resulting MJF can be installed into your WebLogic Server environment, or distributed to your customers for installation into their WebLogic Server environments.

Install the MBean Type Into the WebLogic Server Environment

To install an MBean type into the WebLogic Server environment, copy the MJF into the *WL_HOME*\server\lib\mbeantypes directory, where *WL_HOME* is the top-level installation directory for WebLogic Server. This "deploys" your custom Adjudication provider—that is, it makes the custom Adjudication provider manageable from the WebLogic Server Administration Console.

Notes: *WL_HOME*\server\lib\mbeantypes is the default directory for installing MBean types. However, if you want WebLogic Server to look for MBean types in *additional* directories, use the -Dweblogic.alternateTypesDirectory=<dir> command-line flag when starting your server, where <dir> is a comma-separated list of directory names. When you use this flag, WebLogic Server will always load MBean types from *WL_HOME*\server\lib\mbeantypes first, then will look in the additional directories and load all valid archives present in those directories (regardless of their extension). For example, if -Dweblogic.alternateTypesDirectory = dirX,dirY, WebLogic

Server will first load MBean types from
WL_HOME\server\lib\mbeantypes, then any valid archives present in `dirX`
and `dirY`.

If you instruct WebLogic Server to look in additional directories for MBean
types and are using the Java Security Manager, you must also update the
`weblogic.policy` file to grant appropriate permissions for the MBean type
(and thus, the custom security provider). For more information, see "Using the
Java Security Manager to Protect WebLogic Resources" in *Programming
WebLogic Security*.

It is advisable to keep non-security provider JARs, including backup files, out
of the *WL_HOME*\server\lib\mbeantypes directory.

You can create instances of the MBean type by configuring your custom Adjudication
provider (see "Configure the Custom Adjudication Provider Using the Administration
Console" on page 7-11), and then use those MBean instances from a GUI, from other
Java code, or from APIs. For example, you can use the WebLogic Server
Administration Console to get and set attributes and invoke operations, or you can
develop other Java objects that instantiate MBeans and automatically respond to
information that the MBeans supply. We recommend that you back up these MBean
instances. For more information, see "Backing Up Security Configuration Data" under
"Recovering Failed Servers" in *Creating and Configuring WebLogic Server Domains*.

Configure the Custom Adjudication Provider Using the Administration Console

Configuring a custom Adjudication provider means that you are adding the custom
Adjudication provider to your security realm, where it can be accessed by applications
requiring adjudication services.

Configuring custom security providers is an administrative task, but it is a task that
may also be performed by developers of custom security providers. The steps for
configuring a custom Adjudication provider using the WebLogic Server
Administration Console are described under "Configuring a Custom Security
Provider" in *Managing WebLogic Security*.

8 Role Mapping Providers

Role mapping is the process whereby principals (users or groups) are dynamically mapped to security roles at runtime. In WebLogic Server, a Role Mapping provider determines what security roles apply to the principals stored a subject when the subject is attempting to perform an operation on a WebLogic resource. Because this operation usually involves gaining access to the WebLogic resource, Role Mapping providers are typically used with Authorization providers.

The following sections describe Role Mapping provider concepts and functionality, and provide step-by-step instructions for developing a custom Role Mapping provider:

Role Mapping Concepts

Before you develop a Role Mapping provider, you need to understand the following concepts:

■ "Security Providers and WebLogic Resources" on page 2-23

Security Roles

A **security role** is a named collection of users or groups that have similar permissions to access WebLogic resources. Like groups, security roles allow you to control access to WebLogic resources for several users at once. However, security roles are scoped to specific resources in a WebLogic Server domain (unlike groups, which are scoped to an entire WebLogic Server domain), and can be defined dynamically (as described in "Dynamic Security Role Computation" on page 8-3).

Notes: For more information about security roles, see "Security Roles" in *Securing WebLogic Resources*. For more information about WebLogic resources, see "Security Providers and WebLogic Resources" on page 2-23, and "WebLogic Resources" in *Securing WebLogic Resources*.

The SecurityRole interface in the weblogic.security.service package is used to represent the abstract notion of a security role. (For more information, see the *WebLogic Server 7.0 API Reference Javadoc* for the SecurityRole interface.)

Mapping a principal to a security role grants the defined access permissions to that principal, as long as the principal is "in" the security role. For example, an application may define a security role called AppAdmin, which provides write access to a small subset of that application's resources. Any principal in the AppAdmin security role would then have write access to those resources. For more information, see "Dynamic Security Role Computation" on page 8-3 and "Security Roles" in *Securing WebLogic Resources*.

Many principals can be mapped to a single security role. For more information about principals, see "Users and Groups, Principals and Subjects" on page 3-2.

Security roles are specified in Java 2 Enterprise Edition (J2EE) deployment descriptor files and/or in the WebLogic Server Administration Console. For more information, see "Managing Role Mapping Providers and Deployment Descriptors" on page 8-24.

Dynamic Security Role Computation

Security roles can be declarative (that is, Java 2 Enterprise Edition roles) or dynamically computed based on the context of the request.

Dynamic role computation is the term for this late binding of principals (that is, users or groups) to security roles at runtime. The late binding occurs just prior to an authorization decision for a protected WebLogic resource, regardless of whether the principal-to-security role association is statically defined or dynamically computed. Because of its placement in the invocation sequence, the result of any principal-to-security role computations can be taken as an authentication identity, as part of the authorization decision made for the request.

This dynamic computation of security roles provides a very important benefit: users or groups can be granted a security role based on business rules. For example, a user may be allowed to be in a `Manager` security role only while the actual manager is away on an extended business trip. Dynamically computing this security role means that you do not need to change or redeploy your application to allow for such a temporarily arrangement. Further, you would not need to remember to revoke the special privileges when the actual manager returns, as you would if you temporarily added the user to a `Managers` group.

Note: You typically grant users or groups security roles using the role conditions available in the WebLogic Server Administration Console. (In this release of WebLogic Server, you cannot write custom role conditions.) For more information, see "Security Roles" in *Securing WebLogic Resources*.

The computed security role is able to access a number of pieces of information that make up the context of the request, including the identity of the target (if available) and the parameter values of the request. The context information is typically used as values of parameters in an expression that is evaluated by the WebLogic Security Framework. This functionality is also responsible for computing security roles that were statically defined through a deployment descriptor or through the WebLogic Server Administration Console.

Notes: The computation of security roles for an authenticated user enhances the Role-Based Access Control (RBAC) security defined by the Java 2 Enterprise Edition (J2EE) specification.

You create dynamic security role computations by defining role statements in the WebLogic Server Administration Console. For more information, see "Security Roles" in *Securing WebLogic Resources*.

The Role Mapping Process

The WebLogic Security Framework calls each Role Mapping provider that is configured for a security realm as part of an authorization decision. For related information, see "The Authorization Process" on page 6-2.

The result of the dynamic role computation (performed by the Role Mapping providers) is a set of security roles that apply to the principals stored in a subject at a given moment. These security roles can then be used to make authorization decisions for protected WebLogic resources, as well as for resource container and application code. For example, an Enterprise JavaBean (EJB) could use the Java 2 Enterprise Edition (J2EE) isCallerInRole method to retrieve fields from a record in a database, without having knowledge of the business policies that determine whether access is allowed.

Figure 8-1 shows how the Role Mapping providers interact with the WebLogic Security Framework to create dynamic role computations, and an explanation follows.

Figure 8-1   Role Mapping Providers and the Role Mapping Process
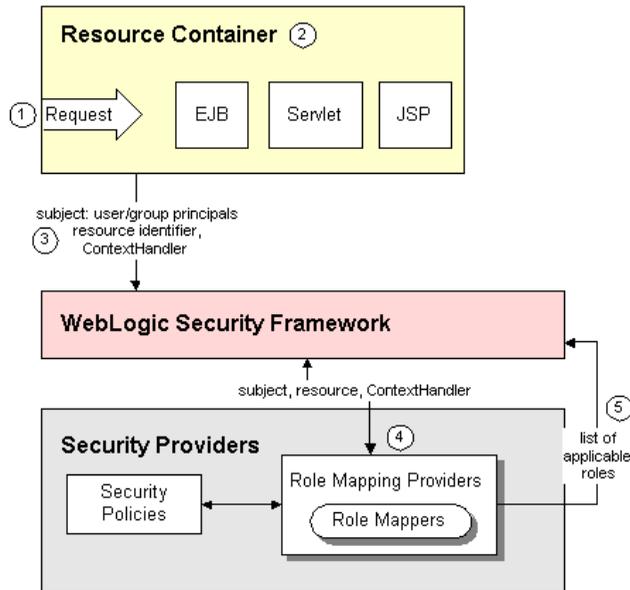
Generally, role mapping is performed in the following manner:

1. A user or system process requests a WebLogic resource on which it will attempt to perform a given operation.

2. The resource container that handles the type of WebLogic resource being requested receives the request (for example, the EJB container receives the request for an EJB resource).

    Note: The resource container could be the container that handles any one of the WebLogic Resources described in "Security Providers and WebLogic Resources" on page 2-23.

3. The resource container constructs a `ContextHandler` object that may be used by Role Mapping providers to obtain information associated with the context of the request.

    Note: For more information about ContextHandlers, see "ContextHandlers and WebLogic Resources" on page 2-33.

The resource container calls the WebLogic Security Framework, passing in the subject (which already contains user and group principals), an identifier for the WebLogic resource, and optionally, the ContextHandler object (to provide additional input).

Note: For more information about subjects, see "Users and Groups, Principals and Subjects" on page 3-2. For more information about resource identifiers, see "WebLogic Resource Identifiers" on page 2-25.

4. The WebLogic Security Framework calls each configured Role Mapping provider to obtain a list of the security roles that apply. This works as follows:

a. The Role Mapping providers use the ContextHandler to request various pieces of information about the request. They construct a set of Callback objects that represent the type of information being requested. This set of Callback objects is then passed as an array to the ContextHandler using the handle method.

The Role Mapping providers may call the ContextHandler more than once in order to obtain the necessary context information. (The number of times a Role Mapping provider calls the ContextHandler is dependent upon its implementation.)

b. Using the context information and their associated security provider databases containing security policies, the subject, and the WebLogic resource, the Role Mapping providers determine whether the requestor (represented by the user and group principals in the subject) is entitled to a certain security role.

The security policies are represented as a set of expressions or rules that are evaluated to determine if a given security role is to be granted. These rules may require the Role Mapping provider to substitute the value of context information obtained as parameters into the expression. In addition, the rules may also require the identity of a user or group principal as the value of an expression parameter.

Note: The rules for security policies are set up in the WebLogic Server Administration Console and in Java 2 Enterprise Edition (J2EE) deployment descriptors. For more information, see "Security Policies" in *Securing WebLogic Resources*.

c. If a security policy specifies that the requestor is entitled to a particular security role, the security role is added to the list of security roles that are applicable to the subject.

    d. This process continues until all security policies that apply to the WebLogic resource or the resource container have been evaluated.

5. The list of security roles is returned to the WebLogic Security Framework, where it can be used as part of other operations, such as access decisions.

Do You Need to Develop a Custom Role Mapping Provider?

The default (that is, active) security realm for WebLogic Server includes a WebLogic Role Mapping provider. The WebLogic Role Mapping provider computes dynamic security roles for a specific user (subject) with respect to a specific protected WebLogic resource for each of the default users and WebLogic resources. The WebLogic Role Mapping provider supports the deployment and undeployment of security roles within the system. The WebLogic Role Mapping provider uses the same security policy engine as the WebLogic Authorization provider. If you want to use a role mapping mechanism that already exists within your organization, you could create a custom Role Mapping provider to tie into that system.

How to Develop a Custom Role Mapping Provider

If the WebLogic Role Mapping provider does not meet your needs, you can develop a custom Role Mapping provider by following these steps:

1. "Create Runtime Classes Using the Appropriate SSPIs" on page 8-8

2. "Generate an MBean Type Using the WebLogic MBeanMaker" on page 8-17

3. "Configure the Custom Role Mapping Provider Using the Administration Console"

Create Runtime Classes Using the Appropriate SSPIs

Before you start creating runtime classes, you should first:

- "Understand the Purpose of the "Provider" SSPIs" on page 2-3

- "Determine Which "Provider" Interface You Will Implement" on page 2-5

- "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes"

When you understand this information and have made your design decisions, create the runtime classes for your custom Role Mapping provider by following these steps:

- "Implement the RoleProvider SSPI" on page 8-8 *or* "Implement the DeployableRoleProvider SSPI" on page 8-9

- "Implement the RoleMapper SSPI" on page 8-10

- "Implement the SecurityRole Interface" on page 8-11

Note: At least one Role Mapping provider in a security realm must implement the `DeployableRoleProvider` SSPI, or else it will be impossible to deploy Web applications and EJBs.

For an example of how to create a runtime class for a custom Role Mapping provider, see "Example: Creating the Runtime Class for the Sample Role Mapping Provider" on page 8-12.

Implement the RoleProvider SSPI

To implement the `RoleProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3 *and* the following method:

getRoleMapper
```
    public RoleMapper getRoleMapper()
```

The `getRoleMapper` method obtains the implementation of the `RoleMapper` SSPI. For a single runtime class called `MyRoleProviderImpl.java`, the implementation of the `getRoleMapper` method would be:

```
return this;
```

If there are two runtime classes, then the implementation of the `getRoleMapper` method could be:

```
return new MyRoleMapperImpl;
```

This is because the runtime class that implements the `RoleProvider` SSPI is used as a factory to obtain classes that implement the `RoleMapper` SSPI.

For more information about the `RoleProvider` SSPI and the `getRoleMapper` method, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the DeployableRoleProvider SSPI

To implement the `DeployableRoleProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3, "Implement the RoleProvider SSPI" on page 8-8, *and* the following methods:

deployRole

```
public void deployRole(Resource resource, java.lang.String
roleName, java.lang.String[] userAndGroupNames) throws
RoleCreationException
```

The `deployRole` method creates a security role on behalf of a deployed Web application or EJB, based on the WebLogic resource to which the security role should apply, the name of the security role within the application, and the user and group names that are in the security role.

undeployRole

```
public void undeployRole(Resource resource, java.lang.String
roleName) throws RoleRemovalException
```

The `undeployRole` method deletes a security role on behalf of an undeployed Web application or EJB, based on the WebLogic resource to which the security role applied and the name of the security role within the application.

For more information about the `DeployableRoleProvider` SSPI and the `deployRole` and `undeployRole` methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the RoleMapper SSPI

To implement the `RoleMapper` SSPI, provide implementations for the following methods:

getRoles

```
public Map getRoles(Subject subject, Resource  resource,
ContextHandler handler)
```

The `getRoles` method returns the security roles associated with a given subject for a specified WebLogic resource, possibly using the optional information specified in the `ContextHandler`. For more information about ContextHandlers, see "ContextHandlers and WebLogic Resources" on page 2-33.

For more information about the `RoleMapper` SSPI and the `getRoles` methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Developing Custom Role Mapping Providers That Are Compatible With the Realm Adapter Authentication Provider

An Authentication provider is the security provider responsible for populating a subject with users and groups, which are then extracted from the subject by other types of security providers, including Role Mapping providers. If the Authentication provider configured in your security realm is a Realm Adapter Authentication provider, the user and group information will be stored in the subject in a way that is slightly different from other Authentication providers. Therefore, this user and group information must also be extracted in a slightly different way.

Listing 8-1 provides code that can be used by custom Role Mapping providers to check whether a subject matches a user or group name when a Realm Adapter Authentication provider was used to populate the subject. This code belongs in the `getRoles` method.

Listing 8-1   Sample Code to Check if a Subject Matches a User or Group Name

```
/**
 * Determines if the Subject matches a user/group name.
 *
 * @param principalWant A String containing the name of a principal in this role
 * (that is, the role definition).
 *
 * @param subject A Subject that contains the Principals that identify the user
```

```
 * who is trying to access the resource as well as the user's groups.
 *
 * @return A boolean. true if the current subject matches the name of the
 * principal in the role, false otherwise.
 */
private boolean subjectMatches(String principalWant, Subject subject)
{
   // first, see if it's a group name match
   if (SubjectUtils.isUserInGroup(subject, principalWant)) {
      return true;
   }
   // second, see if it's a user name match
   if (principalWant.equals(SubjectUtils.getUsername(subject))) {
      return true;
   }
   // didn't match
   return false;
}
```

Implement the SecurityRole Interface

The methods on the `SecurityRole` interface allow you to obtain basic information about a security role, or to compare it to another security role. These methods are designed for the convenience of security providers.

Note: `SecurityRole` implementations are returned as a `Map` by the `getRoles()` method (see).

To implement the `SecurityRole` interface, provide implementations for the following methods:

equals

```
public boolean equals( java.lang.Object another )
```

The `equals` method returns `TRUE` if the security role passed in matches the security role represented by the implementation of this interface, and `FALSE` otherwise.

toString

```
public String toString()
```

The `toString` method returns this security role, represented as a String.

hashCode
```
public int hashCode()
```

The `hashCode` method returns a hashcode for this security role, represented as an integer.

getName
```
public String getName()
```

The `getName` method returns the name of this security role, represented as a String.

getDescription
```
public String getDescription()
```

The `getDescription` method returns a description of this security role, represented as a String. The description should describe the purpose of this security role.

Example: Creating the Runtime Class for the Sample Role Mapping Provider

Listing 8-2 shows the `SampleRoleMapperProviderImpl.java` class, which is the runtime class for the sample Role Mapping provider. This runtime class includes implementations for:

- The three methods inherited from the `SecurityProvider` interface: `initialize`, `getDescription` and `shutdown` (as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.)

- The method inherited from the `RoleProvider` SSPI: the `getRoleMapper` method (as described in "Implement the RoleProvider SSPI" on page 8-8).

- The two methods in the `DeployableRoleProvider` SSPI: the `deployRole` and `undeployRole` methods (as described in "Implement the DeployableRoleProvider SSPI" on page 8-9).

- The method in the `RoleMapper` SSPI: the `getRoles` method (as described in "Implement the RoleMapper SSPI" on page 8-10).

Note: The bold face code in Listing 8-2 highlights the class declaration and the method signatures.

Listing 8-2   SampleRoleMapperProviderImpl.java

```java
package examples.security.providers.roles;

import java.security.Principal;
import java.util.Collections;
import java.util.Enumeration;
import java.util.HashMap;
import java.util.Iterator;
import java.util.Map;
import java.util.Properties;
import java.util.Set;
import javax.security.auth.Subject;
import weblogic.management.security.ProviderMBean;
import weblogic.security.WLSPrincipals;
import weblogic.security.service.ContextHandler;
import weblogic.security.spi.DeployableRoleProvider;
import weblogic.security.spi.Resource;
import weblogic.security.spi.RoleCreationException;
import weblogic.security.spi.RoleMapper;
import weblogic.security.spi.RoleRemovalException;
import weblogic.security.spi.SecurityServices;

public final class SampleRoleMapperProviderImpl implements
DeployableRoleProvider, RoleMapper
{
   private String description;
   private SampleRoleMapperDatabase database;
   private static final Map NO_ROLES = Collections.unmodifiableMap(new
     HashMap(1));

   public void initialize(ProviderMBean mbean, SecurityServices services)
   {
      System.out.println("SampleRoleMapperProviderImpl.initialize");
      SampleRoleMapperMBean myMBean = (SampleRoleMapperMBean)mbean;
      description = myMBean.getDescription() + "\n" + myMBean.getVersion();
      database = new SampleRoleMapperDatabase(myMBean);
   }

   public String getDescription()
   {
      return description;
   }

   public void shutdown()
   {
      System.out.println("SampleRoleMapperProviderImpl.shutdown");
   }
```

```
public RoleMapper getRoleMapper()
{
   return this;
}

public Map getRoles(Subject subject, Resource resource, ContextHandler
handler)
{
   System.out.println("SampleRoleMapperProviderImpl.getRoles");
   System.out.println("\tsubject\t= " + subject);
   System.out.println("\tresource\t= " + resource);

   Map roles = new HashMap();
   Set principals = subject.getPrincipals();

   for (Resource res = resource; res != null; res = res.getParentResource())
   {
      getRoles(res, principals, roles);
   }

   getRoles(null, principals, roles);

   if (roles.isEmpty()) {
      return NO_ROLES;
   }

   return roles;
}

public void deployRole(Resource resource, String roleName, String[]
principalNames) throws RoleCreationException
{
   System.out.println("SampleRoleMapperProviderImpl.deployRole");
   System.out.println("\tresource\t\t= " + resource);
   System.out.println("\troleName\t\t= " + roleName);

   for (int i = 0; principalNames != null && i < principalNames.length; i++)
   {
      System.out.println("\tprincipalNames[" + i + "]\t= " +
      principalNames[i]);
   }

   database.setRole(resource, roleName, principalNames);
}

public void undeployRole(Resource resource, String roleName) throws
RoleRemovalException
{
   System.out.println("SampleRoleMapperProviderImpl.undeployRole");
   System.out.println("\tresource\t= " + resource);
   System.out.println("\troleName\t= " + roleName);
```

```
      database.removeRole(resource, roleName);
   }

   private void getRoles(Resource resource, Set principals, Map roles)
   {
      for (Enumeration e = database.getRoles(resource); e.hasMoreElements();)
      {
         String role = (String)e.nextElement();
         if (roleMatches(resource, role, principals))
         {
            roles.put(role, new SampleSecurityRoleImpl(role, "no description"));
         }
      }
   }

   private boolean roleMatches(Resource resource, String role, Set
principalsHave)
   {
      for (Enumeration e = database.getPrincipalsForRole(resource, role);
        e.hasMoreElements();)
      {
         String principalWant = (String)e.nextElement();
         if (principalMatches(principalWant, principalsHave))
         {
            return true;
         }
      }
      return false;
   }

   private boolean principalMatches(String principalWant, Set principalsHave)
   {
      if (WLSPrincipals.getEveryoneGroupname().equals(principalWant) ||
        (WLSPrincipals.getUsersGroupname().equals(principalWant) &&
        !principalsHave.isEmpty()) || (WLSPrincipals.getAnonymousUsername().
        equals(principalWant) && principalsHave.isEmpty()) ||
        principalsContain(principalsHave, principalWant))
        {
           return true;
        }
      return false;
   }

   private boolean principalsContain(Set principalsHave, String
principalNameWant)
   {
      for (Iterator i = principalsHave.iterator(); i.hasNext();)
      {
         Principal principal = (Principal)i.next();
         String principalNameHave = principal.getName();
```

```
         if (principalNameWant.equals(principalNameHave))
         {
            return true;
         }
      }
      return false;
   }
}
```

Listing 8-3 shows the sample `SecurityRole` implementation that is used along with the `SampleRoleMapperProviderImpl.java` runtime class.

Listing 8-3   SampleSecurityRoleImpl.java

```
package examples.security.providers.roles;

import weblogic.security.service.SecurityRole;

public class SampleSecurityRoleImpl implements SecurityRole
{
   private String _roleName;
   private String _description;
   private int _hashCode;

   public SampleSecurityRoleImpl(String roleName, String description)
   {
      _roleName = roleName;
      _description = description;
      _hashCode = roleName.hashCode() + 17;
   }

   public boolean equals(Object secRole)
   {
      if (secRole == null)
      {
         return false;
      }

      if (this == secRole)
      {
         return true;
      }

      if (!(secRole instanceof SampleSecurityRoleImpl))
      {
```

```
      return false;
   }

   SampleSecurityRoleImpl anotherSecRole = (SampleSecurityRoleImpl)secRole;

   if (!_roleName.equals(anotherSecRole.getName()))
   {
      return false;
   }

   return true;
}

public String toString () { return _roleName; }
public int hashCode () { return _hashCode; }
public String getName () { return _roleName; }
public String getDescription () { return _description; }
}
```

Generate an MBean Type Using the WebLogic MBeanMaker

Before you start generating an MBean type for your custom security provider, you should first:

■ "Understand Why You Need an MBean Type" on page 2-11

■ "Determine Which SSPI MBeans to Extend and Implement" on page 2-12

■ "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12

■ "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15

■ "Understand What the WebLogic MBeanMaker Provides" on page 2-17

When you understand this information and have made your design decisions, create the MBean type for your custom Role Mapping provider by following these steps:

1. "Create an MBean Definition File (MDF)" on page 8-18

2. "Use the WebLogic MBeanMaker to Generate the MBean Type" on page 8-18

3. "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 8-22

4. "Install the MBean Type Into the WebLogic Server Environment" on page 8-22

Notes: Several sample security providers (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) illustrate how to perform these steps.

All instructions provided in this section assume that you are working in a Windows environment.

Create an MBean Definition File (MDF)

To create an MBean Definition File (MDF), follow these steps:

1. Copy the MDF for the sample Role Mapping provider to a text file.

   Note: The MDF for the sample Role Mapping provider is called `SampleRoleMapper.xml`.

2. Modify the content of the `<MBeanType>` and `<MBeanAttribute>` elements in your MDF so that they are appropriate for your custom Role Mapping provider.

3. Add any custom attributes and operations (that is, additional `<MBeanAttribute>` and `<MBeanOperation>` elements) to your MDF.

4. Save the file.

   Note: A complete reference of MDF element syntax is available in Appendix A, "MBean Definition File (MDF) Element Syntax."

Use the WebLogic MBeanMaker to Generate the MBean Type

Once you create your MDF, you are ready to run it through the WebLogic MBeanMaker. The WebLogic MBeanMaker is currently a command-line utility that takes as its input an MDF, and outputs some intermediate Java files, including an MBean interface, an MBean implementation, and an associated MBean information file. Together, these intermediate files form the **MBean type** for your custom security provider.

The instructions for generating an MBean type differ based on the design of your custom Role Mapping provider. Follow the instructions that are appropriate to your situation:

-

-

No Custom Operations

If the MDF for your custom Role Mapping provider does not include any custom operations, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, `xmlFile` is the MDF (the XML MBean Description File) and `filesdir` is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

   Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir`, you are informed that the existing files will be overwritten and are asked to confirm.

   Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

   Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Role Mapping providers).

3. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 8-22.

Custom Operations

If the MDF for your custom Role Mapping provider does include custom operations, consider the following:

- Are you creating an MBean type for the first time? If so, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Role Mapping providers).

3. For any custom operations in your MDF, implement the methods using the method stubs.

4. Save the file.

5. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 8-22.

■ Are you updating an existing MBean type? If so, follow these steps:

1. Copy your existing MBean implementation file to a temporary directory so that your current method implementations are not overwritten by the WebLogic MBeanMaker.

2. Create a new DOS shell.

3. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Role Mapping providers).

4. If you modified the MDF to include any custom operations that were not in the original MDF, implement the methods using the method stubs.

5. Save the version of the MBean implementation file that is complete (that is, has all methods implemented).

6. Copy this MBean implementation file into the directory where the WebLogic MBeanMaker placed the intermediate files for the MBean type. You specified this as *filesdir* in step 3. (You will be overriding the MBean implementation file generated by the WebLogic MBeanMaker as a result of step 3.)

7. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 8-22.

About the Generated MBean Interface File

The MBean interface file is the client-side API to the MBean that your runtime class or your MBean implementation will use to obtain configuration data. It is typically used in the initialize method as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

Because the WebLogic MBeanMaker generates MBean types from the MDF you created, the generated MBean interface file will have the name of the MDF, plus the text "MBean" appended to it. For example, the result of running the SampleRoleMapper MDF through the WebLogic MBeanMaker will yield an MBean interface file called SampleRoleMapperMBean.java.

Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)

Once your have run your MDF through the WebLogic MBeanMaker to generate your intermediate files, and you have edited the MBean implementation file to supply implementations for the appropriate methods within it, you need to package the MBean files *and the runtime classes* for the custom Role Mapping provider into an MBean JAR File (MJF). The WebLogic MBeanMaker also automates this process.

To create an MJF for your custom Role Mapping provider, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMJF=jarfile -Dfiles=filesdir
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMJF` flag indicates that the WebLogic MBeanMaker should build a JAR file containing the new MBean types, `jarfile` is the name for the MJF and `filesdir` is the location where the WebLogic MBeanMaker looks for the files to JAR into the MJF.

   Compilation occurs at this point, so errors are possible. If `jarfile` is provided, and no errors occur, an MJF is created with the specified name.

Notes: If you want to update an existing MJF, simply delete the MJF and regenerate it. The WebLogic MBeanMaker also has a `-DIncludeSource` option, which controls whether source files are included into the resulting MJF. Source files include both the generated source and the MDF itself. The default is `false`. This option is ignored when `-DMJF` is not used.

The resulting MJF can be installed into your WebLogic Server environment, or distributed to your customers for installation into their WebLogic Server environments.

Install the MBean Type Into the WebLogic Server Environment

To install an MBean type into the WebLogic Server environment, copy the MJF into the `WL_HOME\server\lib\mbeantypes` directory, where `WL_HOME` is the top-level installation directory for WebLogic Server. This "deploys" your custom Role Mapping provider—that is, it makes the custom Role Mapping provider manageable from the WebLogic Server Administration Console.

Notes: *WL_HOME*\server\lib\mbeantypes is the default directory for installing MBean types. However, if you want WebLogic Server to look for MBean types in *additional* directories, use the -Dweblogic.alternateTypesDirectory=*<dir>* command-line flag when starting your server, where *<dir>* is a comma-separated list of directory names. When you use this flag, WebLogic Server will always load MBean types from *WL_HOME*\server\lib\mbeantypes first, then will look in the additional directories and load all valid archives present in those directories (regardless of their extension). For example, if -Dweblogic.alternateTypesDirectory = dirX,dirY, WebLogic Server will first load MBean types from *WL_HOME*\server\lib\mbeantypes, then any valid archives present in dirX and dirY.

If you instruct WebLogic Server to look in additional directories for MBean types and are using the Java Security Manager, you must also update the weblogic.policy file to grant appropriate permissions for the MBean type (and thus, the custom security provider). For more information, see "Using the Java Security Manager to Protect WebLogic Resources" in *Programming WebLogic Security*.

It is advisable to keep non-security provider JARs, including backup files, out of the *WL_HOME*\server\lib\mbeantypes directory.

You can create instances of the MBean type by configuring your custom Role Mapping provider (see "Configure the Custom Role Mapping Provider Using the Administration Console" on page 8-24), and then use those MBean instances from a GUI, from other Java code, or from APIs. For example, you can use the WebLogic Server Administration Console to get and set attributes and invoke operations, or you can develop other Java objects that instantiate MBeans and automatically respond to information that the MBeans supply. We recommend that you back up these MBean instances. For more information, see "Backing Up Security Configuration Data" under "Recovering Failed Servers" in *Creating and Configuring WebLogic Server Domains*.

Configure the Custom Role Mapping Provider Using the Administration Console

Configuring a custom Role Mapping provider means that you are adding the custom Role Mapping provider to your security realm, where it can be accessed by applications requiring role mapping services.

Configuring custom security providers is an administrative task, but it is a task that may also be performed by developers of custom security providers. This section contains information that is important for the person configuring your custom Role Mapping providers:

- "Managing Role Mapping Providers and Deployment Descriptors" on page 8-24

- "Enabling Security Role Deployment" on page 8-26

Note: The steps for configuring a custom Role Mapping provider using the WebLogic Server Administration Console are described under "Configuring a Custom Security Provider" in *Managing WebLogic Security*.

Managing Role Mapping Providers and Deployment Descriptors

Some application components, such as Enterprise JavaBeans (EJBs) and Web applications, store relevant deployment information in Java 2 Enterprise Edition (J2EE) and WebLogic Server deployment descriptors. For Web applications, the deployment descriptor files (called web.xml and weblogic.xml) contain information for implementing the J2EE security model, including security roles. Typically, you will want to include this information when first configuring your Role Mapping providers in the WebLogic Server Administration Console.

The Administration Console provides an Ignore Security Data in Deployment Descriptors check box for this purpose, which you or an administrator should be sure is unchecked the first time a custom Role Mapping provider is configured.

Notes: The Ignore Security Data in Deployment Descriptors check box is unchecked by default. To locate this check box, click Security →Realms →*realm* in the left pane of the Administration Console, where *realm* is the name of your security realm. Then select the General tab.

When this check box is unchecked and a Web application is deployed, WebLogic Server reads information from the web.xml and weblogic.xml deployment descriptor files (examples of web.xml and weblogic.xml files are shown in Listing 8-4 and Listing 8-5). This information is then copied into the security provider database for the Role Mapping provider.

Listing 8-4   Sample web.xml File

```
<web-app>

   <welcome-file-list>
      <welcome-file>welcome.jsp</welcome-file>
   </welcome-file-list>

   <security-constraint>
      <web-resource-collection>
         <web-resource-name>Success</web-resource-name>
         <url-pattern>/welcome.jsp</url-pattern>
         <http-method>GET</http-method>
         <http-method>POST</http-method>
      </web-resource-collection>
      <auth-constraint>
         <role-name>developers</role-name>
      </auth-constraint>
   </security-constraint>

   <login-config>
      <auth-method>BASIC</auth-method>
      <realm-name>default</realm-name>
   </login-config>

   <security-role>
      <role-name>developers</role-name>
   </security-role>

</web-app>
```

Listing 8-5 Sample weblogic.xml File

```
<weblogic-web-app>
   <security-role-assignment>
      <role-name>developers</role-name>
      <principal-name>myGroup</principal-name>
   </security-role-assignment>
</weblogic-web-app>
```

While you can set additional security roles in the `web.xml`/`weblogic.xml` deployment descriptors *and* in the Administration Console, BEA recommends that you copy the security roles defined in the Web application deployment descriptors once, then use the Administration Console to define subsequent security roles. This is because any changes made to the seurity roles through the Administration Console during configuration of a Role Mapping provider will **not** be persisted to the `web.xml` and `weblogic.xml` files. Before you deploy the Web application again (which will happen if you redeploy it through the Administration Console, modify it on disk, or restart WebLogic Server), you should check the Ignore Security Data in Deployment Descriptors check box. If you do not, the security roles defined using the Administration Console will be overwritten by those defined in the deployment descriptors. For more information, see "Using the Combined Technique to Secure Your URL (Web) and Enterprise JavaBean (EJB) Resources" in *Securing WebLogic Resources*.

Notes: The same process applies to EJBs, but with the `ejb-jar.xml`/`weblogic-ejb-jar.xml` deployment descriptors.

The Ignore Security Data in Deployment Descriptors check box also affects Authorization providers and Credential Mapping providers. For more information, see "Managing Authorization Providers and Deployment Descriptors" on page 6-21 and "Managing Credential Mapping Providers, Resource Adapters, and Deployment Descriptors" on page 10-16, respectively.

Enabling Security Role Deployment

If you implemented the `DeployableRoleProvider` SSPI and want to support deployable security roles with your custom Role Mapping provider, the person configuring the custom Role Mapping provider (that is, you or an administrator) must

be sure that the Role Deployment Enabled check box in the WebLogic Server Administration Console is checked. Otherwise, deployment for the Role Mapping provider is considered "turned off." Therefore, if multiple Role Mapping providers are configured, the Role Deployment Enabled check box can be used to control which Role Mapping provider is used for security role deployment.

Note: The Ignore Security Data in Deployment Descriptors check box (specified at the security realm level and described in "Managing Role Mapping Providers and Deployment Descriptors" on page 8-24) determines whether you want security roles to be copied into the security databases for the configured Role Mapping providers. The Role Deployment Enabled box (specified for each configured Role Mapping provider) determines whether or not the Role Mapping provider is the one that stores the deployed security role.

Provide a Mechanism for Security Role Management

While configuring a custom Role Mapping provider via the WebLogic Server Administration Console makes it accessible by applications requiring role mapping services, you also need to supply administrators with a way to manage this security provider's associated security roles. The WebLogic Role Mapping provider, for example, supplies administrators with a Role Editor page (see Figure 8-2) that allows them to add, modify, or remove security roles for various WebLogic resources. (This page can be found on the Conditions tab for a specific global or scoped role.)

Figure 8-2 WebLogic Role Mapping Provider's Role Editor Page

Neither the Role Editor page nor access to it is available to administrators when you develop a custom Role Mapping provider. Therefore, you must provide your own mechanism for security role management. This mechanism must read and write security role data (that is, expressions) to and from the custom Role Mapping provider's database.

You can accomplish this task in one of three ways:

- "Option 1: Create Your Own "Role Editor" Page Using Console Extensions" on page 8-28

- "Option 2: Develop a Stand-Alone Tool for Security Role Management" on page 8-29

- "Option 3: Integrate an Existing Security Role Management Tool into the Administration Console" on page 8-30

Option 1: Create Your Own "Role Editor" Page Using Console Extensions

The main benefit of creating console extensions for your custom Role Mapping provider is that the console extension provides you with the ID for the WebLogic resource and therefore, the WebLogic resource's location in the resource hierarchy. (This information is required to read and write expressions to and from the Role

Mapping provider's database.) An additional benefit is that your page can be integrated into the existing WebLogic Server Administration Console GUI, like the Role Editor page provided with the WebLogic Role Mapping provider.

If you selected this option, you need to:

1. Implement the `getExtensionForRole()` method of the `weblogic.management.console.extensibility.SecurityExtension` interface, and have this method return your Role Editor page.

   Note: For more information, see Chapter 12, "Writing Console Extensions for Custom Security Providers."

2. In addition, you must do *one* of the following:

   a. Implement the `RoleEditor` and `RoleReader` optional Authorization SSPI MBeans to develop a management MBean that will act as an intermediary between your Role Editor page and the Role Mapping provider's database. For more information, see "Determine Which SSPI MBeans to Extend and Implement" on page 2-12 and Table 2-4, "Optional Authorization SSPI MBeans," on page 2-21.

      In this case, you also need to develop a syntax for the expressions that make up a security role that can be represented as a string. (For example, `Role=Admin` or `Group=Administrators`.)

      Note: This syntax can be different for different Role Mapping providers. For more information about expressions, see "Components of a Security Role: Role Conditions, Expressions, and Role Statements" in *Securing WebLogic Resources*.

   b. Develop your own MBean APIs for managing security roles, and implement those interfaces to develop a management MBean that will act as an intermediary between your Role Editor page and the Role Mapping provider's database.

   c. Read and write the expressions from and to the custom Role Mapping provider's database directly, without delegating to an MBean.

Option 2: Develop a Stand-Alone Tool for Security Role Management

You would typically select this option if you want to develop a tool that is entirely separate from the WebLogic Server Administration Console.

For this option, you do not need to write any console extensions for your custom Role Mapping provider, nor do you need to develop any management MBeans as described in "Option 1: Create Your Own "Role Editor" Page Using Console Extensions" on page 8-28. However, your tool needs to:

1. Determine the WebLogic resource's ID, since it is not automatically provided to you by the console extension. For more information, see "WebLogic Resource Identifiers" on page 2-25.

2. Determine how to represent the expressions that make up a security role. (This representation is entirely up to you and need not be a string as in "Option 1: Create Your Own "Role Editor" Page Using Console Extensions" on page 8-28)

3. Read and write the expressions from and to the custom Role Mapping provider's database.

Option 3: Integrate an Existing Security Role Management Tool into the Administration Console

You would typically select this option if you have a tool that is separate from the WebLogic Server Administration Console, but you want to launch that tool from the Administration Console.

For this option, your tool needs to:

1. Determine the WebLogic resource's ID, since it is not automatically provided to you by the console extension. For more information, see "WebLogic Resource Identifiers" on page 2-25.

2. Determine how to represent the expressions that make up a security role. (This representation is entirely up to you and need not be a string as in "Option 1: Create Your Own "Role Editor" Page Using Console Extensions" on page 8-28)

3. Read and write the expressions from and to the custom Role Mapping provider's database.

4. Link into the Administration Console using basic console extension techniques, as described in *Extending the Administration Console*.

9 Auditing Providers

Auditing is the process whereby information about operating requests and the

outcome of those requests are collected, stored, and distributed for the purposes of non-repudiation. In WebLogic Server, an Auditing provider provides this electronic trail of computer activity.

The following sections describe Auditing provider concepts and functionality, and provide step-by-step instructions for developing a custom Auditing provider:

Auditing Concepts

Before you develop an Auditing provider, you need to understand the following concepts:

Audit Channels

An **Audit Channel** is the component of an Auditing provider that determines whether a security event should be audited, and performs the actual recording of audit information based on Quality of Service (QoS) policies.

Note: For more information about Audit Channels, see "Implement the AuditChannel SSPI" on page 9-8.

Auditing Events From Custom Security Providers

Each type of security provider can call the configured Auditing providers with a request to write out information about security-related events, before or after these events take place. For example, if a user attempts to access a withdraw method in a bank account application (to which they should not have access), the Authorization provider can request that this operation be recorded. Security-related events are only recorded when they meet or exceed the severity level specified in the configuration of the Auditing providers.

For information about how to post audit events from a custom security provider, see Chapter 11, "Auditing Events From Custom Security Providers."

The Auditing Process

Figure 9-1 shows how Auditing providers interact with the WebLogic Security Framework and other types of security providers (using Authentication providers as an example) to audit selected events. An explanation follows.

Figure 9-1   Auditing Providers, the WebLogic Security Framework, and Other Security Providers
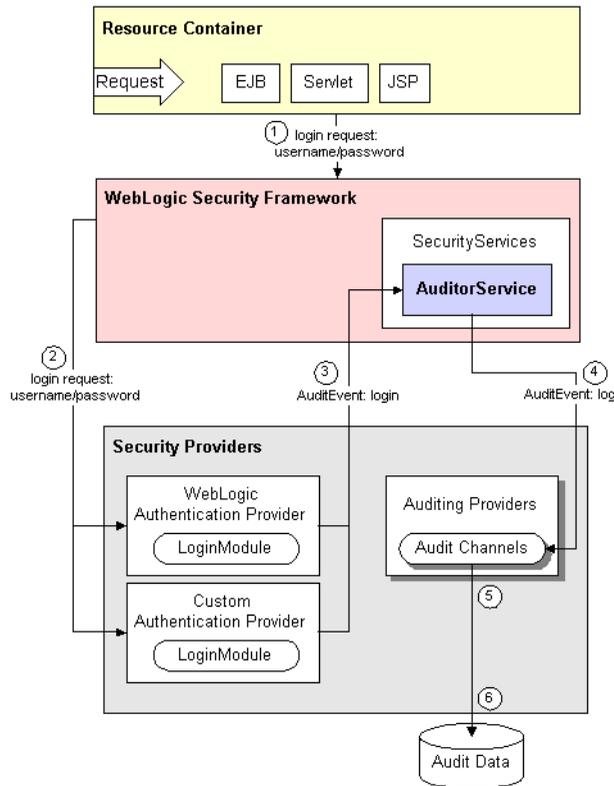
Auditing providers interact with the WebLogic Security Framework and other types of security providers in the following manner:

Note: In Figure 9-1 and the explanation below, the "other types of security providers" are a WebLogic Authentication provider and a custom Authentication provider. However, these can be any type of security provider that is developed as described in Chapter 11, "Auditing Events From Custom Security Providers."

1. A resource container passes a user's authentication information (for example, a username/password combination) to the WebLogic Security Framework as part of a login request.

2. The WebLogic Security Framework passes the information associated with the login request to the configured Authentication providers.

3. If, in addition to providing authentication services, the Authentication providers are designed to post audit events, the Authentication providers will each:

   a. Instantiate an `AuditEvent` object. At minimum, the `AuditEvent` object includes information about the event type to be audited and an audit severity level.

      Note: An `AuditEvent` class is created by implementing either the `AuditEvent` SSPI or an `AuditEvent` convenience interface in the Authentication provider's runtime class, in addition to the other security service provider interfaces (SSPIs) the custom Authentication provider must already implement. For more information about Audit Events and the `AuditEvent` SSPI/convenience interfaces, see "Create an Audit Event" on page 11-4.

   b. Make a trusted call to the Auditor Service, passing in the `AuditEvent` object.

      Note: This is a trusted call because the Auditor Service is already passed to the security provider's `initialize` method as part of its "Provider" SSPI implementation. For more information, see "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

4. The Auditor Service passes the `AuditEvent` object to the configured Auditing providers' runtime classes (that is, the `AuditChannel` SSPI implementations), enabling audit event recording.

   Note: Depending on the Authentication providers' implementations of the `AuditEvent` convenience interface, audit requests may occur both pre and post event, as well as just once for an event.

5. The Auditing providers' runtime classes use the event type, audit severity and other information (such as the Audit Context) obtained from the `AuditEvent` object to control audit record content. Typically, only one of the configured Auditing providers will meet all the criteria for auditing.

   Note: For more information about audit severity levels and the Audit Context, see "Audit Severity" on page 11-8 and "Audit Context" on page 11-9, respectively.

6. When the criteria for auditing specified by the Authentication providers in their `AuditEvent` objects is met, the appropriate Auditing provider's runtime class (that is, the `AuditChannel` SSPI implementation) writes out audit records in the manner their implementation specifies.

Note: Depending on the `AuditChannel` SSPI implementation, audit records may be written to a file, a database, or some other persistent storage medium when the criteria for auditing is met.

Do You Need to Develop a Custom Auditing Provider?

The default (that is, active) security realm for WebLogic Server includes a WebLogic Auditing provider. The WebLogic Auditing provider records information for any changes to the WebLogic Server domain configuration. This includes attribute values that have been changed, edited, or removed, as well as operations that have been invoked.

The WebLogic Auditing provider makes the decision about whether to audit in its `writeEvent` method, based on the audit severity level it has been configured with and the audit severity contained within the `AuditEvent` object that is passed into the method. (For more information about `AuditEvent` objects, see "Create an Audit Event" on page 11-4.

Note: You can change the audit severity level that the WebLogic Auditing provider is configured with using the WebLogic Server Administration Console. For more information, see "Configuring a WebLogic Auditing Provider" in *Managing WebLogic Security*.

If there is a match, the WebLogic Auditing provider writes audit information to the `DefaultAuditRecorder.log` file, which is located in the *bea_home*\user_projects*domain* directory (where *bea_home* represents the central support directory for all BEA products installed on one machine, and *domain* represents the name of a domain you create). Listing 9-1 shows example excerpts from the `DefaultAuditRecorder.log` file.

<div align="center">**Listing 9-1 DefaultAuditRecorder.log File: Sample Output**</div>

When Authentication suceeds. [SUCCESS]

```
#### Audit Record Begin <Feb 23, 2005 11:42:17 AM>  <Severity=SUCCESS>
<<<Event Type = Authentication Audit Event><TestUser><AUTHENTICATE>>> Audit
Record End ####
```

When Authentication fails. [FAILURE]

```
#### Audit Record Begin <Feb 23, 2005 11:42:01 AM>  <Severity=FAILURE>
<<<Event Type = Authentication Audit Event><TestUser><AUTHENTICATE>>> Audit
Record End ####When Operations are invoked.[SUCCESS]
```

When a user account is unlocked. [SUCCESS]

```
#### Audit Record Begin <Feb 23, 2005 11:42:17 AM>  <Severity=SUCCESS>
<<<Event Type = Authentication Audit Event><TestUser><USERUNLOCKED>>> Audit
Record End ####
```

When an Authorization request succeeds. [SUCCESS]

```
#### Audit Record Begin <Feb 23, 2005 11:42:17 AM>  <Severity=SUCCESS>
<<<Event Type = Authorization Audit Event ><Subject: 1
 Principal = class weblogic.security.principal.WLSUserImpl("TestUser")
><ONCE><<jndi>><type=<jndi>, application=, path={weblogic}, action=lookup>>>
Audit Record End ####
```

Each time the WebLogic Server instance is booted, a new
`DefaultAuditRecorder.log` file is created (the old `DefaultAuditRecorder.log`
file is renamed to `DefaultAuditRecorder.log.old`).

If you want to write audit information in addition to that which is specified by the
WebLogic Auditing provider, or to an output repository that is not the
`DefaultAuditRecorder.log` (that is, to a simple file with a different name/location
or to an existing database), then you need to develop a custom Auditing provider.

How to Develop a Custom Auditing Provider

If the WebLogic Auditing provider does not meet your needs, you can develop a custom Auditing provider by following these steps:

1. "Create Runtime Classes Using the Appropriate SSPIs" on page 9-7

2. "Generate an MBean Type Using the WebLogic MBeanMaker" on page 9-10

3. "Configure the Custom Auditing Provider Using the Administration Console" on page 9-17

Create Runtime Classes Using the Appropriate SSPIs

Before you start creating runtime classes, you should first:

- "Understand the Purpose of the "Provider" SSPIs" on page 2-3

- "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes" on page 2-7

When you understand this information and have made your design decisions, create the runtime classes for your custom Auditing provider by following these steps:

- "Implement the AuditProvider SSPI" on page 9-7

- "Implement the AuditChannel SSPI" on page 9-8

For an example of how to create a runtime class for a custom Auditing provider, see "Example: Creating the Runtime Class for the Sample Auditing Provider" on page 9-8.

Implement the AuditProvider SSPI

To implement the `AuditProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3 *and* the following method:

getAuditChannel
```
     public AuditChannel getAuditChannel();
```

The `getAuditChannel` method obtains the implementation of the `AuditChannel` SSPI. For a single runtime class called `MyAuditProviderImpl.java`, the implementation of the `getAuditChannel` method would be:

```
return this;
```

If there are two runtime classes, then the implementation of the `getAuditChannel` method could be:

```
return new MyAuditChannelImpl;
```

This is because the runtime class that implements the `AuditProvider` SSPI is used as a factory to obtain classes that implement the `AuditChannel` SSPI.

For more information about the `AuditProvider` SSPI and the `getAuditChannel` method, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the AuditChannel SSPI

To implement the `AuditChannel` SSPI, provide an implementation for the following method:

writeEvent

```
public void writeEvent(AuditEvent event)
```

The `writeEvent` method writes an audit record based on the information specified in the `AuditEvent` object that is passed in. For more information about `AuditEvent` objects, see "Create an Audit Event" on page 11-4.

For more information about the `AuditChannel` SSPI and the `writeEvent` method, see the *WebLogic Server 7.0 API Reference Javadoc*.

Example: Creating the Runtime Class for the Sample Auditing Provider

Listing 9-2 shows the `SampleAuditProviderImpl.java` class, which is the runtime class for the sample Auditing provider. This runtime class includes implementations for:

■ The three methods inherited from the `SecurityProvider` interface: `initialize`, `getDescription` and `shutdown` (as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.)

- The method inherited from the `AuditProvider` SSPI: the `getAuditChannel` method (as described in "Implement the AuditProvider SSPI" on page 9-7).

- The method in the `AuditChannel` SSPI: the `writeEvent` method (as described in "Implement the AuditChannel SSPI" on page 9-8).

Note: The bold face code in Listing 9-2 highlights the class declaration and the method signatures.

Listing 9-2   SampleAuditProviderImpl.java

```
package examples.security.providers.audit;

import java.io.File;
import java.io.FileOutputStream;
import java.io.IOException;
import java.io.PrintStream;
import weblogic.management.security.ProviderMBean;
import weblogic.security.spi.AuditChannel;
import weblogic.security.spi.AuditEvent;
import weblogic.security.spi.AuditProvider;
import weblogic.security.spi.SecurityServices;

public final class SampleAuditProviderImpl implements AuditChannel, AuditProvider
{
   private String description;
   private PrintStream log;

   public void initialize(ProviderMBean mbean, SecurityServices services)
   {
      System.out.println("SampleAuditProviderImpl.initialize");

      description = mbean.getDescription() + "\n" + mbean.getVersion();

      SampleAuditorMBean myMBean = (SampleAuditorMBean)mbean;
      File file = new File(myMBean.getLogFileName());
      System.out.println("\tlogging to " + file.getAbsolutePath());

      try {
         log = new PrintStream(new FileOutputStream(file), true);
      } catch (IOException e) {
         throw new RuntimeException(e.toString());
      }
   }

   public String getDescription()
   {
```

```
      return description;
   }

   public void shutdown()
   {
      System.out.println("SampleAuditProviderImpl.shutdown");
      log.close();
   }

   public AuditChannel getAuditChannel()
   {
      return this;
   }

   public void writeEvent(AuditEvent event)
   {
      // Write the event out to the sample Auditing provider's log file using
      // the event's "toString" method.
      log.println(event);
   }
}
```

Generate an MBean Type Using the WebLogic MBeanMaker

Before you start generating an MBean type for your custom security provider, you should first:

- "Understand Why You Need an MBean Type" on page 2-11

- "Determine Which SSPI MBeans to Extend and Implement" on page 2-12

- "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12

- "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15

- "Understand What the WebLogic MBeanMaker Provides" on page 2-17

When you understand this information and have made your design decisions, create the MBean type for your custom Auditing provider by following these steps:

Notes: Several sample security providers (available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) illustrate how to perform these steps.

All instructions provided in this section assume that you are working in a Windows environment.

Create an MBean Definition File (MDF)

To create an MBean Definition File (MDF), follow these steps:

1. Copy the MDF for the sample Auditing provider to a text file.

   Note: The MDF for the sample Auditing provider is called `SampleAuditor.xml`.

2. Modify the content of the `<MBeanType>` and `<MBeanAttribute>` elements in your MDF so that they are appropriate for your custom Auditing provider.

3. Add any custom attributes and operations (that is, additional `<MBeanAttribute>` and `<MBeanOperation>` elements) to your MDF.

4. Save the file.

Note: A complete reference of MDF element syntax is available in Appendix A, "MBean Definition File (MDF) Element Syntax."

Use the WebLogic MBeanMaker to Generate the MBean Type

Once you create your MDF, you are ready to run it through the WebLogic MBeanMaker. The WebLogic MBeanMaker is currently a command-line utility that takes as its input an MDF, and outputs some intermediate Java files, including an MBean interface, an MBean implementation, and an associated MBean information file. Together, these intermediate files form the **MBean type** for your custom security provider.

The instructions for generating an MBean type differ based on the design of your custom Auditing provider. Follow the instructions that are appropriate to your situation:

- "No Custom Operations" on page 9-12

- "Custom Operations" on page 9-12

No Custom Operations

If the MDF for your custom Auditing provider does not include any custom operations, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Auditing providers).

3. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 9-15.

Custom Operations

If the MDF for your custom Auditing provider does include custom operations, consider the following:

- Are you creating an MBean type for the first time? If so, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by <filesdir>, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Auditing providers).

3. For any custom operations in your MDF, implement the methods using the method stubs.

4. Save the file.

5. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 9-15.

- Are you updating an existing MBean type? If so, follow these steps:

1. Copy your existing MBean implementation file to a temporary directory so that your current method implementations are not overwritten by the WebLogic MBeanMaker.

2. Create a new DOS shell.

3. Type the following command:

```
java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
weblogic.management.commo.WebLogicMBeanMaker
```

where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File)

and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Auditing providers).

4. If you modified the MDF to include any custom operations that were not in the original MDF, implement the methods using the method stubs.

5. Save the version of the MBean implementation file that is complete (that is, has all methods implemented).

6. Copy this MBean implementation file into the directory where the WebLogic MBeanMaker placed the intermediate files for the MBean type. You specified this as *filesdir* in step 3. (You will be overriding the MBean implementation file generated by the WebLogic MBeanMaker as a result of step 3.)

7. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 9-15.

About the Generated MBean Interface File

The MBean interface file is the client-side API to the MBean that your runtime class or your MBean implementation will use to obtain configuration data. It is typically used in the initialize method as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

Because the WebLogic MBeanMaker generates MBean types from the MDF you created, the generated MBean interface file will have the name of the MDF, plus the text "MBean" appended to it. For example, the result of running the SampleAuditor MDF through the WebLogic MBeanMaker will yield an MBean interface file called SampleAuditorMBean.java.

Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)

Once your have run your MDF through the WebLogic MBeanMaker to generate your intermediate files, and you have edited the MBean implementation file to supply implementations for the appropriate methods within it, you need to package the MBean files *and the runtime classes* for the custom Auditing provider into an MBean JAR File (MJF). The WebLogic MBeanMaker also automates this process.

To create an MJF for your custom Auditing provider, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMJF=jarfile -Dfiles=filesdir
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMJF` flag indicates that the WebLogic MBeanMaker should build a JAR file containing the new MBean types, `jarfile` is the name for the MJF and `<filesdir>` is the location where the WebLogic MBeanMaker looks for the files to JAR into the MJF.

   Compilation occurs at this point, so errors are possible. If `jarfile` is provided, and no errors occur, an MJF is created with the specified name.

Notes: If you want to update an existing MJF, simply delete the MJF and regenerate it. The WebLogic MBeanMaker also has a `-DIncludeSource` option, which controls whether source files are included into the resulting MJF. Source files include both the generated source and the MDF itself. The default is `false`. This option is ignored when `-DMJF` is not used.

The resulting MJF can be installed into your WebLogic Server environment, or distributed to your customers for installation into their WebLogic Server environments.

Install the MBean Type Into the WebLogic Server Environment

To install an MBean type into the WebLogic Server environment, copy the MJF into the *WL_HOME*\server\lib\mbeantypes directory, where *WL_HOME* is the top-level installation directory for WebLogic Server. This "deploys" your custom Auditing provider—that is, it makes the custom Auditing provider manageable from the WebLogic Server Administration Console.

Notes: *WL_HOME*\server\lib\mbeantypes is the default directory for installing MBean types. However, if you want WebLogic Server to look for MBean types in *additional* directories, use the -Dweblogic.alternateTypesDirectory=*<dir>* command-line flag when starting your server, where *<dir>* is a comma-separated list of directory names. When you use this flag, WebLogic Server will always load MBean types from *WL_HOME*\server\lib\mbeantypes first, then will look in the additional directories and load all valid archives present in those directories (regardless of their extension). For example, if -Dweblogic.alternateTypesDirectory = dirX,dirY, WebLogic Server will first load MBean types from *WL_HOME*\server\lib\mbeantypes, then any valid archives present in dirX and dirY.

If you instruct WebLogic Server to look in additional directories for MBean types and are using the Java Security Manager, you must also update the weblogic.policy file to grant appropriate permissions for the MBean type (and thus, the custom security provider). For more information, see "Using the Java Security Manager to Protect WebLogic Resources" in *Programming WebLogic Security*.

It is advisable to keep non-security provider JARs, including backup files, out of the *WL_HOME*\server\lib\mbeantypes directory.

You can create instances of the MBean type by configuring your custom Auditing provider (see "Configure the Custom Auditing Provider Using the Administration Console" on page 9-17), and then use those MBean instances from a GUI, from other Java code, or from APIs. For example, you can use the WebLogic Server Administration Console to get and set attributes and invoke operations, or you can develop other Java objects that instantiate MBeans and automatically respond to information that the MBeans supply. We recommend that you back up these MBean instances. For more information, see "Backing Up Security Configuration Data" under "Recovering Failed Servers" in *Creating and Configuring WebLogic Server Domains*.

Configure the Custom Auditing Provider Using the Administration Console

Configuring a custom Auditing provider means that you are adding the custom Auditing provider to your security realm, where it can be accessed by security providers requiring audit services.

Configuring custom security providers is an administrative task, but it is a task that may also be performed by developers of custom security providers. This section contains information that is important for the person configuring your custom Auditing providers:

■ Configuring Audit Severity

Note: The steps for configuring a custom Auditing provider using the WebLogic Server Administration Console are described under "Configuring a Custom Security Provider" in *Managing WebLogic Security*.

Configuring Audit Severity

During the configuration process, an Auditing provider's audit severity must be set to one of the following severity levels:

■ `INFORMATION`

■ `WARNING`

■ `ERROR`

■ `SUCCESS`

■ `FAILURE`

This severity represents the level at which the custom Auditing provider will initiate auditing.

10 Credential Mapping Providers

Credential mapping is the process whereby a legacy system's database is used to obtain an appropriate set of credentials to authenticate users to a target resource. In WebLogic Server, a Credential Mapping provider is used to provide credential mapping services and bring new types of credentials into the WebLogic Server environment.

The following sections describe Credential Mapping provider concepts and functionality, and provide step-by-step instructions for developing a custom Credential Mapping provider:

- "Credential Mapping Concepts" on page 10-1
- "The Credential Mapping Process" on page 10-2
- "Do You Need to Develop a Custom Credential Mapping Provider?" on page 10-3
- "How to Develop a Custom Credential Mapping Provider" on page 10-4

Credential Mapping Concepts

A **subject**, or source of a WebLogic resource request, has security-related attributes called **credentials**. A credential may contain information used to authenticate the subject to new services. Such credentials include username/password combinations,

Kerberos tickets, and public key certificates. Credentials might also contain data that allows a subject to perform certain activities. Cryptographic keys, for example, represent credentials that enable the subject to sign or encrypt data.

A **credential map** is a mapping of credentials used by WebLogic Server to credentials used in a legacy (or any remote) system, which tell WebLogic Server how to connect to a given resource in that system. In other words, credential maps allow WebLogic Server to log in to a remote system on behalf of a subject that has already been authenticated. You can map credentials in this way by developing a Credential Mapping provider.

The Credential Mapping Process

Figure 10-1 illustrates how Credential Mapping providers interact with the WebLogic Security Framework during the credential mapping process, and an explanation follows.

Figure 10-1   Credential Mapping Providers and the Credential Mapping Process
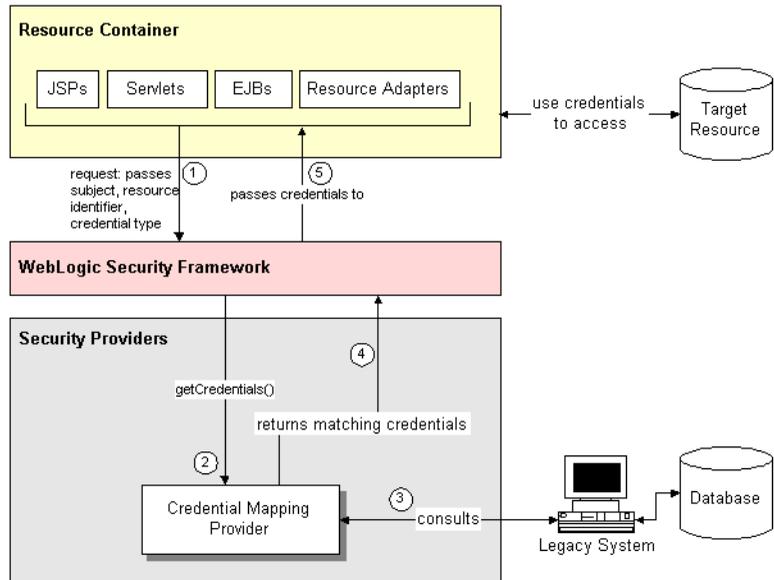
Generally, credential mapping is performed in the following manner:

1. Application components, such as JavaServer Pages (JSPs), servlets, Enterprise JavaBeans (EJBs), or Resource Adapters call into the WebLogic Security Framework through the appropriate resource container. As part of the call, the application component passes in the subject (that is, the "who" making the request), the WebLogic resource (that is, the "what" that is being requested) and information about the type of credentials needed to access the WebLogic resource.

2. The WebLogic Security Framework sends the application component's request for credentials to a configured Credential Mapping provider that handles the type of credentials needed by the application component.

3. The Credential Mapping provider consults the legacy system's database to obtain a set of credentials that match those requested by the application component.

4. The Credential Mapping provider returns the credentials to the WebLogic Security Framework.

5. The WebLogic Security Framework passes the credentials back to the requesting application component through the resource container.

   The application component uses the credentials to access the external system. The external system might be a database resource, such as an Oracle or SQL Server.

Do You Need to Develop a Custom Credential Mapping Provider?

The default (that is, active) security realm for WebLogic Server includes a WebLogic Credential Mapping provider. The WebLogic Credential Mapping provider maps WebLogic Server users and groups to the appropriate username/password credentials that may be required by other, external systems. If the type of credential mapping you want is between WebLogic Server users and groups and username/password credentials in another system, then the WebLogic Credential Mapping provider is

sufficient. However, if you want to map WebLogic Server users and groups to other types of credentials (for example, Kerberos tickets), then you need to develop a custom Credential Mapping provider.

How to Develop a Custom Credential Mapping Provider

If the WebLogic Credential Mapping provider does not meet your needs, you can develop a custom Credential Mapping provider by following these steps:

1. "Create Runtime Classes Using the Appropriate SSPIs" on page 10-4

2. "Generate an MBean Type Using the WebLogic MBeanMaker" on page 10-8

3. "Configure the Custom Credential Mapping Provider Using the Administration Console" on page 10-16

4. "Provide a Mechanism for Credential Map Management" on page 10-18

Create Runtime Classes Using the Appropriate SSPIs

Before you start creating runtime classes, you should first:

- "Understand the Purpose of the "Provider" SSPIs" on page 2-3

- "Determine Which "Provider" Interface You Will Implement" on page 2-5

- "Understand the SSPI Hierarchy and Determine Whether You Will Create One or Two Runtime Classes" on page 2-7

When you understand this information and have made your design decisions, create the runtime classes for your custom Credential Mapping provider by following these steps:

- "Implement the CredentialProvider SSPI" on page 10-5 *or* "Implement the DeployableCredentialProvider SSPI" on page 10-5

■ "Implement the CredentialMapper SSPI" on page 10-6

Note: At least one Credential Mapping provider in a security realm must implement the `DeployableCredentialProvider` SSPI, or else it will be impossible to deploy Resource Adapters.

Implement the CredentialProvider SSPI

To implement the `CredentialProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3 *and* the following method:

getCredentialProvider

```
public CredentialMapper getCredentialProvider();
```

The `getCredentialProvider` method obtains the implementation of the `CredentialMapper` SSPI. For a single runtime class called `MyCredentialMapperProviderImpl.java` (as in Figure 2-3), the implementation of the `getCredentialProvider` method would be:

```
return this;
```

If there are two runtime classes, then the implementation of the `getCredentialProvider` method could be:

```
return new MyCredentialMapperImpl;
```

This is because the runtime class that implements the `CredentialProvider` SSPI is used as a factory to obtain classes that implement the `CredentialMapper` SSPI.

For more information about the `CredentialProvider` SSPI and the `getCredentialProvider` method, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the DeployableCredentialProvider SSPI

To implement the `DeployableCredentialProvider` SSPI, provide implementations for the methods described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3, "Implement the CredentialProvider SSPI" on page 10-5, *and* the following methods:

deployCredentialMapping

```
public void deployCredentialMapping(Resource resource, String
initiatingPrincipal, String eisUsername, String
eisPassword)throws ResourceCreationException;
```

The `deployCredentialMapping` method deploys credential maps (that is, creates a credential mapping on behalf of a deployed Resource Adapter in a database). If the mapping already exists, it is removed and replaced by this mapping. The `resource` parameter represents the WebLogic resource to which the initiating principal (represented as a `String`) is requesting access. The Enterprise Information System (EIS) username and password are the credentials in the legacy (remote) system to which the credential maps are being made.

undeployCredentialMappings

```
public void undeployCredentialMappings(Resource resource)
throws ResourceRemovalException;
```

The `undeployCredentialMappings` method undeploys credential maps (that is, deletes a credential mapping on behalf of an undeployed Resource Adapter from a database). The `resource` parameter represents the WebLogic resource for which the mapping should be removed.

Note: The `deployCredentialMapping/undeployCredentialMappings` methods operate on username/password credentials only.

For more information about the `DeployableCredentialProvider` SSPI and the `deployCredentialMapping/undeployCredentialMappings` methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement the CredentialMapper SSPI

To implement the `CredentialMapper` SSPI, you must provide implementations for the following methods:

getCredentials

```
public java.util.Vector getCredentials(Subject requestor,
Subject initiator, Resource resource, String[]
credentialTypes);
```

The `getCredentials` method obtains the appropriate set of credentials for the target resource, based on the identity of the subject. This version of the method

returns a list of matching credentials for all of the principals within the subject (as a vector) by consulting the remote system's database.

getCredentials

```
public java.lang.Object getCredentials(Subject requestor,
String initiator, Resource resource, String[]
credentialTypes);
```

The `getCredentials` method obtains the appropriate set of credentials for the target resource, based on the identity of the subject. This version of the method returns one credential for the specified subject (as an object) by consulting the remote system's database.

For more information about the `CredentialMapper` SSPI and the `getCredentials` methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Developing Custom Credential Mapping Providers That Are Compatible With the Realm Adapter Authentication Provider

An Authentication provider is the security provider responsible for populating a subject with users and groups, which are then extracted from the subject by other types of security providers, including Credential Mapping providers. If the Authentication provider configured in your security realm is a Realm Adapter Authentication provider, the user and group information will be stored in the subject in a way that is slightly different from other Authentication providers. Therefore, this user and group information must also be extracted in a slightly different way.

Listing 10-1 provides code that can be used by custom Credential Mapping providers to check whether a subject matches a user or group name when a Realm Adapter Authentication provider was used to populate the subject. This code belongs in whatever form of the `getCredentials` method you choose to implement.

Listing 10-1   Sample Code to Check if a Subject Matches a User or Group Name

```
/**
 * Determines if the Subject matches a user/group name.
 *
 * @param principalWant A String containing the name of a principal in this role
 * (that is, the role definition).
 *
 * @param subject A Subject that contains the Principals that identify the user
 * who is trying to access the resource as well as the user's groups.
```

```
 *
 * @return A boolean. true if the current subject matches the name of the
 * principal in the role, false otherwise.
 */
private boolean subjectMatches(String principalWant, Subject subject)
{
   // first, see if it's a group name match
   if (SubjectUtils.isUserInGroup(subject, principalWant)) {
      return true;
   }
   // second, see if it's a user name match
   if (principalWant.equals(SubjectUtils.getUsername(subject))) {
      return true;
   }
   // didn't match
   return false;
}
```

Generate an MBean Type Using the WebLogic MBeanMaker

Before you start generating an MBean type for your custom security provider, you should first:

- "Understand Why You Need an MBean Type" on page 2-11

- "Determine Which SSPI MBeans to Extend and Implement" on page 2-12

- "Understand the Basic Elements of an MBean Definition File (MDF)" on page 2-12

- "Understand the SSPI MBean Hierarchy and How It Affects the Administration Console" on page 2-15

- "Understand What the WebLogic MBeanMaker Provides" on page 2-17

When you understand this information and have made your design decisions, create the MBean type for your custom Credential Mapping provider by following these steps:

1. "Create an MBean Definition File (MDF)" on page 10-9

2. "Use the WebLogic MBeanMaker to Generate the MBean Type" on page 10-9

3. "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 10-14

4. "Install the MBean Type Into the WebLogic Server Environment" on page 10-14

Notes: Several sample security providers (available under available under "Code Samples: WebLogic Server" on the *dev2dev Web site*) illustrate how to perform these steps.

All instructions provided in this section assume that you are working in a Windows environment.

Create an MBean Definition File (MDF)

To create an MBean Definition File (MDF), follow these steps:

1. Copy the MDF for the sample Authentication provider to a text file.

   Note: The MDF for the sample Authentication provider is called `SampleAuthenticator.xml`. (There is currently no sample Credential Mapping provider.)

2. Modify the content of the `<MBeanType>` and `<MBeanAttribute>` elements in your MDF so that they are appropriate for your custom Credential Mapping provider.

3. Add any custom attributes and operations (that is, additional `<MBeanAttribute>` and `<MBeanOperation>` elements) to your MDF.

4. Save the file.

   Note: A complete reference of MDF element syntax is available in Appendix A, "MBean Definition File (MDF) Element Syntax."

Use the WebLogic MBeanMaker to Generate the MBean Type

Once you create your MDF, you are ready to run it through the WebLogic MBeanMaker. The WebLogic MBeanMaker is currently a command-line utility that takes as its input an MDF, and outputs some intermediate Java files, including an MBean interface, an MBean implementation, and an associated MBean information file. Together, these intermediate files form the **MBean type** for your custom security provider.

The instructions for generating an MBean type differ based on the design of your custom Credential Mapping provider. Follow the instructions that are appropriate to your situation:

- "No Optional SSPI MBeans and No Custom Operations" on page 10-10

- "Optional SSPI MBeans or Custom Operations" on page 10-10

No Optional SSPI MBeans and No Custom Operations

If the MDF for your custom Credential Mapping provider does not implement any optional SSPI MBeans *and* does not include any custom operations, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the -DMDF flag indicates that the WebLogic MBeanMaker should translate the MDF into code, *xmlFile* is the MDF (the XML MBean Description File) and *filesdir* is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

   Whenever *xmlfile* is provided, a new set of output files is generated. If files already exist in the location specified by *filesdir*, you are informed that the existing files will be overwritten and are asked to confirm.

   Each time you use the -DcreateStubs=true flag, it overwrites any existing MBean implementation file.

   Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Credential Mapping providers).

3. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 10-14.

Optional SSPI MBeans or Custom Operations

If the MDF for your custom Credential Mapping provider does implement some optional SSPI MBeans *or* does include custom operations, consider the following:

- Are you creating an MBean type for the first time? If so, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, `xmlFile` is the MDF (the XML MBean Description File) and `filesdir` is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

   Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir`, you are informed that the existing files will be overwritten and are asked to confirm.

   Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

   Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Credential Mapping providers).

3. If you implemented optional SSPI MBeans in your MDF, follow these steps:

   a. Locate the MBean implementation file.

      The MBean implementation file generated by the WebLogic MBeanMaker is named *MBeanName*Impl.java. For example, for the MDF named MyCredentialMapper, the MBean implementation file to be edited is named MyCredentialMapperImpl.java.

   b. For each optional SSPI MBean that you implemented in your MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

4. If you included any custom operations in your MDF, implement the methods using the method stubs.

5. Save the file.

6. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 10-14.

■ Are you updating an existing MBean type? If so, follow these steps:

1. Copy your existing MBean implementation file to a temporary directory so that your current method implementations are not overwritten by the WebLogic MBeanMaker.

2. Create a new DOS shell.

3. Type the following command:

   ```
   java -DMDF=xmlfile -Dfiles=filesdir -DcreateStubs=true
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMDF` flag indicates that the WebLogic MBeanMaker should translate the MDF into code, `xmlFile` is the MDF (the XML MBean Description File) and `filesdir` is the location where the WebLogic MBeanMaker will place the intermediate files for the MBean type.

   Whenever `xmlfile` is provided, a new set of output files is generated. If files already exist in the location specified by `filesdir` are informed that the existing files will be overwritten and are asked to confirm.

   Each time you use the `-DcreateStubs=true` flag, it overwrites any existing MBean implementation file.

   Note: The WebLogic MBeanMaker processes one MDF at a time. Therefore, you may have to repeat this process if you have multiple MDFs (in other words, multiple Credential Mapping providers).

4. If you implemented optional SSPI MBeans in your MDF, follow these steps:

   a. Locate the MBean implementation file.

      The MBean implementation file generated by the WebLogic MBeanMaker is named `MBeanNameImpl.java`. For example, for the MDF named `SampleCredentialMapper`, the MBean implementation file to be edited is named `SampleCredentialMapperImpl.java`.

   b. Open your existing MBean implementation file (which you saved to a temporary directory in step 1).

   c. Synchronize the existing MBean implementation file with the MBean implementation file generated by the WebLogic MBeanMaker.

      Accomplishing this task may include, but is not limited to: copying the method implementations from your existing MBean implementation file into the newly-generated MBean implementation file (or, alternatively, adding the new methods from the newly-generated MBean implementation file to your

existing MBean implementation file), and verifying that any changes to method signatures are reflected in the version of the MBean implementation file that you are going to use (for methods that exist in both MBean implementation files).

    d. If you modified the MDF to implement optional SSPI MBeans that were not in the original MDF, copy the method stubs from the "Mapping MDF Operation Declarations to Java Method Signatures Document" (available on the *dev2dev Web site*) into the MBean implementation file, and implement each method. Be sure to also provide implementations for any methods that the optional SSPI MBean inherits.

5. If you modified the MDF to include any custom operations that were not in the original MDF, implement the methods using the method stubs.

6. Save the version of the MBean implementation file that is complete (that is, has all methods implemented).

7. Copy this MBean implementation file into the directory where the WebLogic MBeanMaker placed the intermediate files for the MBean type. You specified this as *filesdir* in step 3. (You will be overriding the MBean implementation file generated by the WebLogic MBeanMaker as a result of step 3.)

8. Proceed to "Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)" on page 10-14.

About the Generated MBean Interface File

The MBean interface file is the client-side API to the MBean that your runtime class or your MBean implementation will use to obtain configuration data. It is typically used in the initialize method as described in "Understand the Purpose of the "Provider" SSPIs" on page 2-3.

Because the WebLogic MBeanMaker generates MBean types from the MDF you created, the generated MBean interface file will have the name of the MDF, plus the text "MBean" appended to it. For example, the result of running the `MyCredentialMapper` MDF through the WebLogic MBeanMaker will yield an MBean interface file called `MyCredentialMapperMBean.java`.

Use the WebLogic MBeanMaker to Create the MBean JAR File (MJF)

Once your have run your MDF through the WebLogic MBeanMaker to generate your intermediate files, and you have edited the MBean implementation file to supply implementations for the appropriate methods within it, you need to package the MBean files *and the runtime classes* for the custom Credential Mapping provider into an MBean JAR File (MJF). The WebLogic MBeanMaker also automates this process.

To create an MJF for your custom Credential Mapping provider, follow these steps:

1. Create a new DOS shell.

2. Type the following command:

   ```
   java -DMJF=jarfile -Dfiles=filesdir
   weblogic.management.commo.WebLogicMBeanMaker
   ```

   where the `-DMJF` flag indicates that the WebLogic MBeanMaker should build a JAR file containing the new MBean types, `jarfile` is the name for the MJF and `filesdir` is the location where the WebLogic MBeanMaker looks for the files to JAR into the MJF.

   Compilation occurs at this point, so errors are possible. If `jarfile` is provided, and no errors occur, an MJF is created with the specified name.

Notes: If you want to update an existing MJF, simply delete the MJF and regenerate it. The WebLogic MBeanMaker also has a `-DIncludeSource` option, which controls whether source files are included into the resulting MJF. Source files include both the generated source and the MDF itself. The default is `false`. This option is ignored when `-DMJF` is not used.

The resulting MJF can be installed into your WebLogic Server environment, or distributed to your customers for installation into their WebLogic Server environments.

Install the MBean Type Into the WebLogic Server Environment

To install an MBean type into the WebLogic Server environment, copy the MJF into the *WL_HOME*\server\lib\mbeantypes directory, where *WL_HOME* is the top-level installation directory for WebLogic Server. This "deploys" your custom Credential Mapping provider—that is, it makes the custom Credential Mapping provider manageable from the WebLogic Server Administration Console.

Notes: *WL_HOME*\server\lib\mbeantypes is the default directory for installing MBean types. However, if you want WebLogic Server to look for MBean types in *additional* directories, use the -Dweblogic.alternateTypesDirectory=*<dir>* command-line flag when starting your server, where *<dir>* is a comma-separated list of directory names. When you use this flag, WebLogic Server will always load MBean types from *WL_HOME*\server\lib\mbeantypes first, then will look in the additional directories and load all valid archives present in those directories (regardless of their extension). For example, if -Dweblogic.alternateTypesDirectory = dirX,dirY, WebLogic Server will first load MBean types from *WL_HOME*\server\lib\mbeantypes, then any valid archives present in dirX and dirY.

If you instruct WebLogic Server to look in additional directories for MBean types and are using the Java Security Manager, you must also update the weblogic.policy file to grant appropriate permissions for the MBean type (and thus, the custom security provider). For more information, see "Using the Java Security Manager to Protect WebLogic Resources" in *Programming WebLogic Security*.

It is advisable to keep non-security provider JARs, including backup files, out of the *WL_HOME*\server\lib\mbeantypes directory.

You can create instances of the MBean type by configuring your custom Credential Mapping provider (see "Configure the Custom Credential Mapping Provider Using the Administration Console" on page 10-16), and then use those MBean instances from a GUI, from other Java code, or from APIs. For example, you can use the WebLogic Server Administration Console to get and set attributes and invoke operations, or you can develop other Java objects that instantiate MBeans and automatically respond to information that the MBeans supply. We recommend that you back up these MBean instances. For more information, see "Backing Up Security Configuration Data" under "Recovering Failed Servers" in *Creating and Configuring WebLogic Server Domains*.

Configure the Custom Credential Mapping Provider Using the Administration Console

Configuring a custom Credential Mapping provider means that you are adding the custom Credential Mapping provider to your security realm, where it can be accessed by applications requiring credential mapping services.

Configuring custom security providers is an administrative task, but it is a task that may also be performed by developers of custom security providers. This section contains information that is important for the person configuring your custom Credential Mapping providers:

■ "Managing Credential Mapping Providers, Resource Adapters, and Deployment Descriptors" on page 10-16

■ "Enabling Deployable Credential Mappings" on page 10-18

Note: The steps for configuring a custom Credential Mapping provider using the WebLogic Server Administration Console are described under "Configuring a Custom Security Provider" in *Managing WebLogic Security*.

Managing Credential Mapping Providers, Resource Adapters, and Deployment Descriptors

Some application components, such as Resource Adapters (Connectors), store relevant deployment information in Java 2 Enterprise Edition (J2EE) and WebLogic Server deployment descriptors. For Resource Adapters, the deployment descriptor file (called weblogic-ra.xml) contains information such as username/password combinations that are used to create credential maps. Typically, you will want to include this credential map information when first configuring your Credential Mapping provider in the WebLogic Server Administration Console.

The Administration Console provides an Ignore Security Data in Deployment Descriptors check box for this purpose, which you or an administrator should be sure is unchecked the first time a custom Credential Mapping provider is configured.

Note: The Ignore Security Data in Deployment Descriptors check box is unchecked by default. To locate this check box, click Security →Realms →*realm* in the left pane of the Administration Console, where *realm* is the name of your security realm. Then select the General tab.

When this check box is unchecked and a Resource Adapter (Connector) is deployed, WebLogic Server reads credential maps from the `weblogic-ra.xml` deployment descriptor file, an example of which is shown in Listing 10-2. This information is then copied into the security provider database for the Credential Mapping provider.

Listing 10-2   Sample weblogic-ra.xml File

```
<weblogic-connection-factory-dd>
    <connection-factory-name>LogicalNameOfBlackBoxNoTx</connection-factory-name>
    <jndi-name>eis/BlackBoxNoTxConnectorJNDINAME</jndi-name>

    <map-config-property>
      <map-config-property-name>ConnectionURL</map-config-property-name>
      <map-config-property-value>jdbc:pointbase:server://localhost/demo
      <map-config-property-value>
    </map-config-property>

    <security-principal-map>
      <map-entry>
        <initiating-principal>*</initiating-principal>
        <resource-principal>
           <resource-username>examples</resource-username>
           <resource-password>examples</resource-password>
        </resource-principal>
      </map-entry>
    </security-principal-map>

</weblogic-connection-factory-dd>
```

Note: The sample Resource Adapter deployment descriptor shown in Listing 10-2 is located in
WL_HOME\samples\server\src\examples\jconnector\simple\rars\
META-INF, where *WL_HOME* is the top-level installation directory for WebLogic Server.

While you can set additional credential maps in deployment descriptors *and* in the Administration Console, BEA recommends that you copy the credential maps defined in the Resource Adapter's deployment descriptor once, then use the Administration Console to define subsequent credential maps. This is because any changes made to the credential maps through the Administration Console during configuration of a Credential Mapping provider will **not** be persisted to the `weblogic-ra.xml` file. Before you deploy the Resource Adapter (Connector) again (which will happen if you

redeploy it through the Administration Console, modify it on disk, or restart WebLogic Server), you should check the Ignore Security Data in Deployment Descriptors check box. If you do not, the credential maps defined using the Administration Console will be overwritten by those defined in the deployment descriptor.

Note: The Ignore Security Data in Deployment Descriptors check box also affects Role Mapping and Authorization providers. For more information, see "Managing Authorization Providers and Deployment Descriptors" on page 6-21 and "Managing Role Mapping Providers and Deployment Descriptors" on page 8-24, respectively.

Enabling Deployable Credential Mappings

If you implemented the `DeployableCredentialProvider` SSPI and want to support deployable credential maps with your custom Credential Mapping provider, the person configuring the custom Credential Mapping provider (that is, you or an administrator) must be sure that the Credential Mapping Deployment Enabled check box in the Administration Console is checked. Otherwise, deployment for the Credential Mapping provider is considered "turned off." Therefore, if multiple Credential Mapping providers are configured, the Credential Mapping Deployment Enabled check box can be used to control which Credential Mapping provider is used for credential mapping deployment.

Note: The Ignore Security Data in Deployment Descriptors check box (specified at the security realm level and described in "Managing Credential Mapping Providers, Resource Adapters, and Deployment Descriptors" on page 10-16) determines whether you want credential maps to be copied into the security databases for the configured Credential Mapping providers. The Credential Mapping Deployment Enabled box (specified for each configured Credential Mapping provider) determines whether or not the Credential Mapping provider is the one that stores the deployed credential maps.

Provide a Mechanism for Credential Map Management

While configuring a custom Credential Mapping provider via the WebLogic Server Administration Console makes it accessible by applications requiring credential mapping services, you also need to supply administrators with a way to manage this

security provider's associated credential maps. In other words, you must provide a mechanism for credential map management. This mechanism must read and write credential maps to and from the custom Credential Mapping provider's database.

You can accomplish this task in one of two ways:

- "Option 1: Develop a Stand-Alone Tool for Credential Map Management" on page 10-19

- "Option 2: Integrate an Existing Credential Map Management Tool into the Administration Console" on page 10-19

Note: In this version of WebLogic Server, you cannot create an "Editor" page using console extensions for the Credential Mapping provider, like you can for custom Authorization and Role Mapping providers.

Option 1: Develop a Stand-Alone Tool for Credential Map Management

You would typically select this option if you want to develop a tool that is entirely separate from the WebLogic Server Administration Console.

For this option, your tool needs to:

1. Determine the WebLogic resource's ID. For more information, see "WebLogic Resource Identifiers" on page 2-25.

2. Determine how to represent the represent the local-to-remote user relationship. (This representation is entirely up to you.)

3. Read and write the expressions from and to the custom Credential Mapping provider's database.

Option 2: Integrate an Existing Credential Map Management Tool into the Administration Console

You would typically select this option if you have a tool that is separate from the WebLogic Server Administration Console, but you want to launch that tool from the Administration Console.

For this option, your tool needs to:

1. Determine the WebLogic resource's ID. For more information, see "WebLogic Resource Identifiers" on page 2-25.

2. Determine how to represent the represent the local-to-remote user relationship. (This representation is entirely up to you.)

3. Read and write the expressions from and to the custom Credential Mapping provider's database.

4. Link into the Administration Console using basic console extension techniques, as described in *Extending the Administration Console*.

11 Auditing Events From Custom Security Providers

As described in Chapter 9, "Auditing Providers," **auditing** is the process whereby information about operating requests and the outcome of those requests are collected, stored, and distributed for the purposes of non-repudiation. Auditing providers provide this electronic trail of computer activity.

Each type of security provider can call the configured Auditing providers with a request to write out information about security-related events, before or after these events take place. For example, if a user attempts to access a `withdraw` method in a bank account application (to which they should not have access), the Authorization provider can request that this operation be recorded. Security-related events are only recorded when they meet or exceed the severity level specified in the configuration of the Auditing providers.

The following sections provide the background information you need to understand before adding auditing capability to your custom security providers, and provide step-by-step instructions for adding auditing capability to a custom security provider:

■ "Security Services and the Auditor Service" on page 11-2

■ "How to Audit From a Custom Security Provider" on page 11-3

Security Services and the Auditor Service

The `SecurityServices` interface, located in the `weblogic.security.spi` package, is a repository for security services (currently just the Auditor Service). As such, the `SecurityServices` interface is responsible for supplying callers with a reference to the Auditor Service via the following method:

getAuditorService

```
public AuditorService getAuditorService
```

The `getAuditorService` method returns the `AuditService` if an Auditing provider is configured.

The `AuditorService` interface, also located in the `weblogic.security.spi` package, provides other types of security providers (for example, Authentication providers) with limited (write-only) auditing capabilities. In other words, the Auditor Service fans out invocations of each configured Auditing provider's `writeEvent` method, which simply writes an audit record based on the information specified in the `AuditEvent` object that is passed in. (For more information about the `writeEvent` method, see "Implement the AuditChannel SSPI" on page 9-8. For more information about `AuditEvent` objects, see "Create an Audit Event" on page 11-4.) The `AuditorService` interface includes the following method:

providerAuditWriteEvent

```
public void providerAuditWriteEvent (AuditEvent event)
```

The `providerAuditWriteEvent` method gives security providers *write access* to the object in the WebLogic Security Framework that calls the configured Auditing providers. The `event` parameter is an `AuditEvent` object that contains the audit criteria, including the type of event to audit and the audit severity level. For more information about Audit Events and audit severity levels, see "Create an Audit Event" on page 11-4 and "Audit Severity" on page 11-8, respectively.

The Auditor Service can be called to write audit events before or after those events have taken place, but does not maintain context in between pre and post operations. Security providers designed with auditing capabilities will need to obtain the Auditor Service as described in "Obtain and Use the Auditor Service to Write Audit Events" on page 11-11.

Notes: Implementations for both the SecurityServices and AuditorService interfaces are created by the WebLogic Security Framework at boot time if an Auditing provider is configured. (For more information about configuring Auditing providers, see "Configure the Custom Auditing Provider Using the Administration Console" on page 9-17.) Therefore, you do not need to provide your own implementations of these interfaces.

Additionally, SecurityServices objects are specific to the security realm in which your security providers are configured. Your custom security provider's runtime class automatically obtains a reference to the realm-specific SecurityServices object as part of its initialize method. (For more information, see "Understand the Purpose of the "Provider" SSPIs" on page 2-3.)

For more information about these interfaces and their methods, see the *WebLogic Server 7.0 API Reference Javadoc* for the SecurityServices interface and the AuditorService interface.

How to Audit From a Custom Security Provider

Add auditing capability to your custom security provider by following these steps:

■ "Create an Audit Event" on page 11-4

■ "Obtain and Use the Auditor Service to Write Audit Events" on page 11-11

Examples for each of these steps are provided in "Example: Implementation of the AuditRoleEvent Interface" on page 11-9 and "Example: Obtaining and Using the Auditor Service to Write Role Audit Events" on page 11-11, respectively.

Note: If your custom security provider is to record audit events, be sure to include any classes created as a result of these steps into the MBean JAR File (MJF) for the custom security provider (that is, in addition to the other files that are required).

Create an Audit Event

Security providers must provide information about the events they want audited, such as the type of event (for example, an authentication event) and the audit severity (for example, "error"). **Audit Events** contain this information, and can also contain any other contextual data that is understandable to a configured Auditing provider. To create an Audit Event, either:

- "Implement the AuditEvent SSPI" on page 11-4 or

- "Implement an Audit Event Convenience Interface" on page 11-5

Implement the AuditEvent SSPI

To implement the `AuditEvent` SSPI, provide implementations for the following methods:

getEventType

```
public java.lang.String getEventType()
```

The `getEventType` method returns a string representation of the event type that is to be audited, which is used by the Audit Channel (that is, the runtime class that implements the `AuditChannel` SSPI). For example, the event type for the BEA-provided implementation is "`Authentication Audit Event`". For more information, see "Audit Channels" on page 9-2 and "Implement the AuditChannel SSPI" on page 9-8.

getFailureException

```
public java.lang.Exception getFailureException()
```

The `getFailureException` method returns an `Exception` object, which is used by the Audit Channel to obtain audit information, in addition to the information provided by the `toString` method.

getSeverity

```
public AuditSeverity getSeverity()
```

The `getSeverity` method returns the severity level value associated with the event type that is to be audited, which is used by the Audit Channel. This allows the Audit Channel to make the decision about whether or not to audit. For more information, see "Audit Severity" on page 11-8.

toString

```
public java.lang.String toString()
```

The `toString` method returns preformatted audit information to the Audit Channel.

For more information about the `AuditEvent` SSPI and these methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

Implement an Audit Event Convenience Interface

There are several subinterfaces of the `AuditEvent` SSPI that are provided for your convenience, and that can assist you in structuring and creating Audit Events.

Each of these Audit Event convenience interfaces can be used by an Audit Channel (that is, a runtime class that implements the `AuditChannel` SSPI) to more effectively determine the instance types of extended event type objects, for a certain type of security provider. For example, the `AuditAtnEvent` convenience interface can be used by an Audit Channel that wants to determine the instance types of extended authentication event type objects. (For more information, see "Audit Channels" on page 9-2 and "Implement the AuditChannel SSPI" on page 9-8.)

The Audit Event convenience interfaces are:

- "The AuditAtnEvent Interface" on page 11-5

- "The AuditAtzEvent and AuditPolicyEvent Interfaces" on page 11-7

- "The AuditMgmtEvent Interface" on page 11-7

- "The AuditRoleEvent and AuditRoleDeploymentEvent Interfaces" on page 11-8

Note: It is recommended, but not required, that you implement one of the Audit Event convenience interfaces.

The AuditAtnEvent Interface

The `AuditAtnEvent` convenience interface helps Audit Channels to determine instance types of extended authentication event type objects.

To implement the `AuditAtnEvent` interface, provide implementations for the methods described in "Implement the AuditEvent SSPI" on page 11-4 *and* the following methods:

getUsername

```
public String getUsername()
```

The `getUsername` method returns the username associated with the authentication event.

AtnEventType

```
public AtnEventType getAtnEventType()
```

The `AtnEventType` method returns an event type that more specifically represents the authentication event. The specific authentication event types are:

`AUTHENTICATE`—simple authentication using a username and password occurred.

`ASSERTIDENTITY`—perimeter authentication based on tokens occurred.

`IMPERSONATEIDENTITY`—client identity has been established using the supplied client username (requires kernal identity).

`VALIDATEIDENTITY`—authenticity (trust) of the principals within the supplied subject has been validated.

`USERLOCKED`—a user account has been locked because of invalid login attempts.

`USERUNLOCKED`—a lock on a user account has been cleared.

`USERLOCKOUTEXPIRED`—a lock on a user account has expired.

toString

```
public String toString()
```

The `toString` method returns the specific authentication information to audit, represented as a string.

Note: The `AuditAtnEvent` convenience interface extends *both* the `AuditEvent` and `AuditContext` interfaces. For more information about the `AuditContext` interface, see "Audit Context" on page 11-9.

For more information about the `AuditAtnEvent` convenience interface and these methods, see the *WebLogic Server 7.0 API Reference Javadoc*.

The AuditAtzEvent and AuditPolicyEvent Interfaces

The `AuditAtzEvent` and `AuditPolicyEvent` convenience interfaces help Audit Channels to determine instance types of extended authorization event type objects.

Note: The difference between the `AuditAtzEvent` convenience interface and the `AuditPolicyEvent` convenience interface is that the latter only extends the `AuditEvent` interface. (It does not also extend the `AuditContext` interface.) For more information about the `AuditContext` interface, see "Audit Context" on page 11-9.

To implement the `AuditAtzEvent` or `AuditPolicyEvent` interface, provide implementations for the methods described in "Implement the AuditEvent SSPI" on page 11-4 *and* the following methods:

getSubject

```
public Subject getSubject()
```

The `getSubject` method returns the subject associated with the authorization event (that is, the subject attempting to access the WebLogic resource).

getResource

```
public Resource getResource()
```

The `getResource` method returns the WebLogic resource associated with the authorization event that the subject is attempting to access.

For more information about these convenience interfaces and methods, see the *WebLogic Server 7.0 API Reference Javadoc* for the AuditAtzEvent interface or the AuditPolicyEvent interface.

The AuditMgmtEvent Interface

The `AuditMgmtEvent` convenience interface helps Audit Channels to determine instance types of extended security management event type objects, such as a security provider's MBean. It contains no methods that you must implement, but maintains the best practice structure for an Audit Event implementation.

Note: For more information about MBeans, see "Security Service Provider Interface (SSPI) MBeans" on page 2-11.

For more information about the `AuditMgmtEvent` convenience interface, see the *WebLogic Server 7.0 API Reference Javadoc*.

The AuditRoleEvent and AuditRoleDeploymentEvent Interfaces

The `AuditRoleDeploymentEvent` and `AuditRoleEvent` convenience interfaces help Audit Channels to determine instance types of extended role mapping event type objects. They contain no methods that you must implement, but maintain the best practice structure for an Audit Event implementation.

Note: The difference between the `AuditRoleEvent` convenience interface and the `AuditRoleDeploymentEvent` convenience interface is that the latter only extends the `AuditEvent` interface. (It does not also extend the `AuditContext` interface.) For more information about the `AuditContext` interface, see "Audit Context" on page 11-9.

For more information about these convenience interfaces, see the *WebLogic Server 7.0 API Reference Javadoc* for the AuditRoleEvent interface or the AuditRoleDeploymentEvent interface.

Audit Severity

The **audit severity** is the level at which a security provider wants audit events to be recorded. When the configured Auditing providers receive a request to audit, each will examine the severity level of events taking place. If the severity level of an event is greater than or equal to the level an Auditing provider was configured with, that Auditing provider will record the audit data.

Note: Auditing providers are configured using the WebLogic Server Administration Console. For more information, see "Configure the Custom Auditing Provider Using the Administration Console" on page 9-17.

The `AuditSeverity` class, which is part of the `weblogic.security.spi` package, provides audit severity levels as both numeric and text values to the Audit Channel (that is, the `AuditChannel` SSPI implementation) through the `AuditEvent` object. The numeric severity value is to be used in logic, and the text severity value is to be used in the composition of the audit record output. For more information about the `AuditChannel` SSPI and the `AuditEvent` object, see "Implement the AuditChannel SSPI" on page 9-8 and "Create an Audit Event" on page 11-4, respectively.

Audit Context

Some of the Audit Event convenience interfaces extend the `AuditContext` interface to indicate that an implementation will also contain contextual information. This contextual information can then be used by Audit Channels. For more information, see "Audit Channels" on page 9-2 and "Implement the AuditChannel SSPI" on page 9-8.

The `AuditContext` interface includes the following method:

getContext
```
public ContextHandler getContext()
```

The `getContext` method returns a `ContextHandler` object, which is used by the runtime class (that is, the `AuditChannel` SSPI implementation) to obtain additional audit information. For more information about ContextHandlers, see "ContextHandlers and WebLogic Resources" on page 2-33.

Example: Implementation of the AuditRoleEvent Interface

Listing 11-1 shows the `MyAuditRoleEventImpl.java` class, which is a sample implementation of an Audit Event convenience interface (in this case, the `AuditRoleEvent` convenience interface). This class includes implementations for:

■ The four methods inherited from the `AuditEvent` SSPI: `getEventType`, `getFailureException`, `getSeverity` and `toString` (as described in "Implement the AuditEvent SSPI" on page 11-4).

■ One additional method: `getContext`, which returns additional contextual information via the ContextHandler. (For more information about ContextHandlers, see "ContextHandlers and WebLogic Resources" on page 2-33.)

Note: The bold face code in Listing 11-1 highlights the class declaration and the method signatures.

Listing 11-1   MyAuditRoleEventImpl.java

```
package mypackage;

import javax.security.auth.Subject;
import weblogic.security.SubjectUtils;
import weblogic.security.service.ContextHandler;
```

```
import weblogic.security.spi.AuditRoleEvent;
import weblogic.security.spi.AuditSeverity;
import weblogic.security.spi.Resource;

/*package*/ class MyAuditRoleEventImpl implements AuditRoleEvent
{
   private Subject subject;
   private Resource resource;
   private ContextHandler context;
   private String details;
   private Exception failureException;

   /*package*/ MyAuditRoleEventImpl(Subject subject, Resource
resource,
      ContextHandler context, String details, Exception
      failureException) {

         this.subject = subject;
         this.resource = resource;
         this.context = context;
         this.details = details;
         this.failureException = failureException;
   }

   public Exception getFailureException()
   {
      return failureException;
   }

   public AuditSeverity getSeverity()
   {
      return (failureException == null) ? AuditSeverity.SUCCESS :
         AuditSeverity.FAILURE;
   }

   public String getEventType()
   {
      return "MyAuditRoleEventType";
   }

   public ContextHandler getContext()
   {
      return context;
   }

   public String toString()
   {
      StringBuffer buf = new StringBuffer();
      buf.append("EventType:" + getEventType() + "\n");
      buf.append("\tSeverity: " +
```

```
      getSeverity().getSeverityString());
   buf.append("\tSubject: " +
      SubjectUtils.displaySubject(getSubject());
   buf.append("\tResource: " + resource.toString());
   buf.append("\tDetails: " + details);

   if (getFailureException() != null) {
      buf.append("\n\tFailureException:" +
         getFailureException());
   }

   return buf.toString();
}

}
```

Obtain and Use the Auditor Service to Write Audit Events

To obtain and use the Auditor Service to write audit events from a custom security provider, follow these steps:

1. Use the `getAuditorService` method to return the Audit Service.

    Notes: Recall that a `SecurityServices` object is passed into a security provider's implementation of a "Provider" SSPI as part of the `initialize` method. (For more information, see "Understand the Purpose of the "Provider" SSPIs" on page 2-3.) An `AuditorService` object will only be returned if an Auditing provider has been configured.

2. Instantiate the Audit Event you created in "Implement the AuditEvent SSPI" on page 11-4 and send it to the Auditor Service through the `AuditService.providerAuditWriteEvent` method.

Example: Obtaining and Using the Auditor Service to Write Role Audit Events

Listing 11-2 illustrates how a custom Role Mapping provider's runtime class (called `MyRoleMapperProviderImpl.java`) would obtain the Auditor Service and use it to write out audit events.

Note: The `MyRoleMapperProviderImpl.java` class relies on the `MyAuditRoleEventImpl.java` class from Listing 11-1.

Listing 11-2 MyRoleMapperProviderImpl.java

```java
package mypackage;

import javax.security.auth.Subject;
import weblogic.management.security.ProviderMBean;
import weblogic.security.SubjectUtils;
import weblogic.security.service.ContextHandler;
import weblogic.security.spi.AuditorService;
import weblogic.security.spi.RoleMapper;
import weblogic.security.spi.RoleProvider;
import weblogic.security.spi.Resource;
import weblogic.security.spi.SecurityServices;

public final class MyRoleMapperProviderImpl implements
RoleProvider, RoleMapper
{

   private AuditorService auditor;

   public void initialize(ProviderMBean mbean, SecurityServices
      services)
   {
      auditor = services.getAuditorService();
      ...
   }

   public Map getRoles(Subject subject, Resource resource,
      ContextHandler handler)
   {
      ...
      if (auditor != null)
      {
         auditor.providerAuditWriteEvent(
            new MyRoleEventImpl(subject, resource, context,
            "why logging this event",
            null);                     // no exception occurred
      }
      ...
   }

}
```

Note: The code in Listing 11-2 shows an example of how to post audit events from
a security provider's runtime class. You can also post audit events from
management methods. For an example of posting audit events from

management methods, see the Manageable Sample Authentication Provider, one of the sample security providers available under "Code Samples: WebLogic Server" on the *dev2dev Web site*.

12 Writing Console Extensions for Custom Security Providers

Console extensions allow you to provide functionality that is not included in the standard WebLogic Server Administration Console, or provide an alternate interface for existing functionality. You provide this functionality by adding nodes to the navigation tree, and/or by adding or replacing tabbed dialogs and dialog screens.

Note: Detailed information about how to write console extensions is provided in *Extending the Administration Console*, and should be reviewed before proceeding.

The following sections provide information about writing console extensions specifically for use with custom security providers:

- "When Should I Write a Console Extension?" on page 12-2

- "When In the Development Process Should I Write a Console Extension?" on page 12-3

- "How Writing a Console Extension for a Custom Security Provider Differs From a Basic Console Extension" on page 12-4

- "Main Steps for Writing an Administration Console Extension" on page 12-4

- "Replacing Custom Security Provider-Related Administration Console Dialog Screens Using the SecurityExtension Interface" on page 12-5

- "How a Console Extension Affects the Administration Console" on page 12-7

When Should I Write a Console Extension?

To get complete configuration and management support through the WebLogic Server Administration Console for a custom security provider, you need to write a console extension when:

■ You decide not to implement an optional SSPI MBean when you generate an MBean type for your custom security provider, but still want to configure and manage your custom security provider via the Administration Console. (That is, you do not want to use the WebLogic Server Command-Line Interface instead.)

Generating an MBean type (as described in "Generating an MBean Type to Configure and Manage the Custom Security Provider" on page 1-4) is the BEA-recommended way for configuring and managing custom security providers. However, you may want to configure and manage your custom security provider completely through a console extension that you write.

■ You implement optional SSPI MBeans for custom security providers that are <u>not</u> custom Authentication providers.

When you implement optional SSPI MBeans to develop a custom Authentication provider, you automatically receive support in the Administration Console for the MBean type's attributes (inherited from the optional SSPI MBean). Other types of custom security providers, such as custom Authorization providers, do not receive this support.

■ You add a custom attribute *that cannot be represented as a simple data type* to your MBean Definition File (MDF), which is used to generate the custom security provider's MBean type.

The Details tab for a custom security provider will automatically display custom attributes, but only if they are represented as a simple data type, such as a string, MBean, boolean or integer value. If you have custom attributes that are represented as atypical data types (for example, an image of a fingerprint), the Administration Console cannot visualize the custom attribute without customization.

■ You add a custom operation to your MBean Definition File (MDF), which is used to generate the custom security provider's MBean type.

Because of the potential variety involved with custom operations, the Administration Console does not know how to automatically display or process

them. Examples of custom operations might be a microphone for a voice print, or import/export buttons. The Administration Console cannot visualize and process these operations without customization.

Some other (optional) reasons for extending the Administration Console include:

■ Corporate branding—when, for example, you want your organization's logo or look and feel on the pages used to configure and manage a custom security provider.

■ Consolidation—when, for example, you want all the fields used to configure and manage a custom security provider on one page, rather than in separate tabs or locations.

When In the Development Process Should I Write a Console Extension?

The various programmatic elements that comprise a console extension are packaged into a Web application and deployed in your WebLogic Server domain. The point in the development process when you develop the Web application is completely up to you.

However, before you or an administrator can use the console extension to configure and manage a custom security provider, the MBean type for the custom security provider must have been generated (as described in "Generating an MBean Type to Configure and Manage the Custom Security Provider" on page 1-4) and the console extension Web application properly packaged and deployed.

Note: For instructions about how to develop, package, and deploy a console extension as a Web application, see "Main Steps for Writing an Administration Console Extension" on page 12-4.

How Writing a Console Extension for a Custom Security Provider Differs From a Basic Console Extension

While basic console extensions (described in *Extending the Administration Console*) provide a great deal of flexibility and capability, the additional mechanisms that are available for writing security provider-specific console extensions enable:

- Tighter integration with the Administration Console pages already provided for configuring and managing custom security providers.

- Integration of tabbed dialogs and dialog screens at several different, specific points. (Basic console extensions only allow you to add tabbed dialogs and dialog screens as part of new navigation tree nodes.)

- Replacement of existing tabbed dialogs and dialog screens used to configure and manage custom security providers.

Main Steps for Writing an Administration Console Extension

Although security provider-specific console extensions provide the additional features described in "How Writing a Console Extension for a Custom Security Provider Differs From a Basic Console Extension" on page 12-4, the main process for writing console extensions is the same:

1. Create a Java class that defines your Administration Console extension. This class defines where your console extension appears in the navigation tree and can provide additional functionality required by your extension. For more information, see "Implementing the NavTreeExtension Interface" in *Extending the Administration Console*.

2. Define the behavior of the Navigation tree. In this step you can define multiple nodes that appear under the node you define in step 1. You can also define right-click menus and actions. For more information, see "Setting Up the Navigation Tree" in *Extending the Administration Console*.

3. Write JavaServer Pages (JSPs) to display your console extension screens. You may use localized text by looking up strings in a localization catalog. A supplied tag library allows you to create tabbed dialog screens similar to those in the standard Administration Console and to access the localization catalogs. For more information, see "Writing the Console Screen JSPs" in *Extending the Administration Console*.

4. Localize the console extension to display it in multiple languages. For more information, see "Localizing the Administration Console Extension" in *Extending the Administration Console*.

5. Package your JSPs, catalogs, and Java classes as a Web application. For more information, see "Packaging the Administration Console Extension" in *Extending the Administration Console*.

6. Deploy the Web application containing your console extension on the Administration Server in your WebLogic Server domain. For more information, see "Deploying an Administration Console Extension" in *Extending the Administration Console*.

Replacing Custom Security Provider-Related Administration Console Dialog Screens Using the SecurityExtension Interface

The `SecurityExtension` interface provides methods that allow you to replace various custom security provider-related Administration Console dialog screens. The Java class you create to define your console extension can implement the `SecurityExtension` interface in addition to (or in place of) extending the `Extension` class. (The `Extension` class is used for basic console extensions, and its use is described in "Implementing the NavTreeExtension Interface" in *Extending the Administration Console*.).

Note: You must implement all the methods in this interface. Simply return `null` for the pages you choose not to replace.

Table 12-1 shows the security provider-related dialog screens that you are most likely to replace, as well as the methods in the `SecurityExtension` interface that you need to implement to replace them.

Table 12-1 Using the SecurityExtension Interface

To Replace Dialog Screens Used to...	Implement the...
Configure a new custom security provider and edit an existing custom security provider's configuration	`getExtensionForProvider` method
Create a new user and edit an existing user. (For use with custom Authentication providers.	`getExtensionForUser` method
Create a new group and edit an existing group. (For use with custom Authentication providers.	`getExtensionForGroup` method
Create a new role and edit an existing role. (For use with custom Role Mapping providers.)	`getExtensionForRole` method
Create a new security policy and edit an existing security policy. (For use with custom Authorization providers.)	`getExtensionForPolicy` method

Note: For more detailed information, see the *WebLogic Server 7.0 API Reference Javadoc* for the SecurityExtension interface and the Extension class.

How a Console Extension Affects the Administration Console

Whether you write a console extension that is meant is to replace the BEA-provided dialog screens for configuring a custom security provider, or the dialog screens for creating and editing users, groups, roles, or security policies that are associated with security providers, the WebLogic Server Administration Console will be affected in the same way.

As an example, the following process will occur when you or an administrator attempt to configure a custom security provider using the WebLogic Server Administration Console:

1. If you or an administrator click a Configure a New *Security_Provider_Type*... link on one of the Administration Console's dialog screens (examples of which are shown in the top portion of Figure 12-1), the Administration Console attempts to locate a console extension for the custom security provider.

Figure 12-1   Configuring the Sample Authentication Provider

myrealm> Authentication Providers

Connected to : localhost :7001 | You are logged in as : weblogic | Logout

Configure a new Default Identity Asserter...
Configure a new Med Rec Sample Authenticator...
Configure a new Simple Sample Identity Asserter...
Configure a new Simple Sample Authenticator...
Configure a new Open LDAPAuthenticator...
Configure a new Novell Authenticator...
Configure a new iPlanet Authenticator...
Configure a new Default Authenticator...
Configure a new Realm Adapter Authenticator...
Configure a new Manageable Sample Authenticator...
Configure a new Active Directory Authenticator...

Re-order the Configured Authentication Providers

Customize this view...

Name	Description	Version

If you or an administrator are *editing* a custom security provider's configuration (rather than adding it as step 1 describes), the Administration Console attempts to locate a console extension when you click the hyperlinked name of the custom security provider (examples of which are shown in the bottom portion of Figure 12-1).

2. If the Administration Console detects that a console extension for the security provider is available, the Administration Console displays the JavaServer Page (JSP) specified by the URL that is returned from the `getExtensionForProvider` method (or other `getExtensionFor*` method described in Table 12-1, "Using the SecurityExtension Interface," on page 12-6).

3. You or an administrator use the JSP to configure and manage the custom security provider, instead of the BEA-provided interface.

A MBean Definition File (MDF) Element Syntax

An **MBean Definition File (MDF)** is an input file to the WebLogic MBeanMaker utility, which uses the file to create an MBean type for managing a custom security provider. An MDF must be formatted as a well-formed and valid XML file that describes a single MBean type. The following sections describe all the elements and attributes that are available for use in a valid MDF:

- "The MBeanType (Root) Element" on page A-1

- "The MBeanAttribute Subelement" on page A-15

- "The MBeanNotification Subelement" on page A-31

- "The MBeanConstructor Subelement" on page A-37

- "The MBeanOperation Subelement" on page A-38

- "Examples: Well-Formed and Valid MBean Definition Files (MDFs)" on page A-46

The MBeanType (Root) Element

All MDFs must contain exactly one root element called MBeanType, which has the following syntax:

```
<MBeanType Name= string    optional_attributes>
     subelements
</MBeanType>
```

The `MBeanType` element must include a `Name` attribute, which specifies the internal, programmatic name of the MBean type. (To specify a name that is visible in a user interface, use the `DisplayName` and `LanguageMap` attributes.) Other attributes are optional.

The following is a simplified example of an `MBeanType` (root) element:

```
<MBeanType Name="MyMBean" Package="com.mycompany">
   <MBeanAttribute Name="MyAttr" Type="java.lang.String" Default="Hello World"/>
</MBeanType>
```

Attributes specified in the `MBeanType` (root) element apply to the entire set of MBeans instantiated from that MBean type. To override attributes for specific MBean instances, you need to specify attributes in the `MBeanAttribute` subelement. For more information, see "The MBeanAttribute Subelement" on page A-15.

Table A-2 describes the attributes available to the `MBeanType` (root) element. The JMX Specification/BEA Extension column indicates whether the attribute is a BEA extension to the JMX specification or a standard JMX attribute. Note that BEA extensions might not function on other J2EE Web servers.

Table A-2 Attributes of the MBeanType (Root) Element

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Abstract	BEA Extension	true/false	A `true` value specifies that the MBean type cannot be instantiated (like any abstract Java class), though other MBean types can inherit its attributes and operations. If you specify `true`, you must create other non-abstract MBean types for carrying out management tasks. If you do not specify a value for this attribute, the assumed value is `false`.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
CachingDisabled	BEA Extension	true/false	Ignored. This flag exists to support future functionality. For example, if caching is provided in the types-stubs, this flag may turn off that caching.
			Currently, MBeans created via the WebLogic MBeanMaker provide server-level caching as per the specification for JMX Model MBeans.
			Note: For more information on JMX Model MBeans, see the *Java Management eXtensions 1.0 specification.*
Classification	BEA Extension	*String*	A string that you can use to classify or group your MBean types, for example, to identify all MBean types that provide implementations of security authorization. There is no default or assumed value for this attribute.
CurrencyTimeLimit	JMX Specification	*Integer*	The number of seconds that any value cached is considered fresh. After this value expires, the next attempt to access the value triggers a recalculation.
			When specified in the MBeanType element, this value is considered the default for MBean types. It can be overridden for individual MBeans by setting the same attribute in the MBean's MBeanAttribute or MBeanOperation subelement.
Deprecated	BEA Extension	true/false	Indicates that the MBean type is deprecated. This information appears in the generated Java source, and is also placed in the ModelMBeanInfo object for possible use by a management application. If you do not specify this attribute, the assumed value is false.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Description	JMX Specification	*String*	An arbitrary string associated with the MBean type that appears in various locations, such as the Javadoc for generated classes. There is no default or assumed value. **Note:** To specify a description that is visible in a user interface, use the `DisplayName`, `DisplayMessage`, and `PresentationString` attributes.
DisplayMessage	JMX Specification	*String*	The message that a user interface displays to describe the MBean type. There is no default or assumed value. The `DisplayMessage` may be a paragraph used in Tool Tips or in Help. A `DisplayMessage` set for the MBean type is considered the default for MBean instances, unless a different value is specified for individual MBeans when the instance is created.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
DisplayName	JMX Specification	*String*	The name that a user interface displays to identify instances of MBean types. For an instance of type X, the default DisplayName is "instance of type X." This value is typically overridden when instances are created.
			If you use the LanguageMap attribute, the DisplayName value is used as a key to find a name in the LanguageMap's resource bundle. If you do not specify the LanguageMap attribute, or if the key is not present in the resource bundle, the DisplayName value itself is displayed in the user interface.
			See also MessageID.
Export	JMX Specification	*String*	The WebLogic MBeanMaker does not use this attribute. However, to support applications that might use it, the WebLogic MBeanMaker adds the value to the MBeanInfo object. There is no default or assumed value.
			Note: For more information on the Export attribute, see the *Java Management eXtensions 1.0 specification.*
Extends	BEA Extension	*Pathname*	A fully qualified MBean type name that this MBean type extends.
			See also Implements.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
GenerateExtended Accessors	BEA Extension	true/false	A `true` value enables all `MBeanAttribute` subelements whose `Type` is array to generate additional operations and interface methods to support indexed access. A `false` value prevents all `MBeanAttribute` subelements from generating additional operations and methods. If you do not specify this attribute, the assumed value is `true`.
Implements	BEA Extension	*Comma-separated list*	A comma-separated list of fully qualified MBean type names that this MBean type implements. See also `Extends`.
InstanceExtent	BEA Extension	true/false	A `true` value specifies that all instances of an MBean type should be retained in a list for faster and easier access. Setting this attribute to `true`, however, takes up more space. **Note:** By default, all security-related MBean types are set to `true`. If instances of those MBeans override this attribute, security may be adversely impacted.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
LanguageMap	BEA Extension	*String*	Specifies a fully qualified pathname to a resource bundle that contains a map of displayable strings. Other attributes, such as `DisplayMessage` and `DisplayName`, use the strings in the LanguageMap to display information about the MBean type.
			If you do not specify this attribute, other attributes, such as DisplayMessage and DisplayName, display their own values (as opposed to using their values as a key to find appropriate strings in the resource bundle).
Listen	BEA Extension	true/false	Causes a stub for a notification listener to be generated in the MBean implementation object. If you do not specify this attribute, the assumed value is `false`.
			Note: For more information about listener stubs, see the *Java Management eXtensions 1.0 specification.*
Log	JMX Specification	true/false	A `true` value specifies that notifications for the MBean type are added to the log file. (The `LogFile` attribute specifies the file into which the information should be written.) If you do not specify this attribute, the assumed value is `false`, and notifications are not added to the log file.
			Note: For more information about MBean notifications and logs, see the *Java Management eXtensions 1.0 specification.*

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
LogFile	JMX Specification	*Pathname*	The fully qualified pathname of an existing, writable file into which messages are written when notifications occur for this MBean type. For logging to occur, the Log attribute must be set to true. There is no default or assumed value for this attribute.
			Note: For more information about MBean notifications and logs, see the *Java Management eXtensions 1.0 specification.*
MBeanClassName	BEA Extension	*Pathname*	A fully qualified classname that is a subclass of an MBean type BEA provides. This is included primarily for future development and for those wanting to extend Model MBeans.
			Note: For more information on JMX Model MBeans, see the *Java Management eXtensions 1.0 specification.*
MessageID	JMX Specification	*String*	Provides a key for retrieving a message from a client-side message repository per the *Java Management eXtensions 1.0 specification.*
			You can use MessageID, or DisplayMessage, or both to describe a notification MBean type. If you do not specify this attribute, no message ID is available.
			Note: MessageID does not use the same resource bundle that the LanguageMap attribute specifies, and it is available for notification MBean types only.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Name	JMX Specification	*String*	Mandatory attribute that specifies the internal, programmatic name of the MBean type.
Package	BEA Extension	*String*	Specifies the package name of the MBean type and determines the location of the class files that the WebLogic MBeanMaker creates. If you do not specify this attribute, the MBean type is placed in the Java default package.
			Note: MBean type names can be the same as long as the package name varies.
PersistLocation	JMX Specification	*Pathname*	The WebLogic MBeanMaker does not use this attribute. However, to support cases where an MBean type extends Model MBeans that do use PersistLocation, the WebLogic MBeanMaker adds the value to the MBeanInfo class. There is no default or assumed value.
			Note: For more information about PersistLocation and Model MBeans, see the *Java Management eXtensions 1.0 specification*.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
PersistName	JMX Specification	*String*	The WebLogic MBeanMaker does not use this attribute. However, to support cases where an MBean type extends Model MBeans that do use PersistName, WebLogic MBeanMaker adds the value to the MBeanInfo class. There is no default or assumed value.
			Note: For more information about PersistName and Model MBeans, see the *Java Management eXtensions 1.0 specification*.
PersistPeriod	JMX Specification	*Integer*	Specifies the number of seconds that the OnTimer or NoMoreOftenThan persistence policies use. If you do not specify this attribute in the MBeanType or MBeanAttribute elements, the assumed value is 0.
			If PersistPolicy is set to OnTimer, then the attribute is persisted when the number of seconds expires. If PersistPolicy is set to NoMoreOftenThan, then persistence is constrained to happen not more often than the specified number seconds.
			Note: When specified in the MBeanType element, this value overrides any setting within an individual MBeanAttribute subelement.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
PersistPolicy	JMX Specification	Never /OnTimer /OnUpdate /NoMoreOf tenThan	Specifies how persistence will occur: ■ Never. The attribute is never stored. This is useful for highly volatile data or data that only has meaning within the context of a session or execution period. ■ OnTimer. The attribute is stored whenever the MBean type's persistence timer, as defined in the PersistPeriod attribute, expires. ■ OnUpdate. The attribute is stored every time the attribute is updated. ■ NoMoreOftenThan. The attribute is stored every time it is updated unless the updates are closer together than the PersistPeriod. This mechanism helps prevent temporarily highly volatile data from affecting performance. If you do not specify this attribute in the MBeanType or MBeanAttribute elements, the assumed value is Never. **Note:** When specified in the MBeanType element, this value overrides any setting within an individual MBeanAttribute subelement.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
PresentationString	JMX Specification	*Pathname*	A fully qualified pathname to a single XML document that provides information that a user interface can use to display the item. The XML document provides additional metadata that is relevant to presentation logic. The format of the PresentationString is any XML/JMX-compliant information.
			Note: BEA does not currently define a specialized format, and recommends that customers wait before defining their own. The PresentationString attribute is for future use.
Readable	JMX Specification	true/false	Determines whether an MBean attribute's value can be read through the MBean API. If you do not specify this attribute in the MBeanType or MBeanAttribute elements, the assumed value is true.
			When specified in the MBeanType element, this value is considered the default for individual MBeanAttribute subelements.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Servers	BEA Extension	*Comma-separated list*	Defines the list of servers that can instantiate instances of an MBean type and the servers to which instances of the MBean type are visible. Instances of the MBean type are guaranteed to be accessible (for read access) from these servers even if the Administration Server is not available.
			The comma-separated list must specify names of servers that are in the same management domain as the MBean type. If no value is specified, the scope is assumed to be global, meaning that the instance is visible to all servers in the domain. If there is only one Managed Server in the list, the scope is server-specific, meaning that instances are only visible to the Managed Server and cannot be replicated to other servers. If an Administration Server and one or more Managed Servers are in the list, the scope is shared, meaning that the instance is visible to the Administration Server and the Managed Servers specified. Specifying more than one Managed Server without an Administration Server produces an error.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
VersionID	BEA Extension	*Long*	Translates to the Java `serialVersionUID`. The provided values are placed directly into the generated implementation file in the following form: `static final long serialVersionUID = <user provided ID>;`
			Users who change an MBean class in an incompatible way will need to modify the `serialVersionUID` (using `VersionID`) to get Java serialization to work correctly.
			For more information about `serialVersionUID`, see the *Java 2 Platform Standard Edition v1.3.1 API specification*.
Visibility	JMX Specification	Integer: `1-4`	Denotes a level of importance for the MBean type. User interfaces use the number to determine whether they present the MBean type to a particular user in a particular context. The lower the value, the higher the level of importance. You can specify a number from `1` to `4`. If you do not specify this attribute, the assumed value is `1`.
			For items that have a high level of interest for users, provide a low `Visibility` number. For example, in the WebLogic Server Administration Console, MBeans with a `Visiblity` value of `1` are displayed in the left-pane navigation tree.

Table A-2 Attributes of the MBeanType (Root) Element (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
`Writeable`	JMX Specification	`true/false`	A `true` value allows the MBean API to set an `MBeanAttribute`'s value. If you do not specify this attribute in `MBeanType` or `MBeanAttribute`, the assumed value is `true`.
			When specified in the `MBeanType` element, this value is considered the default for individual `MBeanAttribute` subelements.

The MBeanAttribute Subelement

You must supply one instance of an `MBeanAttribute` subelement for each attribute in your MBean type. The `MBeanAttribute` subelement must be formatted as follows:

`<MBeanAttribute Name=`*string   optional_attributes* `/>`

The `MBeanAttribute` subelement must include a `Name` attribute, which specifies the internal, programmatic name of the Java attribute in the MBean type. (To specify a name that is visible in a user interface, use the `DisplayName` and `LanguageMap` attributes.) Other attributes are optional.

The following is a simplified example of an `MBeanAttribute` subelement within an `MBeanType` element:

```
<MBeanType Name="MyMBean" Package="com.mycompany">
    <MBeanAttribute Name= "WhenToCache"
    Type="java.lang.String"
    LegalValues="'cache-on-reference','cache-at-initialization','cache-never'"
    Default= "cache-on-reference"
    />
</MBeanType>
```

Attributes specified in an MBeanAttribute subelement apply to a specific MBean instance. To set attributes for the entire set of MBeans instantiated from an MBean type, you need to specify attributes in the MBeanType (root) element. For more information, see "The MBeanType (Root) Element" on page A-1.

Table A-3 describes the attributes available to the MBeanAttribute subelement. The JMX Specification/BEA Extension column indicates whether the attribute is a BEA extension to the JMX specification. Note that BEA extensions might not function on other J2EE Web servers.

Table A-3 Attributes of the MBeanAttribute Subelement

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
CachingDisabled	BEA Extension	true/false	Ignored. This flag exists to support future functionality. For example, if caching is provided in the types-stubs, this flag may turn off that caching.
			Currently, MBeans created via the WebLogic MBeanMaker provide server-level caching as per the specification for JMX Model MBeans.
			Note: For more information on JMX Model MBeans, see the *Java Management eXtensions 1.0 specification.*
CurrencyTimeLimit	JMX Specification	*Integer*	The number of seconds that any value cached is considered fresh. After this value expires, the next attempt to access the value triggers a recalculation.
			When specified in the MBeanType element, this value is considered the default for MBean types. It can be overridden for individual MBeans by setting the same attribute in the MBean's MBeanAttribute or MBeanOperation subelement.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Default	JMX Specification	*String*	The value to be returned if the MBeanAttribute subelement does not provide a getter method or a cached value. The string represents a Java expression that must evaluate to an object of a type that is compatible with the provided data type for this attribute.
			If you do not specify this attribute, the assumed value is null. If you use this assumed value, and if you set the LegalNull attribute to false, then an exception is thrown by WebLogic MBeanMaker and WebLogic Server.
DefaultString	JMX Specification	*String*	Same as Default, but can be used if the type of the attribute is String. If Default is used for a string attribute, the value must be enclosed in quotation marks. If DefaultString is used, the quotation marks should be omitted.
Deprecated	BEA Extension	true/false	Indicates that the MBean attribute is deprecated. This information appears in the generated Java source, and is also placed in the ModelMBeanInfo object for possible use by a management application. If you do not specify this attribute, the assumed value is false.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Description	JMX Specification	*String*	An arbitrary string associated with the MBean attribute that appears in various locations, such as the Javadoc for generated classes. There is no default or assumed value.
			Note: To specify a description that is visible in a user interface, use the DisplayName, DisplayMessage, and PresentationString attributes.
DisplayMessage	JMX Specification	*String*	The message that a user interface displays to describe the MBean attributes. There is no default or assumed value.
			The DisplayMessage may be a paragraph used in Tool Tips or in Help. A DisplayMessage set for the MBean type is considered the default for MBean instances, unless a different value is specified for individual MBeans when the instance is created.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
DisplayName	JMX Specification	*String*	The name that a user interface displays to identify the instances of MBean types.
			The default value for DisplayName (from the MBean type) is typically overridden when instances are created. For an instance of type X, the default DisplayName is "instance of type X."
			If you use the LanguageMap attribute, the DisplayName value is used as a key to find a name in the LanguageMap's resource bundle. If you do not specify the LanguageMap attribute, or if the key is not present in the resource bundle, the DisplayName value itself is displayed in the user interface.
			See also MessageID.
Encrypted	BEA Extension	true/false	A true value indicates that this MBean attribute will be encrypted when it is set. If you do not specify this attribute, the assumed value is false.
Export	JMX Specification	*String*	The WebLogic MBeanMaker does not use this attribute. However, to support applications that might use it, WebLogic MBeanMaker adds the value to the MBeanInfo object. There is no default or assumed value.
			Note: For more information on the Export attribute, see the *Java Management eXtensions 1.0 specification.*

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
GenerateExtended Accessors	BEA Extension	true/false	A true value enables all MBean attributes whose Type is array to generate additional operations and interface methods to support indexed access. A false value prevents all MBeanAttribute subelements from generating additional operations and methods. If you do not specify this attribute, the assumed value is true.
GetMethod	JMX Specification	*String*	Overrides the MBean type's default attribute handling logic and provides the name of a getter method to be used for the current MBeanAttribute subelement. The value must correspond to the Name of an MBeanOperation subelement that defines a getter operation within the current MDF.

If you do not specify this attribute, the MBean uses its default logic to retrieve the MBean attribute's value.

Note: This attribute is affected by the Readable attribute: if Readable is false, then no getters are invoked for the current MBeanAttribute subelement. |
| InterfaceType | BEA Extension | *String* | Classname of an interface to be used instead of the MBean interface generated by the WebLogic MBeanMaker. Currently ignored but may be used for future extensibility. |

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
IsIs	JMX Specification	true/false	Specifies whether a generated Java interface uses the JMX is<AttributeName> method to access the boolean value of the MBean attribute (as opposed to the get<AttributeName> method). If you do not specify this attribute, the assumed value is false.
Iterable	JMX Specification	true/false	For aggregate attribute types, indicates whether the attribute supports iteration (that is, whether it can increment its value each time it is accessed). If you do not specify this attribute, the assumed value is false.
			The WebLogic MBeanMaker does not use this attribute. However, to support applications that might use it, WebLogic MBeanMaker adds the value to the MBeanInfo class.
			Note: For more information on the Iterable attribute, see the *Java Management eXtensions 1.0 specification.*
LanguageMap	BEA Extension	*String*	Specifies a fully qualified pathname to a resource bundle that contains a map of displayable strings. Other attributes, such as DisplayMessage and DisplayName, use the strings in the LanguageMap to display information about the MBean attribute.
			If you do not specify this attribute, other attributes, such as DisplayMessage and DisplayName, display their own values (as opposed to using their values as a key to find appropriate strings in the resource bundle).

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
LegalNull	BEA Extension	true/false	Specifies whether null is an allowable value for the current MBeanAttribute subelement. If you do not specify this attribute, the assumed value is true.
LegalValues	BEA Extension	*Comma-separated list*	Specifies a fixed set of allowable values for the current MBeanAttribute subelement. If you do not specify this attribute, the MBean attribute allows any value of the type that is specified by the Type attribute.
			Note: The items in the list must be convertible to the data type that is specified by the subelement's Type attribute.
Listen	BEA Extension	true/false	Causes a stub for a notification listener to be generated in the MBean implementation object. If you do not specify this attribute, the assumed value is false.
			Note: For more information about listener stubs, see the *Java Management eXtensions 1.0 specification.*

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Log	JMX Specification	true/false	A `true` value specifies that MBean notifications are added to the log file. (The `LogFile` attribute specifies the file into which the information should be written.) If you do not specify this attribute, the assumed value is `false`, and notifications are not added to the log file.
			Note: For more information about MBean notifications and logs, see the *Java Management eXtensions 1.0 specification.*
LogFile	JMX Specification	*Pathname*	The fully qualified pathname of an existing, writable file into which messages are written when notifications occur for this MBean attribute. For logging to occur, the `Log` attribute must be set to `true`. There is no default or assumed value for this attribute.
			Note: For more information about MBean notifications and logs, see the *Java Management eXtensions 1.0 specification.*
Max	BEA Extension	*Integer*	For numeric MBean attribute types only, provides a numeric value that represents the inclusive maximum value for the attribute. If you do not specify this attribute, the value can be as large as the data type allows.
			Note: If this maximum varies dynamically, varies based on context, or has a complex set of value ranges (for example, 1-10 or >100), use the `Validator` attribute instead.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
MessageID	JMX Specification	*String*	Provides a key for retrieving a message from a client-side message repository per the *Java Management eXtensions 1.0 specification*.
			You can use MessageID, or DisplayMessage, or both to describe a notification MBean type. If you do not specify this attribute, no message ID is available.
			Note: MessageID does not use the same resource bundle that the LanguageMap attribute specifies, and it is available for notification MBean types only.
Min	BEA Extension	*Integer*	For numeric MBean attribute types only, provides a numeric value which represents the inclusive minimum value for the attribute. If you do not specify this attribute, the value can be as small as the data type allows.
			Note: If this minimum varies dynamically, varies based on context, or has a complex set of value ranges (for example, 1-10 or >100), use the Validator attribute instead.
Name	JMX Specification	*String*	Mandatory attribute that specifies the internal, programmatic name of the MBean attribute.
NoDump	BEA Extension	true/false	A true value prevents the MBean attribute from being dumped by the WebLogic MBeanDumper utility.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
PersistLocation	JMX Specification	*Pathname*	The WebLogic MBeanMaker does not use this attribute. However, to support cases where an MBean extends Model MBeans that do use PersistLocation, the WebLogic MBeanMaker adds the value to the MBeanInfo class. There is no default or assumed value.
			Note: For more information about PersistLocation and Model MBeans, see tthe *Java Management eXtensions 1.0 specification*.
PersistName	JMX Specification	*String*	The WebLogic MBeanMaker does not use this attribute. However, to support cases where an MBean extends Model MBeans that do use PersistName, WebLogic MBeanMaker adds the value to the MBeanInfo class. There is no default or assumed value.
			Note: For more information about PersistName and Model MBeans, see the *Java Management eXtensions 1.0 specification*.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
PersistPeriod	JMX Specification	*Integer*	Specifies the number of seconds that the OnTimer or NoMoreOftenThan persistence policies use. If you do not specify this attribute in the MBeanType or MBeanAttribute elements, the assumed value is 0.
			If PersistPolicy is set to OnTimer, then the attribute is persisted when the number of seconds expires. If PersistPolicy is set to NoMoreOftenThan, then persistence is constrained to happen not more often than the specified number seconds.
			Note: When specified in the MBeanType element, this value overrides any setting within an individual MBeanAttribute subelement.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
`PersistPolicy`	JMX Specification	`Never /OnTimer /OnUpdate /NoMoreOf tenThan`	Specifies how persistence will occur: ■ `Never`. The attribute is never stored. This is useful for highly volatile data or data that only has meaning within the context of a session or execution period. ■ `OnTimer`. The attribute is stored whenever the MBean attribute's persistence timer, as defined in the `PersistPeriod` attribute, expires. ■ `OnUpdate`. The attribute is stored every time the attribute is updated. ■ `NoMoreOftenThan`. The attribute is stored every time it is updated unless the updates are closer together than the `PersistPeriod`. This mechanism helps prevent temporarily highly volatile data from affecting performance. If you do not specify this attribute in the `MBeanType` or `MBeanAttribute` elements, the assumed value is `Never`. **Note:** When specified in the `MBeanType` element, this value overrides any setting within an individual `MBeanAttribute` subelement.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
PresentationString	JMX Specification	*Pathname*	A fully qualified pathname to a single XML document that provides information that a user interface can use to display the item. The XML document provides additional metadata that is relevant to presentation logic. The format of the PresentationString is any XML/JMX-compliant information.
			Note: BEA does not currently define a specialized format, and recommends that customers wait before defining their own. The PresentationString attribute is for future use.
ProtocolMap	JMX Specification	*Pathname*	The Model MBean APIs allow mapping of the application's Model MBean attributes to existing management data models through the ProtocolMap field of the descriptor. The ProtocolMap field of an attribute's descriptor must contain a reference to an instance of a class that implements the Descriptor interface.
			Note: For more information about the ProtocolMap attribute and Model MBeans, see the *Java Management eXtensions 1.0 specification*.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Readable	JMX Specification	true/false	Determines whether the MBean attribute's value can be read through the MBean API. If you do not specify this attribute in the MBeanType or MBeanAttribute elements, the assumed value is true. When specified in the MBeanType element, this value is considered the default for individual MBeanAttribute subelements.
SetMethod	JMX Specification	*String*	Overrides the MBean type's default attribute handling logic and provides the name of a setter method to be used for the current MBeanAttribute subelement. The value must correspond to the Name of an MBeanOperation subelement that defines a setter operation within the current MDF. If you do not specify this attribute, the MBean uses its default logic to set the MBeanAttribute's value. **Note:** This attribute is affected by the Writeable attribute: if Writable is false, then no setters are invoked for the current MBeanAttribute subelement.
Type	JMX Specification	*Java class name*	The fully qualified classname of the data type of this attribute. This corresponding class must be available on the classpath. If you do not specify this attribute, the assumed value is java.lang.String.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Validator	BEA Extension	*Java method name*	The Validator attribute requires the name of a method that implements the validator logic. This method will be declared in the class generated by WebLogicMBeanMaker.
			If a specific validator is not provided, WebLogic Server does only basic checking to ensure type compatibility and, for numeric values, simple range checking (as specified in Min and Max).
			Instantiation and use of a validator is automatic and requires no additional action, beyond that of providing the validator name in the MBean Definition File (MDF) and the validator class on the classpath.
Visibility	JMX Specification	Integer: 1-4	Denotes a level of importance for the MBean attribute. User interfaces use the number to determine whether they present the MBean attribute to a particular user in a particular context. The lower the value, the higher the level of importance. You can specify a number from 1 to 4. If you do not specify this attribute, the assumed value is 1.
			For items that have a high level of interest for users, provide a low Visibility number. For example, in the WebLogic Server Administration Console, MBeans with a Visiblity value of 1 are displayed in the left-pane navigation tree.

Table A-3 Attributes of the MBeanAttribute Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Writeable	JMX Specification	true/false	A true value allows the MBean API to set an MBeanAttribute's value. If you do not specify this attribute in MBeanType or MBeanAttribute, the assumed value is true.
			When specified in the MBeanType element, this value is considered the default for individual MBeanAttribute subelements.

The MBeanNotification Subelement

You must supply one instance of an MBeanNotification subelement for each type of notification (that is, broadcast of a management event) that your MBean type can issue. The MBeanNotification must be formatted as follows:

```
<MBeanNotification Name=string   optional_attributes />
```

The MBeanNotification subelement must include a Name attribute, which specifies the internal, programmatic name of the Java notification, and a comma-separated list of NotificationTypes. (To specify a name that is visible in a user interface, use the DisplayName and LanguageMap attributes.) Other attributes are optional.

The following is a simplified example of an MBeanNotification subelement within an MBeanType element:

```
<MBeanType Name="MyMBean" Package="com.mycompany">
   <MBeanNotification Name="com.mycompany.myNotification"
    NotificationTypes="1.1.1.1.2.3.5" />
</MBeanType>
```

Table A-4 describes the attributes available to the MBeanNotification subelement. The JMX Specification/BEA Extension column indicates whether the attribute is a BEA extension to the JMX specification. Note that BEA extensions might not function on other J2EE Web servers.

Table A-4 Attributes of the MBeanNotification Subelement

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Classname	JMX Specification	*String*	The classname for the MBeanNotification, as defined by the *Java Management eXtensions 1.0 specification*. The default classname will work in most cases, but if desired, this attribute allows you to change it.
Deprecated	BEA Extension	true/false	Indicates that the MBean notification is deprecated. This information appears in the generated Java source, and is also placed in the ModelMBeanInfo object for possible use by a management application. If you do not specify this attribute, the assumed value is false.
Description	JMX Specification	*String*	An arbitrary string associated with the MBean notification type that appears in various locations, such as the Javadoc for generated classes. There is no default or assumed value.
			Note: To specify a description that is visible in a user interface, use the DisplayName, DisplayMessage, and PresentationString attributes.

Table A-4 Attributes of the MBeanNotification Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
DisplayMessage	BEA Extension	*String*	The message that a user interface displays to describe the MBean notification. There is no default or assumed value.
			The DisplayMessage may be a paragraph used in Tool Tips or in Help. A DisplayMessage set for the MBean type is considered the default for MBean instances, unless a different value is specified for individual MBeans when the instance is created.
DisplayName	JMX Specification	*String*	The name that a user interface displays to identify the MBean notification type. There is no default or assumed value.
			If you use the LanguageMap attribute, the DisplayName value is used as a key to find a name in the LanguageMap's resource bundle. If you do not specify the LanguageMap attribute, or if the key is not present in the resource bundle, the DisplayName value itself is displayed in user interfaces.
			See also MessageID.
LanguageMap	BEA Extension	*String*	Specifies a fully qualified pathname to a resource bundle that contains a map of displayable strings. Other attributes, such as DisplayMessage and DisplayName, use the strings in the LanguageMap to display information about the MBean notification.
			If you do not specify this attribute, other attributes, such as DisplayMessage and DisplayName, display their own values (as opposed to using their values as a key to find appropriate strings in the resource bundle).

Table A-4 Attributes of the MBeanNotification Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Listen	BEA Extension	true/false	Causes a stub for a notification listener to be generated in the MBean implementation object. If you do not specify this attribute, the assumed value is false.
			Note: For more information about listener stubs, see the *Java Management eXtensions 1.0 specification.*
Log	JMX Specification	true/false	A true value specifies that MBean notifications are added to the log file. (The LogFile attribute specifies the file into which the information should be written.) If you do not specify this attribute, the assumed value is false, and notifications are not added to the log file.
			Note: For more information about MBean notifications and logs, see the *Java Management eXtensions 1.0 specification.*
LogFile	JMX Specification	*Pathname*	The fully qualified pathname of an existing, writable file into which messages are written when notifications occur for this MBean notification type. For logging to occur, the Log attribute must be set to true. There is no default or assumed value for this attribute.
			Note: For more information about MBean notifications and logs, see the *Java Management eXtensions 1.0 specification.*

Table A-4 Attributes of the MBeanNotification Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
MessageID	JMX Specification	*String*	Provides a key for retrieving a message from a client-side message repository per the *Java Management eXtensions 1.0 specification*.
			You can use MessageID, or DisplayMessage, or both to describe a notification MBean type. If you do not specify this attribute, no message ID is available.
			Note: MessageID does not use the same resource bundle that the LanguageMap attribute specifies and it is available for notification MBeans only.
Name	JMX Specification	*String*	Mandatory attribute that specifies the internal, programmatic name of the Java notification.
NotificationTypes	JMX Specification	*Comma-separated list*	The types of notifications that are the characterizations of generic notification objects.The list consists of any number of dot-separated components, separated by commas to allow an arbitrary, user-defined structure in the naming of notification types.
			Note: For more information about notification types, see the *Java Management eXtensions 1.0 specification*

Table A-4 Attributes of the MBeanNotification Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
PresentationString	JMX Specification	*Pathname*	A fully qualified pathname to a single XML document that provides information that a user interface can use to display the item. The XML document provides additional metadata that is relevant to presentation logic. The format of the PresentationString is any XML/JMX-compliant information.
			Note: BEA does not currently define a specialized format, and recommends that customers wait before defining their own. The PresentationString attribute is for future use.
Severity	JMX Specification	*Integer* or *String*	Indicates the severity of the notification. You must use one of the following values:
			■ 0 or unknown
			■ 1 or non-recoverable
			■ 2, critical, or failure
			■ 3, major, or severe
			■ 4, minor, marginal, or error
			■ 5 or warning
			■ 6, normal, cleared, or info
			The value of this tag can be either the number or any of the provided strings (case insensitive). If you use a string, the MBeanInfo object always converts it to the numerical equivalent and stores the numeric value.
			If you do not specify this attribute, the notification reports a severity of unknown.

Table A-4 Attributes of the MBeanNotification Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
`Visibility`	JMX Specification	Integer: 1-4	Denotes a level of importance for the MBean notification. User interfaces use the number to determine whether they present the MBean notification to a particular user in a particular context. The lower the value, the higher the level of importance. You can specify a number from `1` to `4`. If you do not specify this attribute, the assumed value is `1`.
			For items that have a high level of interest for users, provide a low `Visibility` number. For example, in the WebLogic Server Administration Console, MBeans with a `Visibility` value of `1` are displayed in the left-pane navigation tree.

The MBeanConstructor Subelement

`MBeanConstructor` subelements are not currently used by the WebLogic MBeanMaker, but are supported for compliance with the *Java Management eXtensions 1.0 specification* and upward compatibility. Therefore, attribute details for the `MBeanConstructor` subelement (and its associated `MBeanConstructorArg` subelement) are omitted from this documentation.

The MBeanOperation Subelement

You must supply one instance of an MBeanOperation subelement for each operation (method) that your MBean type supports. The MBeanOperation must be formatted as follows:

```
<MBeanOperation Name=string    optional_attributes >
       <MBeanOperationArg Name=string  optional_attributes />
</MBeanOperation>
```

The MBeanOperation subelement must include a Name attribute, which specifies the internal, programmatic name of the operation. (To specify a name that is visible in a user interface, use the DisplayName and LanguageMap attributes.) Other attributes are optional.

Within the MBeanOperation element, you must supply one instance of an MBeanOperationArg subelement for each argument that your operation (method) uses. The MBeanOperationArg must be formatted as follows:

```
<MBeanOperationArg Name=string    optional_attributes />
```

The Name attribute must specify the name of the operation. The only optional attribute for MBeanOperationArg is Type, which provides the Java class name that specifies behavior for a specific type of Java attribute. If you do not specify this attribute, the assumed value is java.lang.String.

The following is a simplified example of an MBeanOperation and MBeanOperationArg subelement within an MBeanType element:

```
<MBeanType Name="MyMBean" Package="com.mycompany">

    <MBeanOperation
     Name= "findParserSelectMBeanByKey"
     ReturnType="XMLParserSelectRegistryEntryMBean"
     Description="Given a public ID, system ID, or root element tag, returns the
object name of the corresponding XMLParserSelectRegistryEntryMBean."
     >
        <MBeanOperationArg Name="publicID" Type="java.lang.String"/>
        <MBeanOperationArg Name="systemID" Type="java.lang.String"/>
        <MBeanOperationArg Name="rootTag" Type="java.lang.String"/>
    </MBeanOperation>

</MBeanType>
```

Table A-5 describes the attributes available to the MBeanOperation subelement. The JMX Specification/BEA Extension column indicates whether the attribute is a BEA extension to the JMX specification. Note that BEA extensions might not function on other J2EE Web servers.

Table A-5 Attributes of the MBeanOperation Subelement

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
CurrencyTimeLimit	JMX Specification	*Integer*	The number of seconds that any value cached is considered fresh. After this value expires, the next attempt to access the value triggers a recalculation.
			When specified in the MBeanType element, this value is considered the default for MBean types. It can be overridden for individual MBeans by setting the same attribute in the MBean's MBeanAttribute or MBeanOperation subelement.
Deprecated	BEA Extension	true/false	Indicates that the MBean operation is deprecated. This information appears in the generated Java source, and is also placed in the ModelMBeanInfo object for possible use by a management application. If you do not specify this attribute, the assumed value is false.

Table A-5 Attributes of the MBeanOperation Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Description	JMX Specification	*String*	An arbitrary string associated with the MBean operation that appears in various locations, such as the Javadoc for generated classes. There is no default or assumed value.
			Note: To specify a description that is visible in a user interface, use the DisplayName, DisplayMessage, and PresentationString attributes.
DisplayMessage	BEA Extension	*String*	The message that a user interface displays to describe the MBean operation.There is no default or assumed value.
			The DisplayMessage may be a paragraph used in Tool Tips or in Help. A DisplayMessage set for the MBean type is considered the default for MBean instances, unless a different value is specified for individual MBeans when the instance is created.

Table A-5 Attributes of the MBeanOperation Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
DisplayName	JMX Specification	*String*	The name that a user interface displays to identify the MBean operation. There is no default or assumed value.
			If you use the LanguageMap attribute, the DisplayName value is used as a key to find a name in the LanguageMap's resource bundle. If you do not specify the LanguageMap attribute, or if the key is not present in the resource bundle, the DisplayName value itself is displayed in user interfaces.
			See also MessageID.
Impact	JMX Specification		The part of an MBean operation that communicates the impact the operation will have on the managed entity represented by the MBean.
			Note: For more information, see the *Java Management eXtensions 1.0 specification*

Table A-5 Attributes of the MBeanOperation Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
LanguageMap	BEA Extension	*String*	Specifies a fully qualified pathname to a resource bundle that contains a map of displayable strings. Other attributes, such as DisplayMessage and DisplayName, use the strings in the LanguageMap to display information about the MBean operation.
			If you do not specify this attribute, other attributes, such as DisplayMessage and DisplayName, display their own values (as opposed to using their values as a key to find appropriate strings in the resource bundle).
Listen	BEA Extension	true/false	Causes a stub for a notification listener to be generated in the MBean implementation object. If you do not specify this attribute, the assumed value is false.
			Note: For more information about listener stubs, see the *Java Management eXtensions 1.0 specification.*

Table A-5 Attributes of the MBeanOperation Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
MessageID	JMX Specification	*String*	Provides a key for retrieving a message from a client-side message repository per the *Java Management eXtensions 1.0 specification*.
			You can use MessageID, or DisplayMessage, or both to describe a notification MBean type. If you do not specify this attribute, no message ID is available.
			Note: MessageID does not use the same resource bundle that the LanguageMap attribute specifies and it is available for notification MBeans only.
Name	JMX Specification	*String*	Mandatory attribute that specifies the internal, programmatic name of the MBean operation.
PresentationString	JMX Specification	*Pathname*	A fully qualified pathname to a single XML document that provides information that a user interface can use to display the item. The XML document provides additional metadata that is relevant to presentation logic. The format of the PresentationString is any XML/JMX-compliant information.
			Note: BEA does not currently define a specialized format, and recommends that customers wait before defining their own. The PresentationString attribute is for future use.

Table A-5 Attributes of the MBeanOperation Subelement (Continued)

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
ReturnType	JMX Specification	*String*	A string containing the fully qualified classname of the Java object returned by the operation being described.
ReturnTypeDescription	JMX Specification	*String*	A textual description of the Java object returned by the operation being described, which can be used in the Javadoc or a graphical user interface.
Visibility	JMX Specification	Integer: 1-4	Denotes a level of importance for the MBean operation. User interfaces use the number to determine whether they present the MBean operation to a particular user in a particular context. The lower the value the higher the level of importance. You can specify a number from 1 to 4. If you do not specify this attribute, the assumed value is 1.
			For items that have a high level of interest for users, provide a low Visibility number. For example, in the WebLogic Server Administration Console, MBeans with a Visiblity value of 1 are displayed in the left-pane navigation tree.

Table A-6 describes the attributes available to the MBeanOperationArg subelement. The JMX Specification/BEA Extension column indicates whether the attribute is a BEA extension to the JMX specification. Note that BEA extensions might not function on other J2EE Web servers.

Table A-6 Attributes of the MBeanOperationArg Subelement

Attribute	JMX Specification /BEA Extension	Allowed Values	Description
Description	JMX Specification	*String*	An arbitrary string associated with the MBean operation argument that appears in various locations, such as the Javadoc for generated classes. There is no default or assumed value.
InterfaceType	BEA Extension	*String*	Classname of an interface to be used instead of the MBean interface generated by the WebLogic MBeanMaker. Currently ignored but may be used for future extensibility.
Name	JMX Specification	*String*	Mandatory attribute that specifies the name of the argument.
Type	JMX Specification	*String*	The type of the MBean operation argument. If you do not specify this attribute, the assumed value is java.lang.String.

Examples: Well-Formed and Valid MBean Definition Files (MDFs)

Listing A-1 and Listing A-2 provide examples of MBean Definition Files (MDFs) that use many of the attributes described in this Appendix. Listing A-1 shows the MDF used to generate an MBean type that manages predicates and reads data about predicates and their arguments. Listing A-2 shows the MDF used to generate the MBean type for the WebLogic (default) Authorization provider.

Listing A-1   PredicateEditor.xml

```
<?xml version="1.0" ?>
<!DOCTYPE MBeanType SYSTEM "commo.dtd">

<MBeanType
 Name = "PredicateEditor"
 Package = "weblogic.security.providers.authorization"
 Implements = "weblogic.security.providers.authorization.PredicateReader"
 PersistPolicy = "OnUpdate"
 Abstract = "false"
 Description = "This MBean manages predicates and reads data about predicates and
their arguments.&lt;p&gt;"
>

   <MBeanOperation
    Name = "registerPredicate"
    ReturnType = "void"
    Description = "Registers a new predicate with the specified class name."
   >

     <MBeanOperationArg
      Name = "predicateClassName"
      Type = "java.lang.String"
      Description = "The name of the Java class that implements the predicate."
     />

     <MBeanException>weblogic.management.utils.InvalidPredicateException</MBean
Exception>

     <MBeanException>weblogic.management.utils.AlreadyExistsException</MBeanExc
eption>
```

```
   </MBeanOperation>

   <MBeanOperation
    Name = "unregisterPredicate"
    ReturnType = "void"
    Description = "Unregisters the currently registered predicate."
   >

     <MBeanOperationArg
      Name = "predicateClassName"
      Type = "java.lang.String"
      Description = "The name of the Java class that implements predicate to be
unregistered."
     />

     <MBeanException>weblogic.management.utils.NotFoundException</MBeanExceptio
n>

   </MBeanOperation>

</MBeanType>
```

Listing A-2   DefaultAuthorizer.xml

```
<?xml version="1.0" ?>
<!DOCTYPE MBeanType SYSTEM "commo.dtd">

<MBeanType
 Name = "DefaultAuthorizer"
 DisplayName = "DefaultAuthorizer"
 Package = "weblogic.security.providers.authorization"
 Extends = "weblogic.management.security.authorization.DeployableAuthorizer"
 Implements = "weblogic.management.security.authorization.PolicyEditor,
weblogic.security.providers.authorization.PredicateEditor"
 PersistPolicy = "OnUpdate"
 Description = "This MBean represents configuration attributes for the WebLogic
Authorization provider. &lt;p&gt;"
>

   <MBeanAttribute
    Name = "ProviderClassName"
    Type = "java.lang.String"
    Writeable = "false"
    Default =
"&quot;weblogic.security.providers.authorization.DefaultAuthorizationProviderIm
pl&quot;"
    Description = "The name of the Java class used to load the WebLogic
```

```
Authorization provider."
   />

   <MBeanAttribute
    Name = "Description"
    Type = "java.lang.String"
    Writeable = "false"
    Default = "&quot;Weblogic Default Authorization Provider&quot;"
    Description = "A short description of the WebLogic Authorization provider."
   />

   <MBeanAttribute
    Name = "Version"
    Type = "java.lang.String"
    Writeable = "false"
    Default = "&quot;1.0&quot;"
    Description = "The version of the WebLogic Authorization provider."
   />

</MBeanType>
```

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