

Oracle® Fusion Middleware

Developing Applications Using Continuous Integration

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Describes how to build automation and continuous integration for applications that you develop and deploy to a Fusion Middleware runtime environment. It uses Subversion, Maven, Archiva, Hudson, and Oracle Maven plug-ins to demonstrate continuous integration.

Oracle Fusion Middleware Developing Applications Using Continuous Integration, 12c (12.2.1.2)

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Preface

This book describes build automation and continuous integration for applications that you develop and deploy to a Fusion Middleware runtime environment. This book describes the features in Fusion Middleware 12c to make it easier for users to automate application build and test and to adopt continuous integration techniques with Fusion Middleware.

Audience

This document is intended for developers and build managers who are responsible for building applications that will be deployed into a Fusion Middleware runtime environment and who want to automate their build processes or adopt, or both continuous integration techniques in the context of Fusion Middleware.

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Related Documents

For more information, see the following documents in the Oracle Fusion Middleware documentation set:

- *Developing Applications for Oracle WebLogic Server*
- *Developing Applications with Oracle JDeveloper*
- *Developing Services with Oracle Service Bus*
- *Developing SOA Applications with Oracle SOA Suite*

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
<i>italic</i>	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
monospace	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

Introduction to Continuous Integration

Continuous integration involves applying small and frequent quality control efforts, and automated builds, deployment, and testing. Together with a set of tools, you can create a continuous integration environment in the context of Oracle Fusion Middleware.

Topics:

- [Introducing Continuous Integration for Oracle Fusion Middleware](#)
- [Version Control with Subversion](#)
- [Build Automation and Dependency Management with Maven](#)
- [About the Oracle Maven Repository](#)
- [Repository Management with Archiva](#)
- [Continuous Integration with Hudson](#)
- [Summary](#)

1.1 Introducing Continuous Integration for Oracle Fusion Middleware

When enterprises develop applications to support their business needs, they typically employ teams of developers who work together, often in small teams, with each team building a part of the application. These parts are then assembled to create the whole application. To improve quality and reduce the time to deliver software, apply small and frequent quality control efforts, and automated builds, deployment, and testing. This is known as continuous integration.

Many modern applications are based on a service-oriented architecture (SOA). This means that developers build services (small pieces of business functionality) that can be assembled in various ways to meet the needs of the business application. Some of the features of SOA that make it popular today are:

- Loose coupling of components of the application, which reduces the impact of change
- Reuse of services, a long time goal of Information Technology development
- The flexibility and agility to easily change the application's behavior as the business need changes

In this new paradigm, many development organizations are also adopting iterative development methodologies to replace the older waterfall-style methodologies. Iterative, agile development methodologies focus on delivering smaller increments of functionality more often than traditional waterfall approaches. Proponents of the new approach claim that the impact is usually less for errors that are found sooner and that

the approach is especially suitable to today's environment of constant and rapid change in business requirements.

Many of these techniques also feature the adoption of continuous integration. Organizations have a strong interest in automating their software builds and testing, and continuous integration can help accomplish this.

Continuous integration is a software engineering practice that attempts to improve quality and reduce the time taken to deliver software by applying small and frequent quality control efforts. It is characterized by these key practices:

- A version control system is used to track changes.
- All developers commit to the main code line, head and trunk, every day.
- The product is built on every commit operation.
- The build must be automated and fast.
- There is automated deployment to a production-like environment.
- Automated testing is enabled.
- Results of all builds are published, so that everyone can see if anyone breaks a build.
- Deliverables are easily available for developers, testers, and other stakeholders.

Oracle Fusion Middleware 12c provides support for enterprises that adopt continuous integration techniques to develop applications on the Oracle Fusion Middleware platform. Specifically, it provides the following:

- Integration with common version control systems from the development tool, Oracle JDeveloper
- The ability to build projects from the command line using Maven, a build and project management system, so that the build can be scripted and automated
- The ability to create new projects from Maven archetypes
- The ability to download necessary dependencies from the Oracle Maven Repository, and other Maven repositories
- The ability to parameterize projects so that builds can be targeted to different environments, such as Test, QA, SIT, and production
- The ability to include testing of projects in the Maven build life cycle
- The ability to populate a Maven repository with Oracle-provided dependencies from an existing local Oracle home software installation directory
- The ability to run Maven builds under the control of a continuous integration server like Hudson
- Comprehensive documentation about setting up your build or continuous integration environment, or both, to use with Oracle Fusion Middleware

Choices are available for version control, continuous integration, and other components that enterprises typically use in this kind of environment. Many of these components are free and open source, and others are commercial products. This guide presents a reference environment based on the following set of components:

- Apache Subversion for version control
- Apache Maven for build or project management
- Apache Archiva as the Maven repository manager
- Apache Hudson as the continuous integration server

Note that these are not the only choices available. You can use, for example, a different version control system or a different continuous integration server. For most common alternatives, you should be able to adapt the examples in this guide without much difficulty.

1.2 Version Control with Subversion

Subversion is a popular version control system. It was originally created as a logical successor to the Concurrent Versioning System (CVS), which is still widely used today. It works well in various network environments.

Subversion is used as the version control system in the examples in this guide for the following reasons:

- It is well integrated with Oracle JDeveloper, the development tool that is most commonly used to build applications for the Oracle Fusion Middleware platform and with other common development tools.
- It works well in various network environments, including virtual private networks and HTTP proxies. Thus, it is well suited for the kind of network environments often encountered in enterprises and their partners, and suppliers.
- It supports various authentication options, including strong authentication with certificates.
- For projects using Oracle SOA Suite, it provides an atomic commit that enables developers to update several files as part of a single check-in or commit operation.

A typical Subversion environment consists of one or more Subversion repositories that store source code artifacts. These are accessed by developers using Subversion clients, either included in their integrated development environments or as standalone clients. Developers can copy artifacts to and from the repositories. When a developer changes an artifact, a new version of the artifact is created in the repository. Developers can view and compare versions of artifacts to see what was changed and who changed it.

1.3 Build Automation and Dependency Management with Maven

Maven is a project management and build management system and is based on the central concept of a build life cycle. The process for building and distributing a particular artifact or project is clearly defined.

Maven provides project management in terms of:

- Naming and version numbering
- Dependencies
- Where the source code is stored
- Where builds are stored
- Templates for project types

- The release process

Maven provides build management in terms of:

- How to execute the build
- What to do in each phase
- Parameterization of the build
- An extensible framework

For developers to use Maven, they must learn a small set of commands that enable them to build any Maven project. The Maven Project Object Model (POM) ensures that the project is built correctly.

There are three main life cycles defined:

- **Default:** To build the project
- **Clean:** To remove all generated artifacts from the project
- **Site:** To build documentation for the project

Build life cycles are further defined by a set of build phases. A build phase represents a stage in the life cycle. Build phases are executed sequentially to complete the life cycle. Build phases consist of goals that perform the actual tasks. There is a default set of goal bindings for standard lifecycle phases. Maven plug-ins contribute additional goals to a project. The following table shows the build phase and purpose of each phase:

Table 1-1 Maven Build Phases

Build Phase	Purpose
validate	Ensure that the project is correct and all necessary information is available.
compile	Compile the source of the project.
test	Test the compiled source code using a suitable unit testing framework; tests should not require the code to be packaged or deployed.
package	Take the compiled code and package it in its distributable format, such as a JAR, WAR, EAR, SAR, or GAR files.
integration-test	Process and deploy the package, if necessary, into an environment where integration tests can be run.
verify	Run checks to verify whether the package is valid and meets quality criteria.
install	Install the package into the local repository for use as a dependency in other projects locally.
deploy	For the final release, copy the final package to a remote repository for sharing with other developers and projects.

A typical Maven environment consists of a Maven installation on each developer's local machine, a shared Maven repository manager within the enterprise, and one or

more public Maven repositories where dependencies are stored. The main Maven repository is known as Maven's central repository. This repository stores many free and open source libraries that are commonly used as dependencies during development projects. Examples include the JUnit unit testing framework; Spring, Struts, and other common user interface libraries; and code coverage and style-checking libraries like Cobertura and PMD.

1.4 About the Oracle Maven Repository

The Oracle Maven Repository contains artifacts provided by Oracle that you may require to compile, test, package, perform integration testing, or deploy reapplications.

Specifically, the Oracle Maven Repository contains the following:

- Client API classes
- Compilation, packaging, and deployment utilities, for example, `wlst`
- Component JARs that must be embedded in the application
- Client-side runtime classes, for example, `t3` and JAX-WS client runtimes

1.5 Repository Management with Archiva

When several developers are working on a project, enterprises often find it useful to establish their own internal Maven repository and to manage it with a Maven Repository Manager, such as Apache Archiva.

Consider establishing your own internal Maven repository to:

- To act as a proxy or cache for external Binary repositories, like Maven's central repository or the Oracle Maven Repository, so that dependencies are downloaded only once and cached locally so that all developers can use them.
- To store artifacts that are built by the developers so that they can be shared with other developers or projects.

Although a Maven repository can be as simple as a file system in a particular layout (directory structure), most organizations find that it is more convenient to use a type of software called a Maven repository manager. This helps in addressing the purposes previously listed. In this guide, Apache Archiva is used as the Maven Repository Manager. Others are available, either for free and commercially.

In a typical enterprise that use Archiva, Archiva is set up on a server that is accessible to developers and build machines. The enterprise defines the following repositories on this server:

- A mirror of Maven's central repository
- An internal repository to store internally developed artifacts that are completed or published
- A snapshot repository to store internally developed artifacts that are under development and not completed yet

There can also be additional repositories depending on the need. For example, there can be additional repositories for particular projects, or for different versions of dependencies needed for different life cycle stages. For example, bug fix to production might use different dependencies from the current version under development.

All developers must configure Maven installations to point to these internal repositories instead of the external repositories, so that developers can use artifacts already stored in the internal repositories and reduce the download and build time. This also helps to ensure that all developers use the same version for various dependencies.

Archiva also provides the ability to manage the expiration of artifacts from your snapshot repository. Each time that you execute a build, artifacts are created and stored in the snapshot repository. If you are using continuous integration, you may want to execute builds several times each day. The best practice is to configure Archiva to remove these stored artifacts after a certain amount of time (for example, one week). Alternatively, you can configure Archiva to keep just the last n versions of each artifact. Either approach helps to automatically manage the expiration and deletion of your snapshot artifacts.

1.6 Continuous Integration with Hudson

Hudson is a common continuous integration server product that enables you to automate the build process.

Typically, this automation includes steps such as:

- Initiating a build whenever a developer commits to the version control system
- Checking out the code from the version control system
- Compiling the code
- Running unit tests and collating results (often through JUnit)
- Packaging the code into a deployment archive format
- Deploying the package to a runtime environment
- Running integration tests and collating results
- Triggering the build to the Maven snapshot repository
- Alerting developers through email of any problems

However, it is also possible to use the build system to enforce compliance with corporate standards and best practices. For example, enterprises can include the following steps in the build process:

- Running code coverage checks to ensure that an appropriate number of unit tests exist and are executed
- Running code quality checks to look for common problems
- Running checks to ensure compliance with naming conventions, namespaces, and so on
- Running checks to ensure that documentation is included in the code
- Running checks to ensure that the approved versions of dependencies are used and that no other dependencies are introduced without approval

Hudson provides a web-based console that enables build managers to define, execute, and monitor builds. Builds are executed on one or more build servers. The number of build servers is typically defined based on the volume of builds and the expected time

for a build to complete. Hudson also provides APIs and can be extended through a plug-in mechanism, so that additional functionality can be added, as needed.

1.7 Summary

This guide describes how to establish a continuous integration environment that supports a large team of developers who develop applications on the Oracle Fusion Middleware 12c platform.

This environment includes version control, Maven for build automation and dependency management, Archiva as a Maven repository, and the use of a continuous integration server like Hudson to automate the build process.

All examples in this book use Apache tools: Subversion, Maven, Archiva, and Hudson. However, there are other commercial and open source alternatives that you can use. The intention here is to provide an example that you can refer to and that should be easy enough to adapt to other tools. For example, you may choose to use git for version control or Nexus as your repository manager. The choice of tools in this documentation does not imply that other tools will not deliver equivalent outcome.

Roadmap for Continuous Integration

Oracle Fusion Middleware 12c introduces new capabilities for build automation and continuous integration. Continuous integration is both a journey and a destination. If you have not automated your build process before, then you may find yourself at the beginning of the journey.

This chapter provides a roadmap to help you to understand the steps you need to take to attain continuous integration.

If you are familiar with build automation or continuous integration already, this chapter provides a summary of the features provided in Oracle Fusion Middleware 12c and helps you relate it to your existing experiences.

This chapter also describes a reference continuous integration environment. This is provided as an example to help you to visualize what your environment may look like after adopting the continuous integration approach and the tools and technologies described in this book.

Topics:

- [Roadmap to Continuous Integration](#)
- [Overview of the Reference Continuous Integration Environment](#)
- [Shared Disk Layout](#)

2.1 Roadmap to Continuous Integration

When you use continuous integration, you follow a well-defined series of steps.

[Table 2-1](#) describes the common steps that you must take to implement continuous integration, and also provides pointers for more information in each step.

Table 2-1 Roadmap to Attain Continuous Integration

Step	Task	For More Information
1.	Implement a version control strategy	<p>Installing and Configuring Subversion for Version Control provides details on how to set up a version control environment using Subversion.</p> <p>If you are not currently using version control in your development environment, pay particular attention to repository layout, the Subversion workflow, and tagging and branching, which are described in Installing and Configuring Subversion for Version Control.</p> <p>For more information about Version Control with Subversion, see:</p> <p>http://svnbook.red-bean.com</p>

Table 2-1 (Cont.) Roadmap to Attain Continuous Integration

Step	Task	For More Information
2.	Implement a binary repository strategy	Installing and Configuring the Archiva Maven Repository Manager provides details on how to use Apache Archiva to set up a repository for binary artifacts, both those that you are building and those that your builds depend on. Pay particular attention to understanding the need for multiple repositories, understanding the difference between snapshot and other repositories, and the administration and maintenance required for repositories.
3.	Implement a build automation and dependency management strategy	Installing and Configuring Maven for Build Automation and Dependency Management provides a brief introduction to Maven and the installation and configuration steps. If you have never used Maven before, read material about it to get familiar with it. Start by reading "What is Maven?" at the official Maven web site at: http://maven.apache.org/what-is-maven.html There are also a number of resources available online, including: <ul style="list-style-type: none"> • <i>Maven By Example</i> and <i>Maven: The Complete Reference</i> at: http://www.sonatype.org/maven • <i>Better Builds with Maven</i> at: http://www.maestrodev.com/better-builds-with-maven/about-this-guide/ These resources can help you to form a comprehensive understanding on how to use Maven, some of the principles behind its design, and the kind of things you can do with Maven.
4.	Populate your repository with Oracle artifacts	Populating the Maven Repository Manager provides details on how to populate your Maven Repository with Oracle-provided artifacts. Pay particular attention to understanding the Oracle Maven Synchronization plug-in, what happens when you apply patches to your Oracle runtime environments, the implications of patching on your build environment, and understanding the role of archetypes.
5.	Ensure that you understand Maven version numbers	About Maven Version Numbers provides details on the important nuances of Maven version numbers. Ensure that you understand how to use Maven version numbers and version number ranges to specify dependencies, and how Maven resolves dependencies based on the way you specify version numbers.
6.	Learn how to build Java EE applications for WebLogic Server using Maven	Building Java EE Projects for WebLogic Server with Maven provides details on how to create Java EE applications using the Oracle WebLogic Maven archetypes, and how to compile, package, and deploy your applications to a WebLogic Server.

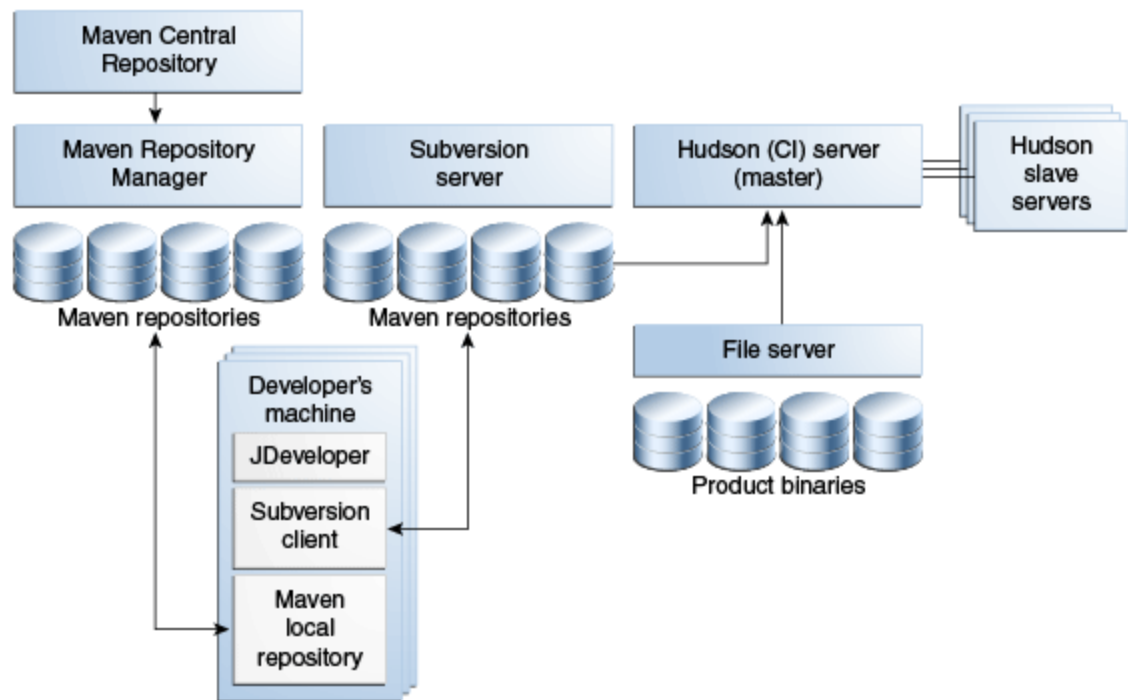
Table 2-1 (Cont.) Roadmap to Attain Continuous Integration

Step	Task	For More Information
7.	Learn how to build Coherence applications using Maven	Building Oracle Coherence Projects with Maven provides details on how to create Coherence GAR applications using the Oracle Coherence Maven archetypes, and how to compile, package, and deploy your applications to the Coherence container on WebLogic Server.
8.	Learn how to build other types of applications using Maven	For information on building other types of applications using Maven, see: <ul style="list-style-type: none"> • Building ADF Projects with Maven • Building Oracle SOA Suite and Oracle Business Process Management Projects with Maven • Building Oracle Service Bus Projects with Maven
9.	Learn how to build a whole application using Maven	Building a Real Application with Maven describes how to bring together many of these concepts to build a more realistic application. The example application has multiple component parts, each targeted to a different Oracle Fusion Middleware runtime environment. It also has dependencies between components, and some custom packaging requirements.
10.	Learn how to customize your build process using Maven POM inheritance	Customizing the Build Process with Maven POM Inheritance provides details on the Maven POM hierarchy that is included with Oracle Fusion Middleware 12c. The common Oracle parent POMs provide an easy way to customize your build process.
11.	Implement a continuous integration strategy	Installing and Configuring Hudson for Continuous Integration describes how to set up Hudson to create an environment in which to perform continuous integration. From Build Automation to Continuous Integration expands on this with details of the important considerations for establishing and operating a continuous integration environment.

2.2 Overview of the Reference Continuous Integration Environment

This guide uses a specific reference implementation of a continuous integration environment based on Subversion, Maven, Hudson, and Archiva.

[Figure 2-1](#) provides an overview of the recommended development environment.

Figure 2-1 Reference Continuous Integration Environment Architecture

The following is a description of the environment:

- **Maven's Central Repository and Oracle Maven Repository:** These are external Maven repositories that hold open source and Oracle dependencies, which you may need for a build. The Maven Repository Manager is able to search these repositories for any dependencies that it does not have in its own repository, and obtain them if they are available.
- **The Maven Repository Manager:** The repository for all built artifacts and dependencies, both for those created in your environment and those from external sources. Typically, there are different repositories for different purposes:
 - The Binary Repository Manager acts as a mirror or proxy for external Maven repositories like Maven's central repository and the Oracle Maven Repository. When artifacts from these repositories are needed for a build, they are downloaded and stored in a repository managed by the Maven Repository Manager.
 - When you build an artifact (for example, a WAR, JAR, or SAR file), it is published into a repository managed by the Maven Repository Manager. Often there are separate repositories for SNAPSHOT (work in progress) artifacts and release (final) artifacts.
- **The Subversion server:** The repository for source artifacts that are created by your developers. Typically, there are multiple repositories. For example, there may be one per project.
- **The Hudson continuous integration (master) server:** The server that manages your continuous integration builds. It is responsible for running builds and collecting and reporting results of those builds.

- **Hudson slave servers:** Optional additional Hudson servers that are used to provide additional capacity. If you are running a large number of builds, you can set up several Hudson slave servers to share or perform some of the builds.
- **File server:** A storage area network (SAN) or network-attached storage (NAS) that hosts copies of any product binaries that are needed by the Hudson build servers. For example, **ojdeploy** is required to build Oracle ADF applications. All of the Hudson servers have access to this file server.
- **Test servers** (not shown): If you are performing integration tests, you may also have a set of test servers in which you deploy built artifacts like WARs, JARs, and SARs, and execute your integration tests.
- **The developer's machine:** Each developer has a workstation on which to run an integrated development environment (Oracle JDeveloper) to create source artifacts like Java code, deployment descriptors, BPEL processes, and ADF user interface projects. JDeveloper includes a Subversion client. This enables the developer to perform actions like checking code in and out of repositories on the Subversion server, checking differences, performing merges, and resolving conflicts. Each developer's machine also has a local Maven repository on their workstation, which holds dependencies that are needed to perform local builds that they may want to perform on their workstation. For example, a developer might want to check a build and run unit tests locally before checking in code to the shared Subversion server.

Depending on the size of your environment, these components (excluding the external ones and the developer's machine), might be on a single server, or spread across several machines.

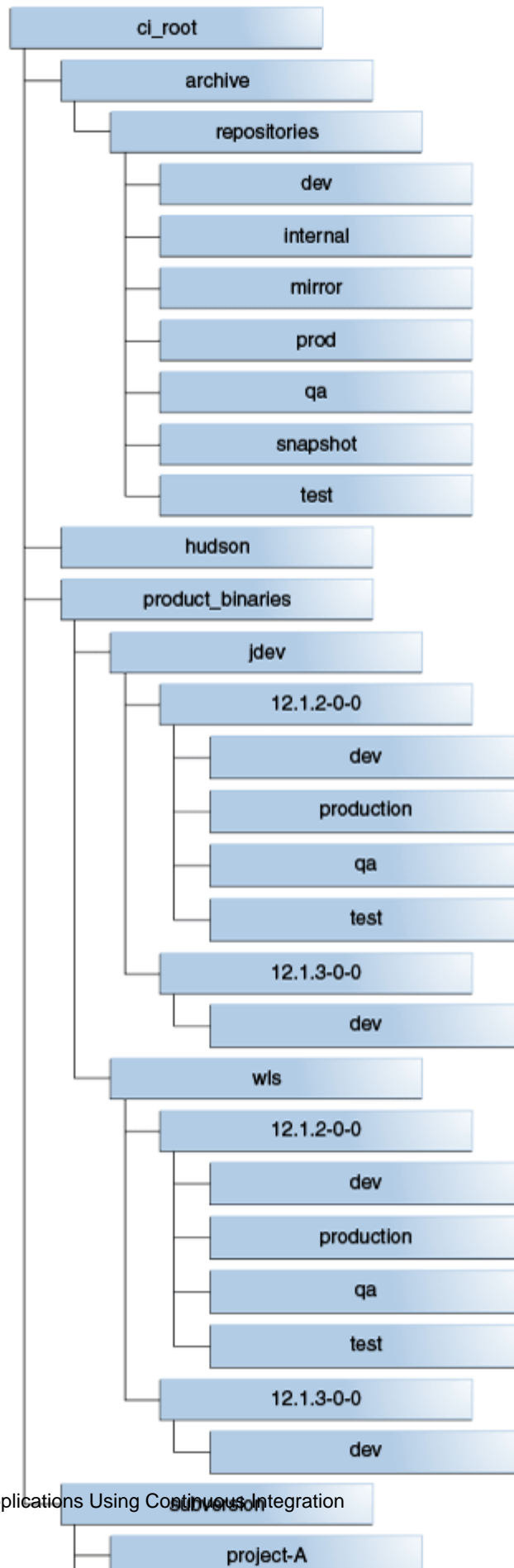
2.3 Shared Disk Layout

You can use a shared disk in a continuous integration environment, but you should use a well-thought out directory structure.

If you plan to use a shared disk, consider keeping all of your Subversion, Maven, Hudson data, and product binaries on the shared disk.

[Figure 2-2](#) shows a suggested directory structure. This structure shows only the high-level directories that you would consciously consider creating.

Figure 2-2 Directory Structure for a Shared Disk



Note that for the product binaries, you must keep one copy for each environment (such as production, development, and QA). Although the product binaries are on the same version of the software, they are likely to have different patches installed. Ensure that you can always build using the same set of artifacts, possibly patched, as the environment to which you want to deploy.

Although you may have moved your development environment to 12.1.3 in the example in [Figure 2-2](#), you still must be able to build against 12.1.2. If you find a bug in production or QA, you must be able to build using the same versions of artifacts as you have installed in those environments.

Your Maven Repository Manager, Archiva in this case, includes the following repositories:

- **Internal:** Stores finished artifacts that you have built in your development environment.
- **Snapshot:** Stores work-in-progress artifacts that you have built in your development environment.
- **Mirror:** Stores dependencies that have been downloaded from an external repository.
- **Dev, test, qa, prod:** You have one repository for storing the dependencies needed for each target environment. You do this because it is possible that two environments might have the same version of an artifact (for example, 12.1.3-0-0) even though the artifact has been patched in one environment, and is therefore different. See [Things to Know About Patching](#) to learn more about this requirement.

The shared disk server must provide sufficient space for product binaries, Subversion repositories, the Archiva repository, Maven binaries, Hudson binaries, configuration, and file storage. At a minimum, Oracle recommends that you allocate at least 40 gigabytes. Factors, such as Archiva snapshot clean up rules and whether or not you permit check-in of binaries into the source control system, can increase the required space.

Installing and Configuring Subversion for Version Control

Subversion is a version control system that keeps track of changes made to files and folders or directories, thus facilitating data recovery and providing a history of the changes that have been made over time.

This chapter describes how to install and configure Subversion for version control.

Topics:

- [Downloading Subversion](#)
- [Installing Subversion](#)
- [Configuring the Subversion Server as a Service](#)
- [Setting Up a Repository](#)
- [Understanding the SVN Workflow](#)
- [Working with Subversion Projects](#)
- [Considerations for Tagging and Branching](#)
- [About Subversion Clients](#)
- [More Information About Subversion](#)

3.1 Downloading Subversion

Although Subversion is an Apache project, Apache does not build their own binary files for any operating system. Third parties build binary files for all major operating systems.

The following URL provides links to the latest stable releases of Subversion built by third parties for all major operating systems:

<http://subversion.apache.org/packages.html>

If possible, use a package manager such as YUM or APT to manage the installation of other software.

On Windows, Oracle recommends that you use a precompiled binary package such as Silk SVN which is available in the following URL:

<http://www.silksvn.com>

On Windows, if you install Subversion through the installer package, then ensure that you choose an installer which includes the server binary files.

3.2 Installing Subversion

You can install Subversion on any major platform.

The installation method varies depending upon the platform and distribution method.

For example, if you use YUM, the command is likely to be:

```
sudo yum install subversion
```

On Windows, you can change the default installation path to a shorter location:

```
C:\svn
```

Ensure that the `PATH` variable is correctly set by the installer.

To obtain the version information of `svnserve`, run the following command:

```
svnserve --version
```

If you cannot find the command, then do the following:

1. Open **Control Panel**.
2. Select **System**, and then **Advanced System Settings**.
3. Under **Advanced**, select **Environment Variables**.
4. Edit the `PATH` variable in the **System variables** pane by adding the path to the Subversion binary directory.

3.3 Configuring the Subversion Server as a Service

To ensure that Subversion is running when you need it, configure it as a service.

To configure the Subversion server as a service:

- **On Linux**

The Linux installation process automatically creates an `/etc/init.d/svnserve` script. This starts the server when you start up your system.

To start the service manually, run the following command:

```
sudo /etc/init.d/svnserve start
```

- **On Windows**

You must register `svnserve` with the service manager. To register `svnserve`, run the following command:

```
sc create svnservice binpath= "C:\svn\svnserve.exe" --service -r "REPOS_PATH"  
displayname="Subversion" depend=Tcpip start=auto
```

In the preceding command, `REPOS_PATH` is the absolute path to the local file system.

3.4 Setting Up a Repository

A Subversion repository is a collection of versioned artifacts on the Subversion server.

This section contains the following topics:

- [Creating a Repository](#)
- [Using a Consistent Subversion Layout](#)
- [Importing Existing Projects](#)

3.4.1 Creating a Repository

After Subversion is installed, you must create a repository. The command-line utility called `svnadmin` is the primary tool for server-side administrative operations.

To create a repository:

1. Create a directory for the repository using the following command:

```
(Linux) mkdir -p REPOS_PATH
(Windows) mkdir REPOS_PATH
```

In this command, `REPOS_PATH` is the absolute path to the local file system.

For example:

```
(Linux) mkdir -p /ciroot/subversion/repository
(Windows) mkdir C:\ciroot\subversion\repository
```

2. Create a repository on a given path using the following command:

```
svnadmin create REPOS_PATH
```

In this command `REPOS_PATH` is the absolute path to the local file system.

For example:

```
(Linux) svnadmin create /ciroot/subversion/repository
(Windows) svnadmin create C:\ciroot\subversion\repository
```

Access to the repository is controlled by file permissions and the user referenced for accessing the repository through the SVN client. Ensure that user and group permissions for all files in the new repository reflect the type of access control that you want to have over the repository contents.

By default, anonymous, read-only access is enabled for a new repository. This means that anyone with SSH access, regardless of repository permissions settings, can check out repository files. You can modify this in the `REPOS_PATH/conf/svnserve.conf` file.

Now that you have created a repository, you can use the Subversion client to perform standard operations against the new repository by using the following base URL:

```
svn+ssh://USER@HOST/REPOS_PATH
```

For example:

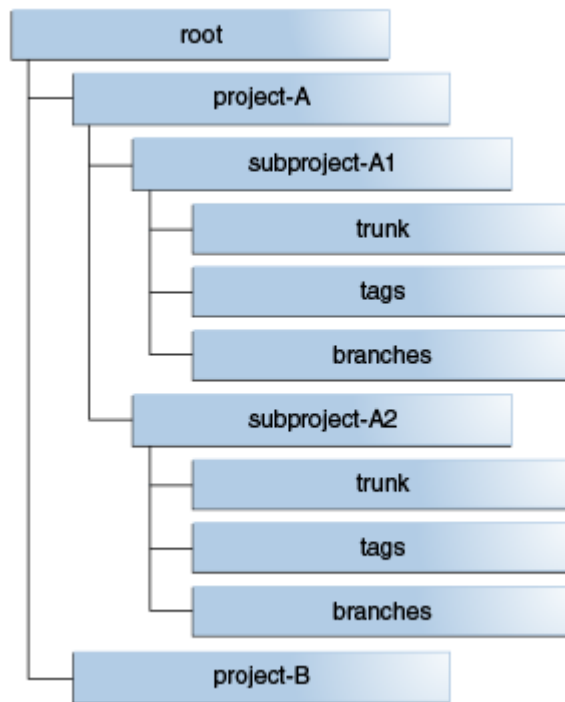
```
svn ls svn+ssh://mycompany@localhost/ciroot/subversion/repository
```

In addition to `svn+ssh`, there are several other protocols that are supported by Subversion. Refer to the Subversion documentation for information on how to configure other protocols. `svn+ssh` might not be available on Windows by default.

3.4.2 Using a Consistent Subversion Layout

Although Subversion does not require any particular subdirectory structure within a repository, it is a good idea to follow an established convention, as this book does.

The typical repository layout should resemble the following figure:



Development of the main code line occurs in the `trunk` directories. When a release is made, the current trunk source is copied into the `tags` directory, to a tag corresponding to the release. Subversion copy operations are not expensive in terms of storage because the server tracks changes internally.

The following is an example of a tag:

```
my-project/tags/3.0.5
```

In the preceding example, `3.0.5` indicates the release version to which this tag corresponds.

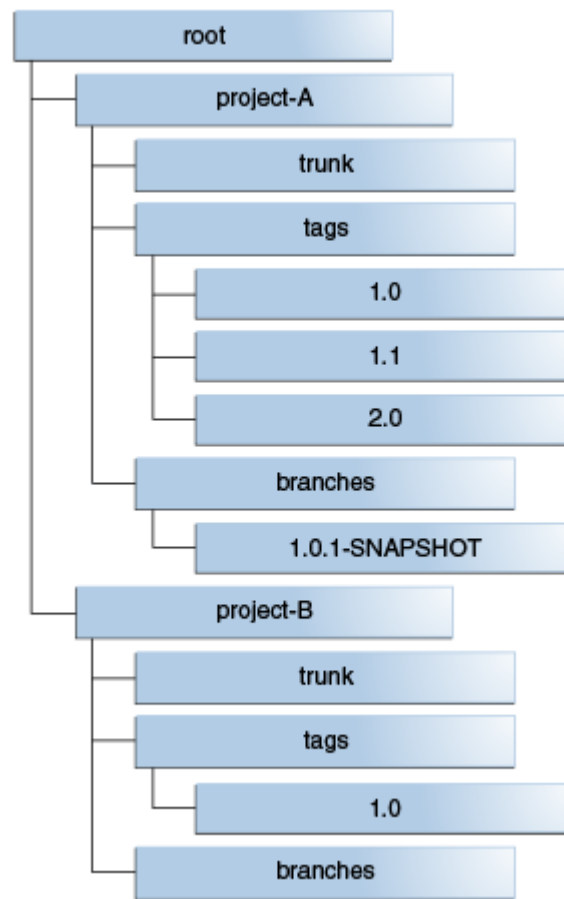
A tag is important for future work that might be necessary for patch creation or bug-fix releases. Another importance of a release tag is to facilitate investigation regarding issues in the associated release.

If a patch or subsequent change of a tag is considered necessary, you must create a branch. A **branch** is a copy of a location elsewhere in the repository and does not differ in composition from a tag. After a copy of the tag is made under the `branches` directory, you can check out the code and modify it as necessary. When changes are complete, the new release is made from the branch and a corresponding tag is created.

The following Project-A example outlines the general workflow for patch management of source code:

1. In Project-A, the main code line is managed under `project-A/trunk`. The current version developing under the `trunk` directory is version 2.1. The three previous releases of Project-A are 1.0, 1.1, and 2.0.
2. A problem is discovered in version 1.0 that requires a patch release.
3. To address the problem, the `project-A/tags/1.0` tag is copied, using the `svn copy` command, to `project-A/branches/1.0.1-SNAPSHOT`. The `SNAPSHOT`

designation is a Maven device indicating a version that is not yet released, as shown in the following figure:



- When the branch code fix is complete, the branch is copied from `project-A/branches/1.0.1-SNAPSHOT` to a `project-A/tags/1.0.1` tag. The release build can then be made from the tag.

For more information on directory structure conventions, see the section about the recommended repository layout in *Version Control with Subversion* at:

<http://svnbook.red-bean.com/>

3.4.3 Importing Existing Projects

If you have existing projects that you want to manage in your repository, you can import them using the SVN client's `import` command:

```
svn import LOCAL_PATH REPOSITORY_URL/REPOSITORY_PATH
```

For example:

```
svn import /checkouts/project-a svn+ssh://user@svn.mycompany.com/ciroot/subversion/
repository/project-a/trunk/ -m "initial import"
```

3.5 Understanding the SVN Workflow

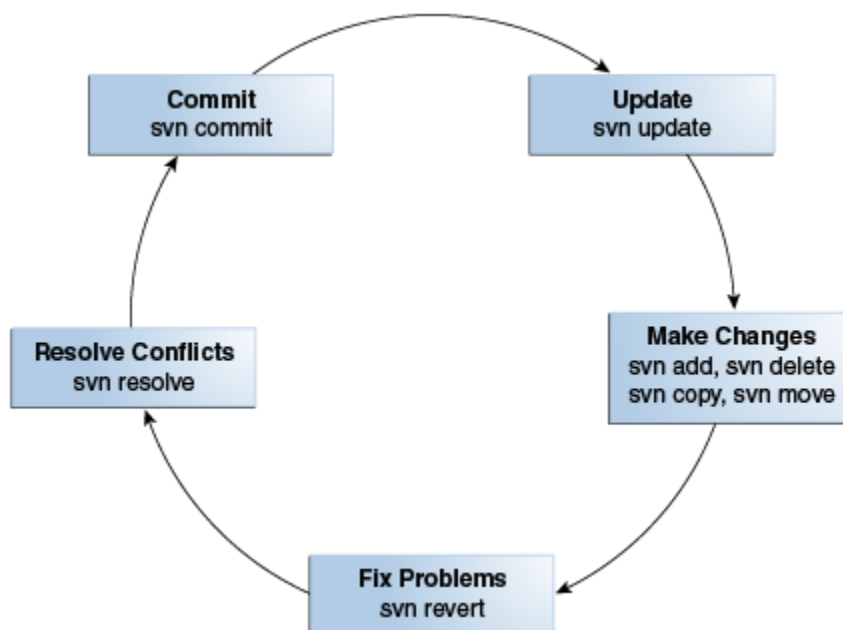
Before you start working in SVN, you should understand the typical workflow.

To modify code, you usually perform the following operations:

1. Update the working copy using the `svn update` command.
2. Make changes. Use the `svn add`, `svn delete`, `svn copy`, and `svn move` commands as needed to edit your files.
3. Review changes through the `svn status` and `svn diff` commands.
4. Fix mistakes. You can revert and abandon changes using the `svn revert` command.
5. Resolve conflicts. When they are resolved, mark them using the `svn resolve` command.
6. Commit changes using the `svn commit` or `svn ci` command.

Figure 3-1 shows the complete life cycle of an SVN operation:

Figure 3-1 SVN Workflow



In a continuous integration development process, this workflow remains largely unchanged. Committed change sets tend to be smaller and occur more frequently than in a noncontinuous integration process. You must commit the active trunk or branch code for the target release so that the continuous integration system can perform an integration build. Avoid creating a personal branch with the intention of merging back to the main-line code base in the future. The personal branch and merge technique defers integration and runs counter to continuous integration precepts.

3.6 Working with Subversion Projects

When you are working with Subversion projects, you check out the files into your local file system. Then, when you are ready to commit the files to the repository, you check the project in.

To begin working on a Subversion-managed project, you must first check out the files into your local file system. The SVN client copies the project files to your system, including Subversion metadata in `.svn` directories located in each subdirectory.

To work with Subversion projects:

1. Run the following command to check out files:

```
svn co REPOSITORY_URL/REPOSITORY_PATH LOCAL_DIRECTORY
```

In the preceding command:

- *REPOSITORY_URL* is the URL to the Subversion repository.
- *REPOSITORY_PATH* is the path to the directory being checked out.
- *LOCAL_DIRECTORY* is the path to the local directory in which the checked out project is stored.

The test-project example demonstrates main-line code development on a project:

```
svn checkout  
svn+ssh://user@svn.mycompany.com/subversion/repository/test-project/trunk test-  
project
```

In this case, a directory called `test-project` is created and the project contents are recursively copied into the directory from the server.

2. You can make any number of changes to the checked out files.

After the project is checked out once on your system, there is no need to perform subsequent checkouts on that source code. To stay synchronized with the Subversion repository content, you can run the `svn update` command on a checked out directory or even on individual files.

3. When you are ready to commit the changes to the repository, check in the files or directories that you want to commit. The file or directory set being checked in does not have to correspond to what was checked out as long as all components are members of the checked out directory. Run the following commands to commit the changes:

```
svn commit -m "Added code and test case" test-project/src/main/java  
test-project/src/test/resources/testdata.xml  
svn resolve test-project/src/test/resources/testdata.xml
```

After you have resolved any conflict, proceed with a normal check-in operation.

4. Before committing local changes to the repository operation, run `svn update` to integrate any changes committed to the code by others, since your last checkout or update, by running the following command:

```
svn update
```

5. Commit your changes by running the following command:

```
svn commit -m "description of the updates"
```

3.7 Considerations for Tagging and Branching

Tagging creates a named point-in-time copy of a branch.

Tag releases on the following occasions:

- Whenever a project is released
- Whenever an important milestone occurs

It is important to tag releases, as tags provide a simple mechanism for patching releases. When a bug is found in a release, you can branch from the tag for that release, implement the fix, and then create a patch for the release. Tag this new (patched) release as well, in case you find an issue with it later and need to fix that new issue.

If you do not tag a release, it is very difficult to obtain the exact code line that was built into that release.

Note:

Treat tagged releases as read-only artifacts. You must not continue merging into a release after it is tagged.

3.8 About Subversion Clients

There are several Subversion clients that are available.

This section describes two popular Subversion clients:

- [WebSVN](#)
- [TortoiseSVN](#)

3.8.1 WebSVN

WebSVN provides a web-based view of a repository and supports visual differences, blame, and search.

WebSVN can be downloaded from:

<http://www.websvn.info/>

3.8.2 TortoiseSVN

TortoiseSVN is a free Windows Subversion client that integrates with Windows Explorer. All standard Subversion client operations can be performed through the Windows user interface. Folder and file icon decorators indicate the status of Subversion files. Command-line tools are mapped with menu items and options are configurable through dialogs boxes. Tortoise also provides sophisticated graphical diff and merge tools that can be helpful for resolving conflicts.

TortoiseSVN can be downloaded from:

<http://tortoisesvn.net/>

3.9 More Information About Subversion

This document is meant as a quick guide for starting and running Subversion and does not provide extensive detail on Subversion operations.

For a detailed guide, see *Version Control with Subversion* at:

<http://svnbook.red-bean.com>

Note:

Oracle strongly recommends reading [Version Control with Subversion](#) if you are new to Subversion.

Installing and Configuring the Archiva Maven Repository Manager

Apache Archiva is one of several choices for an artifact repository, an important component of a Maven-based continuous integration build system. Learn how to install and perform the basic configuration of Archiva.

If you are not familiar with Maven Repository Managers or artifact repositories, see [Repository Management with Archiva](#) for more details.

Topics:

- [Overview of Archiva](#)
- [Downloading Archiva](#)
- [Installing Archiva](#)
- [Configuring Archiva](#)
- [More Information About Archiva](#)
- [About Maven Repository Manager Administration](#)

After you have completed installation and configuration of Archiva (as detailed in this chapter) and Maven (as detailed in [Installing and Configuring Maven for Build Automation and Dependency Management](#)), populate your Archiva repository with the Oracle-provided artifacts. Refer to [Populating the Maven Repository Manager](#) for more details.

4.1 Overview of Archiva

Archiva is distributed as a standalone installation that is bundled with Jetty. A WAR file distribution is also provided so that Archiva can be installed into an existing application server.

This chapter describes the process of installing the standalone version. Instructions for WAR file installation and configuration are available in the official Archiva documentation in the following location:

<http://archiva.apache.org/docs/1.3.6>

4.2 Downloading Archiva

You can download the latest standalone Archiva release either as a `.zip` file or `.tar.gz` file.

Download it from the following location:

<http://archiva.apache.org/download.html>

4.3 Installing Archiva

To install Archiva, unpack the distribution to the target installation directory. This location depends on your preference and target operating system.

Oracle recommends that you create a common location for continuous integration related workspaces. For example, unpack the distribution in the following location:

```
/ciroot/archiva
```

- **On Linux**

Run the following command:

```
sudo mkdir -p /ciroot/archiva ; sudo tar xzvf apache-archiva-1.3.6-bin.tar.gz  
--strip-components 1 -C /ciroot/archiva
```

After you run the command, ensure that you change the owner of the files to match your user and group. For example, if you are using `oracle` as the user id and `oracle` as the group name, you would run the following command:

```
chown -R oracle:oracle /ciroot/archiva
```

- **On Windows**

Create a directory to create the Archiva installation files:

```
mkdir c:\ciroot\archiva
```

Extract the Archiva zip file that you downloaded into this new directory.

4.4 Configuring Archiva

This section provides details on how to configure Archiva, not just in general, but also some specific configuration for use in an Oracle Fusion Middleware environment.

This section contains the following topics:

- [Configuring the Server](#)
- [Starting the Server](#)
- [Creating an Administrator User](#)
- [About Internal and Snapshot Repositories](#)
- [About the Proxy Repository](#)
- [Configuring Mirror Repositories](#)
- [Creating Development, Production, Quality Assurance, and Test Repositories](#)
- [Creating a Deployment Capable User](#)

4.4.1 Configuring the Server

The Archiva Jetty instance starts up with a default HTTP port of 8080. If you want to change the port, before startup, modify `/ciroot/archiva/conf/jetty.xml`. Change the connector configuration's `SystemProperty` value for `jetty.port` to a different value, for example, 8081:

```
<Call name="addConnector">
  <Arg>
    <New class="org.mortbay.jetty.nio.SelectChannelConnector">
      <Set name="host">
        <SystemProperty name="jetty.host"/>
      </Set>
      <Set name="port">
        <SystemProperty name="jetty.port" default="8081"/>
      </Set>
    </New>
  </Arg>
</Call>
```

4.4.2 Starting the Server

After the server is configured, you can start it from the command-line interface:

1. Run the following command:

```
/ciroot/archiva/bin/archiva start
```

On 64-bit Linux systems, you may receive an error message similar to this:

```
./archiva: /ciroot/archiva/bin/./wrapper-linux-x86-32:
/lib/ld-linux.so.2: bad ELF interpreter: No such file or directory
```

If you receive this error, install the `glibc.i686` package (using `yum` for example) and try again.

2. Check the log output while the server is starting, to ensure that it starts as expected, by running the following command:

```
tail -f /ciroot/archiva/logs/*
```

After the startup tasks complete, the Archiva server is available in the following location:

```
http://localhost:8081
```

4.4.3 Creating an Administrator User

When you visit the Archiva home page for the first time, you are prompted to set the administration password. Specify the full name, email address, and password of the administration user.

Apache Archiva \ Create Admin ...

localhost:8081/archiva/security/addadmin.action

archiva

Find

Search

Browse

Create Admin User

Username: admin

Full Name*: CI Admin User

Email Address*: adminuser@mycompany.org

Password*:

Confirm Password*:

4.4.4 About Internal and Snapshot Repositories

Archiva starts up with two hosted repositories configured:

- Internal

The internal repository is for maintaining fixed-version released artifacts deployed by your organization, which includes finished versions of artifacts, versions that are no longer in development, and released versions. Note that in-development versions of the same artifacts may exist in the snapshot repository in the future.
- Snapshot

The snapshot repository holds the work-in-progress artifacts, which are denoted with a version with the suffix `SNAPSHOT`, and artifacts that have not yet been released.

4.4.5 About the Proxy Repository

In addition to hosting your internally deployed artifacts, the internal repository is configured to serve as a proxy for the public Maven Central repository by default. A proxy repository can be used instead of directly referring to a third-party repository. A proxy caches previously requested artifacts locally. This reduces the load on public servers, which is recommended, especially if you run builds from a clean repository. If you place too much load on the public server, it may throttle or ban your host from placing additional requests. For significant build performance improvement, fetch dependencies from a less loaded, more proximate, proxy server.

If you require third-party artifacts from other public repositories, then add them to your repository as additional Proxy Connectors.

4.4.6 Configuring Mirror Repositories

Because you will typically want to share cached third-party proxied artifacts among multiple repositories, separate the cached artifacts from your project artifacts by moving them into a separate repository.

To create and configure mirror repositories:

1. Remove the proxy connections from the internal repository.
 - a. Under the **Administration** menu, click **Proxy Connections**.
 - b. Delete the **Central Repository** and **maven2-repository.dev.java.net** proxy connectors by clicking the red **X** on each entry.
2. Add a new mirror repository:
 - a. From the **Administration** menu, click **Repositories**.
 - b. From the top right corner, click **Add**.
 - c. Specify the following information in the **Admin: Add Managed Repository** dialog box:
 - **Identifier:** mirror
 - **Name:** Mirror
 - **Directory:** `/ciroot/archiva/data/repositories/mirror`
 - Select **Releases Included, Block Re-deployment of Released Artifacts, and Scannable**.
 - d. Click **Add Repository**.

Admin: Add Managed Repository

*Identifier**:

*Name**:

*Directory**:

Index Directory:

Type:

*Cron**:

Repository Purge By Days Older Than:

Repository Purge By Retention Count:

Releases Included

Block Re-deployment of Released Artifacts

Snapshots Included

Scannable

Delete Released Snapshots

3. Add proxy connectors to the mirror repository:
 - a. Under the **Administration** menu, click **Proxy Connections**.
 - b. Click **Add**.
 - c. Select **mirror** in Managed Repository.
 - d. Select **central** for Remote Repository.
 - e. Click **Add Proxy Connector**.

After completing these steps, you should see the following:

Repository Proxy Connectors

The screenshot displays the 'Repository Proxy Connectors' configuration interface. It features a list of connectors. The top connector is 'mirror', which is a 'Mirror' type. Below it are two 'Proxy Connector' entries. The first is 'central', labeled as 'Central Repository' with the URL 'http://repo1.maven.org/maven2'. The second is 'maven2-repository.dev.java.net', labeled as 'Java.net Repository for Maven 2' with the URL 'http://download.java.net/maven/2/'. Each entry has a 'Settings' link below it.

4. To configure the anonymous guest user to have read privileges for the new repository:
 - a. Under the **Management** menu, click **User management**.
 - b. Click **Guest**.
 - c. Click **Edit Roles**.
 - d. Select the **Repository Observer** role next to **mirror**.
 - e. Click **Submit** to save your changes.

To configure a mirror repository in a remote repository, complete steps 1-3. However, select **maven2-repository.dev.java.net** in step 1-b.

4.4.7 Creating Development, Production, Quality Assurance, and Test Repositories

You must create a separate repository for each Oracle Fusion Middleware environment that you want to target with a Maven build. Oracle's support for one-off patching (see [Things to Know About Patching](#)), means that it is possible that you could have two different environments (for example, production and test), which are at the same version but have some different files due to different one-off patches applied.

To ensure that your Maven builds are using the correct version of files, create and configure a group Maven repository for each target environment:

1. Create a repository:
 - a. From the **Administration** menu, click **Repositories**.
 - b. To add a new repository, click **Add** from the top right corner.

- c. In the **Admin: Add Managed Repository** dialog box, specify the following details:
- **Identifier:** Provide an identifier, like dev, prod, qa, or test.
 - **Name:** Provide a name.
 - **Directory:** Add a directory path like /ciroot/archiva/data/repositories/\${IDENTIFIER}, where \${IDENTIFIER} matches the string that you provided in **Identifier**.
 - Deselect **Block Re-deployment of Released Artifacts**.
 - Select **Releases Included** and **Scannable**.

Admin: Add Managed Repository

*Identifier**:
*Name**:
*Directory**:
Index Directory:
Type:
*Cron**:
Repository Purge By Days Older Than:
Repository Purge By Retention Count:

Releases Included
 Block Re-deployment of Released Artifacts
 Snapshots Included
 Scannable
 Delete Released Snapshots

- d. Click **Add Repository**.
2. To configure the anonymous guest user to have read privileges for the new repository:
- Under **Manage**, click **User Management**.
 - Select **guest**.
 - Select **Edit Roles**.
 - Select the **Repository Observer** role next to the appropriate repository entry.
 - Click **Submit** to save your changes.

3. To create a corresponding group for the new repository:
 - a. From the **Administration** menu, click **Repository Groups**.
 - b. In the top right corner, click **Add Group**.
 - c. In the **Identifier** field, specify a name that matches the repository that you created, with the addition of **-group**, for example, **dev-group**.
 - d. Click **Add Group**.
 - e. Select your new repository, like **dev**, from the drop-down menu next to **Add Repository** and click **Add Repository**.

Repeat steps 3-a to 3-d to add **mirror** and **snapshots**.

The following figure shows the Repository Groups page.

Administration - Repository Groups

Repository Groups



dev-group

<http://host.example.com:8092/archiva/repository/dev-group>

Repository



mirror

Mirror

<http://host.example.com:8092/archiva/repository/mirror>

Repository



dev

Oracle Dev

<http://host.example.com:8092/archiva/repository/dev>

Repository



snapshots

Archiva Managed Snapshot Repository

<http://host.example.com:8092/archiva/repository/snapshots>

- Repeat the repository and group creation steps 1-3 for each repository type: **test**, **qa**, and **prod**.

4.4.8 Creating a Deployment Capable User

To support deployment in your internal repository, you must add at least one user with appropriate permissions:

1. Under **Management**, click **User Management**.
2. Click **Create New User** to add a user. Then, specify the required details like name, email address, and password. After the user is added, you are directed to a **Role Administration** dialog box for that user.
3. In the **Role Administration** dialog box, under **Resource Roles**, select the **Repository Manager** role for **Snapshot** and **Internal Repositories**.
4. Click **Submit** to save your changes.

Note:

The Repository Manager role, while allowing you to upload artifacts, also allows you to change the repository configuration.

To customize or change the role, in the **User Roles** section, add a new more limited role and assign it to the appropriate users.

Typically, you want to create a new user for each individual with access to the repository. For Hudson, to publish build output to the repository, each user who accesses the repository should have their own user ID, and you should create an additional user with deployment permissions.

After you have completed installation and configuration of Archiva (as detailed in this chapter) and Maven (as detailed in [Installing and Configuring Maven for Build Automation and Dependency Management](#)), populate your Archiva repository with the Oracle-provided artifacts, as described in [Populating the Maven Repository Manager](#).

4.5 More Information About Archiva

The Archiva user guide provides much more information about Archiva.

The user guide for Archiva 1.3.6 is available at:

<http://archiva.apache.org/docs/1.3.6/userguide/>

Other releases are available in the Archiva home page at:

<http://archiva.apache.org>

4.6 About Maven Repository Manager Administration

Administering the Maven Repository Manager involves understanding and using snapshot options, setting retention options, and backing up Archiva

This section contains the following topics:

- [Understanding Snapshot Cleanup](#)
- [About Advanced User Management](#)
- [Backing Up Archiva](#)

- [About Archiva and Failover](#)

4.6.1 Understanding Snapshot Cleanup

Archiva retains an instance of a particular snapshot-versioned artifact for every successfully deployed job. When you request a snapshot artifact, the most recent snapshot is obtained. Maven examines the associated metadata in the repository to determine the correct copy to download. The Maven Repository Manager maintains each copy with a unique timestamp and build number.

For example, the contents of the repository directory for an artifact should look similar to the following:

```
maven-metadata.xml
test-artifact-2.1-20110928.112713-14.jar
test-artifact-2.1-20110928.112713-14.pom
test-artifact-2.1-20110924.121415-13.pom
test-artifact-2.1-20110924.121415-13.jar
```

The corresponding repository metadata should look similar to the following:

```
<?xml version="1.0" encoding="UTF-8"?>
<metadata>
  <groupId>com.my.company</groupId>
  <artifactId>test-artifact</artifactId>
  <version>2.1-SNAPSHOT</version>
  <versioning>
    <snapshot>
      <timestamp>20110928.112713</timestamp>
      <buildNumber>14</buildNumber>
    </snapshot>
    <lastUpdated>20110928112718</lastUpdated>
    <snapshotVersions>
      <snapshotVersion>
        <extension>jar</extension>
        <value>2.1-20110928.112713-14</value>
        <updated>20110928112713</updated>
      </snapshotVersion>
      <snapshotVersion>
        <extension>pom</extension>
        <value>2.1-20110928.112713-14</value>
        <updated>20110928112713</updated>
      </snapshotVersion>
      <snapshotVersion>
        <extension>jar</extension>
        <value>2.1-20110924.121415-13</value>
        <updated>20110924121415</updated>
      </snapshotVersion>
      <snapshotVersion>
        <extension>pom</extension>
        <value>2.1-20110924.121415-13</value>
        <updated>20110924121415</updated>
      </snapshotVersion>
      ...
    </snapshotVersions>
  </versioning>
</metadata>
```

The `/metadata/versioning/snapshot` element contains the information for the latest snapshot that is fetched when you request the snapshot artifact for `test-artifact-2.1-SNAPSHOT`. You can directly request a specific snapshot of your

requirement by referencing timestamp and build numbers in your version, for example, `2.1.-20110928.112713-14`.

Usually, only the latest snapshot is required for proper operation of continuous integration builds. Retention of older instances of a snapshot is helpful for troubleshooting purposes when the continuous integration server indicates that a snapshot dependency change has broken the integration process. It is sometimes useful to pull slightly older builds from the repository, after the last working build, to identify the problem.

If no recurring cleanup operation occurs, snapshot instances can accumulate quite rapidly over the lifetime of a project. To keep storage requirements of the repository manager under control, delete older snapshots. Set options regarding retention policy according to available storage and performance requirements.

4.6.1.1 Setting Retention Options

In a continuous integration environment, where builds are often triggered by checking in artifacts, there is the potential for a large number of builds to be executed. Each of these builds, at least the successful ones, results in some artifacts being published into the repository. These can start consuming a lot of space, and it is important to manage them.

Archiva provides two different options for automatically cleaning up old snapshots on a per-repository basis:

- Repository Purge by Number of Days Older

Archiva automatically deletes snapshots older than the specified number of days. Archiva always retains the most recent snapshot, no matter how old it is.

- Repository Purge by Retention Count

To use this method, you must set the `purge-by-days-older` value to 0. Archiva retains only the most recent snapshot instances up to this value. Older instances that exceed this count are deleted.

Both of these options can be viewed and changed by clicking **Repositories** under the **Administration** menu, and then clicking **Edit** for the repository you are interested in.

4.6.1.2 About Deleted Released Snapshots

Once the corresponding version is released, a snapshot of that version is no longer needed. Not only does this save space, but it also ensures that your dependency references are up-to-date.

Any existing continuous integration builds that refer to the snapshot fail with a missing dependency message after the dependency is deleted from the repository manager. This failure reminds you that a dependency reference is stale and encourages you to fix the problem.

4.6.2 About Advanced User Management

Archiva uses Apache Redback for its user management infrastructure. To use Archiva's authentication and role management system with your organization's existing user management system, you must provide additional configuration with Redback. Redback has limited support for LDAP and other authentication systems.

Complete details are available in the following location:

<http://archiva.apache.org/redback/>

4.6.3 Backing Up Archiva

You should provide a mechanism for backing up your Archiva file store and configuration so that you can restore it if a file system failure or corruption occurs.

The choice of backup solutions may be affected by your failover method.

4.6.4 About Archiva and Failover

Although Archiva does not provide a failover solution, it is important for you to maintain a failover system that stays current. Depending on your preference, you can either set up an identically configured backup system with a separate file system that is synchronized with the primary systems or configure both systems to use the same shared file system.

For more information, see the Archiva page:

<https://cwiki.apache.org/confluence/display/ARCHIVA/High+Availability+Archiva>

Installing and Configuring Maven for Build Automation and Dependency Management

Maven is a build management tool that is central to project build tasks such as compilation, packaging, and artifact management. Maven uses a strict XML-based rule set to promote consistency while maintaining flexibility. Because most Java-centric continuous integration systems integrate well with Maven, it is a good choice for an underlying build system.

This chapter describes how to install and configure Maven.

Topics:

- [Setting Up the Maven Distribution](#)
- [Customizing Maven Settings](#)
- [Populating the Maven Repository Manager](#)

5.1 Setting Up the Maven Distribution

A distribution of Maven 3.2.5 is included with Oracle Fusion Middleware.

After you install Oracle WebLogic Server, you can find Maven in your Oracle home in the following location:

```
ORACLE_HOME/oracle_common/modules/org.apache.maven_3.2.5
```

This is a copy of the standard Maven 3.2.5 release, without any modifications.

Alternatively, you can download and install your own copy of Maven from the Maven website:

<http://maven.apache.org>

Oracle Fusion Middleware supports Maven 3.0.5 or higher.

After installation, add Maven to your operating system's PATH environment variable:

- On Linux:

You must update your shell startup script, your `.profile` or `.bash_profile`, to update the path.

For example, if you have installed Oracle WebLogic Server in `/u01/fmwhome` and you are using the `bash` shell, then you must add the following to the PATH environment variable:

```
export M2_HOME=/u01/fmwhome/oracle_common/modules/org.apache.maven_3.2.5
export PATH=${M2_HOME}/bin:$PATH
```

You also need to set the `JAVA_HOME` environment variable to point to your JDK installation. For example:

```
export JAVA_HOME=/u01/jdk1.7.0_45
```

- On Windows:

Edit your PATH environment variable and add the correct path to Maven at the beginning of the PATH environment variable.

For example, if you have installed WebLogic Server in `c:\fmwhome`, then you must add the following:

```
C:\fmwhome\oracle_common\modules\org.apache.maven_3.2.5\bin
```

You also need to set the JAVA_HOME environment variable to point to your JDK installation.

5.2 Customizing Maven Settings

You can create a Maven settings file to specify proxy servers, servers, and mirrors.

You must create a Maven settings file if:

- You are working behind a firewall or proxy server.
- Your organization has its own internal Maven Repository Manager.
- You plan to access the Oracle Maven Repository.

If you have installed Maven for the first time, either as part of the Oracle WebLogic Server installation, or by downloading it from the Maven website, you will not have a settings file yet. You must create it, naming it `settings.xml`

The following is an example of a Maven settings file:

```
<settings>
<proxies>
  <proxy>
    <active>true</active>
    <protocol>http</protocol>
    <host>proxy.mycompany.com</host>
    <port>8080</port>
    <nonProxyHosts>mycompany.com</nonProxyHosts>
  </proxy>
</proxies>
<servers>
  <server>
    <id>maven.mycompany.com</id>
    <username>me@mycompany.com</username>
    <password>{COQLCE6DU6GtcS5P=}</password>
  </server>
</servers>
<mirrors>
  <mirror>
    <id>archiva</id>
    <name>Internal Archiva Mirror of Central</name>
    <url>http://archiva.mycompany.com/repositories/internal</url>
    <mirrorOf>central</mirrorOf>
  </mirror>
</mirrors>
</settings>
```

This example shows three common configuration settings that you may need to use:

- **Proxy:** Enables you to communicate with Maven about the HTTP proxy server that is required to access Maven repositories on the Internet.
- **Servers:** Enables you to communicate with Maven about your credentials for the Maven repository, so that you do not have to enter them every time you want to access the repository.
- **Mirrors:** Informs Maven that instead of trying to access the Maven central repository directly, it should use your internal Maven repository manager as a mirror (cache) of Maven's central repository.

If you are not familiar with these terms, review the introduction in [Introduction to Continuous Integration](#). For more information about available Maven settings, see the Maven documentation at:

<http://maven.apache.org/settings.html>

The Maven settings file, `settings.xml`, is usually kept in the `.m2` directory inside your home directory. However, if you want to point Maven to a different location, see the Maven documentation.

If your user name is **bob**, then the directory path should look similar to the following:

```
(Linux) /home/bob/.m2/settings.xml  
(Windows) C:\Users\bob\.m2\settings.xml
```

5.3 Populating the Maven Repository Manager

After you have configured your Maven Repository Manager, for example, you set up Archiva, you populate it with Oracle artifacts.

Setting up Archiva is described in [Installing and Configuring the Archiva Maven Repository Manager](#).

A Maven Synchronization plug-in allows you to populate a local or shared Maven repository from an Oracle home. When you install a Fusion Middleware 12c product, the Maven archetypes, plug-ins, and POMs are installed with the product so that the Synchronization plug-in can find them.

This section contains the following topics:

- [Introduction to the Maven Synchronization Plug-In](#)
- [Installing the Oracle Maven Synchronization Plug-In](#)
- [Running the Oracle Maven Synchronization Plug-In](#)
- [Replacing Artifacts](#)
- [Populating Your Maven Repository](#)
- [Running the Push Goal on an Existing Maven Repository](#)
- [Things to Know About Patching](#)
- [Considerations for Archetype Catalogs](#)
- [Example settings.xml file](#)
- [Deploying a Single Artifact](#)

5.3.1 Introduction to the Maven Synchronization Plug-In

Oracle Fusion Middleware 12c provides a **Maven Synchronization plug-in** that simplifies the process of setting up repositories and completely eliminates the need to know what patches are installed in a particular environment. This plug-in enables you to populate a Maven repository from a given Oracle home. After you patch your Oracle home, run this plug-in to ensure that your Maven repository matches Oracle home. This ensures that your builds use correct versions of all artifacts in that particular environment.

The Oracle Maven Synchronization plug-in is included in the Oracle WebLogic Server, Oracle Coherence and Oracle JDeveloper installations. To use the plug-in, you must specify the location of the Oracle home and the location of the Maven repository. The Maven repository can be specified using either a file system path or a URL. The plug-in checks for all Maven artifacts in the Oracle home, ensures that all artifacts are installed in the specified Maven repository, and that the versions match exactly. This means that the version numbers and the files are exactly same at the binary level, ensuring that all patched files reflect accurately in the Maven repository.

Oracle homes in 12c contain maven directories which contain Maven Project Object Models (POMs) for artifacts provided by Oracle, archetypes for creating projects, and Maven plug-ins provided by Oracle, for executing various build operations.

5.3.2 Installing the Oracle Maven Synchronization Plug-In

Before you start using the Oracle Maven Synchronization plug-in, you must install it into your Maven repository. You can install it into your local repository on your computer, or you can deploy it into your shared internal repository, if you have one.

The plug-in is located in your Oracle WebLogic Server 12c home and consists of two files:

- The Maven Project Object Model (POM) file, which describes the plug-in. It is located at:

```
ORACLE_HOME/oracle_common/plugins/maven/com/oracle/maven/oracle-maven-sync/12.2.1/  
oracle-maven-sync-12.2.1.pom
```

- The JAR file, which contains the plug-in. It is located at:

```
ORACLE_HOME/oracle_common/plugins/maven/com/oracle/maven/oracle-maven-sync/12.2.1/  
oracle-maven-sync-12.2.1.jar
```

To install and deploy the plug-in:

1. To install the plug-in into your local Maven repository, run the following command from the `ORACLE_HOME/oracle_common/plugins/maven/com/oracle/maven/oracle-maven-sync/12.2.1` directory:

```
mvn install:install-file -DpomFile=oracle-maven-sync-12.2.1.pom -Dfile=oracle-  
maven-sync-12.2.1.jar
```

2. To deploy the plug-in, use one of the following methods:
 - The simplest way to deploy the plug-in into a shared internal repository is to use the web user interface provided by your Maven Repository Manager to upload the JAR file into the repository.
 - An alternative method is to use the deploy plug-in, which you can do by using a command like the following from the `ORACLE_HOME/oracle_common/`

```
plugins/maven/com/oracle/maven/oracle-maven-sync/12.2.1
directory:
```

```
mvn deploy:deploy-file -DpomFile=oracle-maven-sync-12.2.1.pom -Dfile=oracle-
maven-sync-12.2.1.jar
-Durl=http://servername/archiva/repositories/internal -DrepositoryId=internal
```

3. To use the deploy plug-in, you must define the repository in your Maven settings.xml file and define the credentials if anonymous publishing is not allowed.

For information about this command, refer to the Maven documentation at:

<http://maven.apache.org/plugins/maven-deploy-plugin/deploy-file-mojo.html>

If you would like to use the shorter name for the Oracle Maven Synchronization plug-in, so that you do not have to provide the full coordinates when using it, add an entry to your Maven settings.xml as follows:

```
<pluginGroups>
  <pluginGroup>com.oracle.maven</pluginGroup>
  ...
</pluginGroups>
```

This allows you to refer to the plug-in using the name `oracle-sync`.

To configure your Maven installation and download, and use the plug-in from the Oracle Maven Repository, you must register for access in the Oracle Public Maven Repository and add a server entry to your Maven settings.xml file, as described in [About the Oracle Maven Repository](#).

5.3.3 Running the Oracle Maven Synchronization Plug-In

The Oracle Maven Synchronization plug-in supports a single push goal used to populate a repository.

To obtain usage and parameter descriptions, invoke the `help:describe` goal by running the following command:

```
mvn help:describe -Dplugin=com.oracle.maven:oracle-maven-sync -Ddetail
```

This output shows the parameters that are available for the plug-in's **push** goal. [Table 5-1](#) describes the parameters.

Table 5-1 Push Goal Parameters and Description

Parameter	Description
<code>serverId</code>	A pointer to the server entry in your Maven settings.xml file. This is required only if you intend to deploy to a remote repository. The settings.xml should provide the remote artifact repository's deployment information, such as URL, user name, and password.
<code>oracleHome</code>	The path to the Oracle home from which you want to populate the Maven repository.

Table 5-1 (Cont.) Push Goal Parameters and Description

Parameter	Description
<code>testingOnly</code>	A parameter to control whether the plug-in attempts to publish the artifacts to the repository. If you set this to <code>true</code> , which is the default value, then the push goal finds all of your POM files and prints out details of what it would have been done if this is set to <code>false</code> . However, it does not publish any artifacts or make any change to the system.
<code>failOnError</code>	If you set this property to <code>false</code> and the plug-in fails to process a resource, it continues to process all other resources. Failures are logged as warnings, but the process completes successfully. If you set this property to <code>true</code> , when it encounters the first problem, the plug-in immediately exits with an error. This is the default.
<code>overwriteParent</code>	If you set this property to <code>true</code> , the plug-in overwrites POM artifacts with ancestry to <code>oracle-common</code> if they exist in the target repository. The default value of <code>false</code> prevents automatic overwrite of customized POM contents. If any such POMs are encountered during plug-in execution, an error is thrown and handled according to the <code>failOnError</code> flag value. To carry over changes, save the existing POMs, run the push goal with <code>overwriteParent=true</code> , and manually transfer the changes to the newly pushed POMs.
<code>pushDuplicates</code>	If you set this property to <code>true</code> , the plug-in pushes all duplicate locations. That is, if multiple POMs with different Maven coordinates (GAV) are assigned to the same location path, the plug-in pushes them all to the destination repository.

5.3.4 Replacing Artifacts

Some Maven Repository Managers have a setting that controls whether you can replace an existing artifact in the repository. If your Maven Repository Manager has such a setting, you must ensure that you have set it correctly so that the Oracle Maven Synchronization plug-in is able to update the artifacts in your repository.

For Archiva:

1. From the Administration menu, select **Repositories**.
2. Click **Edit** to change the setting of the repository you want to change.

If you are using Archiva, you must deselect the **Block Re-deployment of Released Artifacts** option in the **Managed Repository** settings.

Other Maven Repository Managers have similar settings. If you are using a different tool, consult the documentation for that tool to find out how to change this setting.

5.3.5 Populating Your Maven Repository

To populate your repository, you must use the **push** goal. You can specify the parameters given in [Table 5-1](#) on the command line or in your Project Object Model file.

This section contains the following topics:

- [About Running the Push Goal](#)
- [Populating a Local Repository](#)
- [Populating a Remote Repository](#)

5.3.5.1 About Running the Push Goal

When you run the **push** goal, it takes the following actions:

- Checks the Oracle home you have provided and makes a list of all of the Maven artifacts inside that Oracle home. This is done by looking for Project Object Model files in the `ORACLE_HOME/oracle_common/plugins/maven` dependencies directory and its subdirectories, recursively, and in the `ORACLE_HOME/PRODUCT_HOME/plugins/maven` directory and its subdirectories recursively for each `PRODUCT_HOME` that exists in the `ORACLE_HOME`.
- Checks if the JAR file referred to by each Project Object Model file is available in the Oracle home.
- Calculates a SHA1 checksum for the JAR file.
- Attempts to publish the JAR, Project Object Model, and SHA1 files to the repository that you have provided.

The following types of Maven artifacts are installed into your repository:

- Maven dependencies provided by Oracle, which include the following:
 - Client API classes
 - Compilation, packaging, and deployment utilities, for example, `appc` and `wlst`
 - Component JARs that must be embedded in the application
 - Client-side runtime classes, for example, `t3` and JAX-WS client runtimes
- Maven plug-ins provided by Oracle that handle compilation, packaging, and deployment
- Maven archetypes provided by Oracle that provide project templates

5.3.5.2 Populating a Local Repository

You need to populate a local repository:

1. To populate a local repository, you only need to specify `oracleHome` and `testingOnly=false`. For example:

```
mvn com.oracle.maven:oracle-maven-sync:push
  -Doracle-maven-sync.oracleHome=/path/to/oracleHome
  -DtestingOnly=false
```

The `localRepository` element in your `settings.xml` file indicates the location of your local Maven repository. If you exclude the `localRepository` element in `settings.xml`, the default location is in the `${HOME}/.m2/repository` directory.

If you want to override the `localRepository` value, then you must specify the override location on the command line as a Maven option. For example:

```
mvn com.oracle.maven:oracle-maven-sync:push
-DoracleHome=/path/to/oracleHome
-Dmaven.repo.local=/alter/nate/path
```

2. To specify the parameters in your Project Object Model file, you must add a plug-in entry similar to the following:

```
<plugin>
  <groupId>com.oracle.maven</groupId>
  <artifactId>oracle-maven-sync</artifactId>
  <version>12.2.1-0-0</version>
  <configuration>
    <oracleHome>/path/to/oracleHome</oracleHome>
    <testOnly>>false</testOnly>
  </configuration>
</plugin>
```

3. After adding the plug-in, execute Maven by running the following command:

```
mvn com.oracle.maven:oracle-maven-sync:push
```

5.3.5.3 Populating a Remote Repository

To populate a remote repository, you must specify `serverId` and `oracleHome` on the command-line interface or in the plug-in configuration. You must also have a repository configuration in your `settings.xml` file that matches the `serverId` you provide to the plug-in. If authentication is required for deployment, you must also add a server entry to your Maven `settings.xml` file.

For example:

```
mvn com.oracle.maven:oracle-maven-sync:push
-DoracleHome=/path/to/oracleHome
-DserverId=internal
```

The corresponding Maven `settings.xml` file with authentication details looks similar to the following:

```
...
<profiles>
  <profile>
    <id>default</id>
  <repositories>
    <repository>
      <releases>
        <enabled>>true</enabled>
        <updatePolicy>always</updatePolicy>
        <checksumPolicy>warn</checksumPolicy>
      </releases>
      <snapshots>
        <enabled>true</enabled>
        <updatePolicy>never</updatePolicy>
        <checksumPolicy>fail</checksumPolicy>
      </snapshots>
      <id>internal</id>
      <name>Team Internal Repository</name>
      <url>http://some.host/maven/repo/internal</url>
      <layout>default</layout>
    </repository>
  </repositories>
</profile>
</profiles>
```

```

...
<server>
  <id>internal</id>
  <username>deployer</username>
  <password>welcome1</password>
</server>
...
<activeProfiles>
  <activeProfile>default</activeProfile>
</activeProfiles>

```

You must define the target repository in a profile, and activate that profile using the `activeProfiles` tag as shown in the preceding example.

Note:

You should specify an encrypted password in the server section. For details on how to encrypt the server passwords, see:

http://maven.apache.org/guides/mini/guide-encryption.html#How_to_encrypt_server_passwords

To specify the parameters in your Project Object Model file, you must add a plug-in entry similar to the following:

```

<plugin>
  <groupId>com.oracle.maven</groupId>
  <artifactId>oracle-maven-sync</artifactId>
  <version>12.2.1-0-0</version>
  <configuration>
    <serverId>internal</serverId>
    <oracleHome>/path/to/oracleHome</oracleHome>
    <testOnly>>false</testOnly>
  </configuration>
</plugin>

```

After adding the plug-in, execute Maven by running the following command:

```
mvn com.oracle.maven:oracle-maven-sync:push
```

After you have populated the repository you may want to perform some operations on the repository manager, such as update indexes or update the archetype catalog. Refer to the documentation for the repository manager to check if any such operations are necessary or recommended.

5.3.6 Running the Push Goal on an Existing Maven Repository

When you run the push goal against a Maven repository that already has Oracle artifacts in it, the Oracle Maven Synchronization plug-in detects that you have existing Parent POMs in the repository. It does not overwrite these Parent POMs, in case you have modified them, for example, by adding your own settings to them. Instead, it prints a warning message. If you want to overwrite the Parent POMs, you need to specify the extra parameter `-DoverrideParents=true` on the push goal.

5.3.7 Things to Know About Patching

Patching is the practice of updating a system with minor changes, usually to fix bugs that have been identified after the software goes into production. Oracle Fusion

Middleware uses the OPatch utility to manage application of patches to installed software in the Oracle home. When you use OPatch to apply a patch, the version number of the installed software may not change.

Maven uses a different approach to patching which assumes that released software will never be changed. When a patch is necessary, a new version of the artifact, with a new version number, is created and distributed as the patch.

This difference creates an issue when you use Maven to develop applications in an Oracle Fusion Middleware environment. Oracle Fusion Middleware provides a mechanism to address this issue.

5.3.7.1 Oracle's Approach to Patching

If any problems are found after a release of Oracle Fusion Middleware (for example, 12.2.1) into production, a one-off patch is created to fix that problem. Between any two releases, for example 12.2.1 and 12.2.1, a number of these patches are released. You can apply many combinations of these patches, including all or none of these patches.

This approach gives a great deal of flexibility and you can apply only the patches that you need, and ignore the rest. However, it can create an issue when you are using Maven. Ensure that the artifacts you are using in your build system are the exact same (potentially patched) versions that are used in the target environment.

The complications arises when you have a number of environments, like test, QA, SIT, and production, which are likely to have different versions (or patches) installed.

Oracle recommends that, in such a situation, you set up one Maven repository for each environment that you want to target. For example, a Maven test repository that contains artifacts that matches the versions and patches installed in the test environment and a Maven QA repository that contains artifacts that match the versions and patches installed in the QA environment.

5.3.7.2 Run the Oracle Maven Synchronization Plug-In Push Goal After Patching

After you patch your Oracle home, run this plug-in to ensure that your Maven repository matches the Oracle home. This ensures that your builds use correct versions for all artifacts in that particular environment. See [Running the Oracle Maven Synchronization Plug-In](#).

5.3.8 Considerations for Archetype Catalogs

By running the Oracle Maven Synchronization plug-in's **push** goal, you may have installed new Maven archetypes into your Maven repository. You might need to run a command to rebuild the index of archetypes. Some Maven repository managers do this automatically.

To rebuild your local archetype catalog, execute a command similar to the following:

```
mvn archetype:crawl -Dcatalog=$HOME/.m2/archetype-catalog.xml
```

5.3.9 Example settings.xml file

This example settings.xml file provides a template for Maven integration with the rest of the continuous integration system described in this book. It provides configuration to support central Archiva repository interaction and Hudson continuous integration server integration, as described in [Installing and Configuring the Archiva Maven Repository Manager](#) and [From Build Automation to Continuous Integration](#). You must change values, such as URLs and passwords, to match your system's values:


```

<settings>
  <profiles>
    <profile>
      <id>default</id>
      <repositories>
        <repository>
          <id>dev-group</id>
          <name>Dev Group</name>
          <releases>
            <enabled>true</enabled>
            <updatePolicy>always</updatePolicy>
            <checksumPolicy>warn</checksumPolicy>
          </releases>
          <snapshots>
            <enabled>false</enabled>
            <updatePolicy>never</updatePolicy>
            <checksumPolicy>fail</checksumPolicy>
          </snapshots>
          <url>http://SERVER:PORT/archiva/repository/dev-group</url>
          <layout>default</layout>
        </repository>
        <repository>
          <id>dev</id>
          <name>Dev</name>
          <releases>
            <enabled>true</enabled>
            <updatePolicy>always</updatePolicy>
            <checksumPolicy>warn</checksumPolicy>
          </releases>
          <snapshots>
            <enabled>false</enabled>
            <updatePolicy>never</updatePolicy>
            <checksumPolicy>fail</checksumPolicy>
          </snapshots>
          <url>http://SERVER:PORT/archiva/repository/dev</url>
          <layout>default</layout>
        </repository>
        <repository>
          <id>prod-group</id>
          <name>Prod Group</name>
          <releases>
            <enabled>true</enabled>
            <updatePolicy>always</updatePolicy>
            <checksumPolicy>warn</checksumPolicy>
          </releases>
          <snapshots>
            <enabled>false</enabled>
            <updatePolicy>never</updatePolicy>
            <checksumPolicy>fail</checksumPolicy>
          </snapshots>
          <url>http://SERVER:PORT/archiva/repository/prod-group</url>
          <layout>default</layout>
        </repository>
        <repository>
          <id>prod</id>
          <name>Prod</name>
          <releases>
            <enabled>true</enabled>
            <updatePolicy>always</updatePolicy>
            <checksumPolicy>warn</checksumPolicy>
          </releases>

```

```
<snapshots>
  <enabled>false</enabled>
  <updatePolicy>never</updatePolicy>
  <checksumPolicy>fail</checksumPolicy>
</snapshots>
<url>http://SERVER:PORT/archiva/repository/prod</url>
<layout>default</layout>
</repository>
<repository>
  <id>qa-group</id>
  <name>QA Group</name>
  <releases>
    <enabled>true</enabled>
    <updatePolicy>always</updatePolicy>
    <checksumPolicy>warn</checksumPolicy>
  </releases>
  <snapshots>
    <enabled>false</enabled>
    <updatePolicy>never</updatePolicy>
    <checksumPolicy>fail</checksumPolicy>
  </snapshots>
  <url>http://SERVER:PORT/archiva/repository/qa-group</url>
  <layout>default</layout>
</repository>
<repository>
  <id>qa</id>
  <name>QA</name>
  <releases>
    <enabled>true</enabled>
    <updatePolicy>always</updatePolicy>
    <checksumPolicy>warn</checksumPolicy>
  </releases>
  <snapshots>
    <enabled>false</enabled>
    <updatePolicy>never</updatePolicy>
    <checksumPolicy>fail</checksumPolicy>
  </snapshots>
  <url>http://SERVER:PORT/archiva/repository/qa</url>
  <layout>default</layout>
</repository>
<repository>
  <id>test-group</id>
  <name>Test Group</name>
  <releases>
    <enabled>true</enabled>
    <updatePolicy>always</updatePolicy>
    <checksumPolicy>warn</checksumPolicy>
  </releases>
  <snapshots>
    <enabled>false</enabled>
    <updatePolicy>never</updatePolicy>
    <checksumPolicy>fail</checksumPolicy>
  </snapshots>
  <url>http://SERVER:PORT/archiva/repository/test-group</url>
  <layout>default</layout>
</repository>
<repository>
  <id>test</id>
  <name>Test</name>
  <releases>
    <enabled>true</enabled>
```

```

        <updatePolicy>always</updatePolicy>
        <checksumPolicy>warn</checksumPolicy>
    </releases>
    <snapshots>
        <enabled>false</enabled>
        <updatePolicy>never</updatePolicy>
        <checksumPolicy>fail</checksumPolicy>
    </snapshots>
    <url>http://SERVER:PORT/archiva/repository/test</url>
    <layout>default</layout>
</repository>
<repository>
    <id>archiva-snapshots</id>
    <name>Archiva Snapshots</name>
    <releases>
        <enabled>false</enabled>
        <updatePolicy>always</updatePolicy>
        <checksumPolicy>warn</checksumPolicy>
    </releases>
    <snapshots>
        <enabled>true</enabled>
        <updatePolicy>never</updatePolicy>
        <checksumPolicy>fail</checksumPolicy>
    </snapshots>
    <url>http://SERVER:PORT/archiva/repository/snapshots</url>
    <layout>default</layout>
</repository>
</repositories>
</profile>
</profiles>
<servers>
    <server>
        <id>dev</id>
        <username>hudson</username>
        <password>PASSWORD</password>
    </server>
    <server>
        <id>dev-group</id>
        <username>hudson</username>
        <password>PASSWORD</password>
    </server>
    <server>
        <id>archiva-snapshots</id>
        <username>hudson</username>
        <password>PASSWORD</password>
    </server>
</servers>
<mirrors>
    <mirror>
        <id>dev-mirror</id>
        <name>All else</name>
        <url>http://SERVER:PORT/archiva/repository/dev-group</url>
        <mirrorOf>*</mirrorOf>
    </mirror>
</mirrors>
<activeProfiles>
    <activeProfile>default</activeProfile>
</activeProfiles>
</settings>

```

5.3.10 Deploying a Single Artifact

You can use the Maven deploy plug-in to deploy an artifact (or artifacts) and Project Object Module to the remote artifact repository.

For example, run the following command to deploy to the `archiva-releases` repository, as defined in the sample `settings.xml` file:

```
mvn deploy:deploy-file
  -Dfile=/path/to/oracle-maven-sync-12.2.1.jar
  -DrepositoryId=archiva-releases
  -DpomFile=/path/to/oracle-maven-sync-12.2.1.pom
  -Durl=http://server:port/archiva/repository/internal
```

Configuring the Oracle Maven Repository

The Oracle Maven Repository contains artifacts provided by Oracle that you may require to compile, test, package, perform integration testing, or deploy reapplications. Learn how to access and configure Oracle Maven Repository.

Topics:

- [Accessing the Oracle Maven Repository](#)
- [Artifacts Provided](#)
- [Adding the Oracle Maven Repository to Your Project POM](#)
- [Configure Maven to Use a Compatible HTTP Wagon](#)
- [Configuring the HTTP Wagon](#)
- [Considerations for Using the Oracle Maven Repository with Maven Without a POM](#)
- [Accessing the Oracle Maven Repository from an Automated Build Tool](#)

6.1 Accessing the Oracle Maven Repository

To access the Oracle Maven Repository, you must first register for access on Oracle Technology Network.

The registration application is located at:

<https://www.oracle.com/webapps/maven/register/license.html>

This application displays the license agreement for access to the Oracle Maven Repository. You must accept the license agreement to access the Oracle Maven Repository.

Every time you want to access the Oracle Maven Repository, you must provide the user name and the password you used to log in to Oracle Technology Network (OTN). Access is only provided over HTTPS. You can store your credentials in the Maven settings file so that you do not have to specify them manually every time. Oracle recommends that you encrypt your password, using the utilities provided with Maven.

To access the Oracle Maven Repository, you must use Maven 3.0.4 or later and make a few modifications to your Maven settings and project POM, as described in [Adding the Oracle Maven Repository to Your Project POM](#), [Configure Maven to Use a Compatible HTTP Wagon](#), and [Configuring the HTTP Wagon](#).

Note that due to changes made in Maven 3.1, some Maven plug-ins developed for Maven 3.0.*n* may not work properly with Maven 3.1.*n* (or later). Oracle recommends that you use the version of Maven recommended by your particular Oracle Fusion Middleware release.

6.2 Artifacts Provided

Oracle Maven Repository provides only release-level artifacts, such as 12.1.2, 12.1.3, and 12.2.1.

If a patch is required, please obtain the patch from Oracle Support, apply it to a local Oracle Home installation, and use the Maven Synchronization plug-in to update your local Maven repository.

6.3 Adding the Oracle Maven Repository to Your Project POM

You must add a repository definition to Maven.

Add a repository definition to your Maven settings.xml file or to your Maven Project Object Model (POM) files, or both. The repository definition should look like the following:

```
<repositories>
  <repository>
    <id>maven.oracle.com</id>
    <releases>
      <enabled>true</enabled>
    </releases>
    <snapshots>
      <enabled>>false</enabled>
    </snapshots>
    <url>https://maven.oracle.com</url>
    <layout>default</layout>
  </repository>
</repositories>
<pluginRepositories>
  <pluginRepository>
    <id>maven.oracle.com</id>
    <url>https://maven.oracle.com</url>
  </pluginRepository>
</pluginRepositories>
```

6.4 Configure Maven to Use a Compatible HTTP Wagon

By default, Maven uses the wagon-http component to access remote repositories including the Oracle Maven Repository.

Since the Oracle Maven Repository is protected by Oracle's Single Sign-On (SSO) technology, the Oracle Maven Repository requires a version of the wagon-http component that supports authentication with an enterprise-grade SSO solution. Prior to wagon-http version 2.8, the wagon-http component did not support the necessary configuration to be able to handle SSO-style authentication. As such, the Oracle Maven Repository requires the use of wagon-http 2.8 (or later).

By default, Maven picks up the version of the wagon-http from the local Maven installation. As of Maven 3.2.5, the wagon-http version included in the Maven distribution is wagon-http version 2.8.

Users of older versions of Maven can configure Maven to use wagon-http version 2.8 by adding the wagon-http 2.8 version:

1. Download the wagon-http 2.8 shaded JAR file from Maven Central:

<http://central.maven.org/maven2/org/apache/maven/wagon/wagon-http/2.8/wagon-http-2.8-shaded.jar>

2. Move that JAR file to the following directory:

```
MAVEN_HOME/lib/ext/
```

6.5 Configuring the HTTP Wagon

The Maven settings.xml file requires additional settings to support the Oracle Maven Repository and to configure the HTTP wagon.

Add the following <server> element to the <servers> section of the Maven settings.xml:

```
<server>
  <id>maven.oracle.com</id>
  <username>username</username>
  <password>password</password>
  <configuration>
    <basicAuthScope>
      <host>ANY</host>
      <port>ANY</port>
      <realm>OAM 11g</realm>
    </basicAuthScope>
    <httpConfiguration>
      <all>
        <params>
          <property>
            <name>http.protocol.allow-circular-redirects</name>
            <value>%b,true</value>
          </property>
        </params>
      </all>
    </httpConfiguration>
  </configuration>
</server>
```

Replace the <username> and <password> entries with your OTN user name and password. Oracle strongly recommends that you encrypt your password using the standard Maven encryption mechanisms, as described in the following:

<http://maven.apache.org/guides/mini/guide-encryption.html>

6.6 Considerations for Using the Oracle Maven Repository with Maven Without a POM

When you invoke Maven from the command-line to run a plug-in goal directly, Maven uses a standalone POM that does not use the repositories listed in the settings.xml file unless they are part of a profile that is set to be "active by default".

For example, the typical way to generate a new project from an archetype is to invoke the Maven's `archetype:generate` goal from the command line directly without a project POM in place. In order for this to work, the Oracle Maven Repository must be declared within a profile that is active by default, as shown in the following example:

```
<profiles>
  <profile>
    <id>main</id>
    <activation>
      <activeByDefault>true</activeByDefault>
    </activation>
    <repositories>
      <repository>
```

```
<id>maven.oracle.com</id>
<url>https://maven.oracle.com</url>
<layout>default</layout>
<releases>
  <enabled>true</enabled>
</releases>
</repository>
</repositories>
</profile>
</profiles>
```

6.7 Accessing the Oracle Maven Repository from an Automated Build Tool

You can access the Oracle Maven Repository from an automated build tool.

To access the Oracle Maven Repository from an automated build tool, such as Hudson Continuous Integration server, you may wish to encrypt your password and store it in your Maven settings-security.xml file.

Installing and Configuring Hudson for Continuous Integration

Hudson is a popular continuous integration server product. It enables you to define build jobs and manages the execution of those jobs for you. If necessary, it has the ability to scale up to a farm of build servers.

This chapter describes how to install and configure Hudson to automate the build process and how to integrate Hudson with Maven.

Topics:

- [Prerequisites for Installing and Configuring Hudson](#)
- [Downloading Hudson](#)
- [Installing Hudson](#)
- [Configuring the HTTP Port](#)
- [Starting Hudson](#)
- [Configuring Maven After Startup](#)
- [More Information About Hudson](#)

7.1 Prerequisites for Installing and Configuring Hudson

Before you install Hudson, you must meet the prerequisites.

Ensure that you have the following components of the continuous integration system configured before you begin installing Hudson:

- Subversion server configured and running, as directed in [Installing and Configuring Subversion for Version Control](#).
- Archiva configured and running as directed in [Installing and Configuring the Archiva Maven Repository Manager](#), which implies that you have an Oracle Fusion Middleware product installed in an Oracle home and have run the Oracle Maven Synchronization plug-in to populate Archiva.
- JDK 1.6 or higher installed on the Hudson host.
- Maven 3 installed on the Hudson host.

7.2 Downloading Hudson

You can download Hudson either as a WAR file or as Linux RPMs.

The latest production version of Hudson can be downloaded directly from the following location:

<http://hudson-ci.org/>

Hudson is distributed in two distinct versions:

- WAR file, which can either run as standalone or can be added to an existing application server installation.
- Linux RPMs compiled for specific operating systems. Package management support in the form of appropriate repositories are available to install the RPM and necessary dependencies.

This document focuses on Oracle Linux and Windows installation. Details for the other operating systems may vary from these. For instructions on various types of installations, see http://wiki.eclipse.org/Hudson-ci/Installing_Hudson.

7.3 Installing Hudson

You can install Hudson on Linux or Windows.

- On Linux:

On a Linux computer supporting YUM, run the following commands:

```
sudo wget -O /etc/yum.repos.d/hudson.repo http://hudson-ci.org/redhat/hudson.repo
sudo yum check-update
sudo yum install hudson
```

This installs Hudson as a daemon and creates a Hudson user. This user is used by the server to perform build job-related activities.

- On Windows:

You must download the Hudson WAR distribution. Then, to install it:

1. Start Hudson in standalone mode by running the following command:

```
java -jar hudson-3.2.1.war
```

2. When Hudson starts:

- a. Open the following URL in a web browser:

```
http://localhost:8080
```

- b. Navigate to **Manage Hudson**, then **Install as Windows Service**. This enables you to configure Hudson as a standard Windows service.

For instructions, see

http://wiki.eclipse.org/Hudson-ci/Installing_Hudson_Windows_Service

7.4 Configuring the HTTP Port

If you are using a single host for your artifact repository and continuous integration server, you must change the HTTP port used by Hudson.

To change the HTTP port:

- On Linux

This value is located in the `/etc/sysconfig/hudson` directory with `HUDSON_PORT`.

- On Windows

This value is located in the `c:\ciroot\hudson\etc\sysconfig\hudson` directory.

7.5 Starting Hudson

You can start Hudson and monitor its logs.

To start Hudson:

- On Linux

If you have installed Hudson as a service, you can start the application by running the following command:

```
/etc/init.d/hudson start
```

You can monitor start up by checking the logs in the following directory:

```
/var/log/hudson/hudson.log
```

Run the following command to monitor logs:

```
tail -f /var/log/hudson/hudson.log
```

- On Windows

Start Hudson on Windows as a normal service:

1. Go to **Control Panel**.
2. Navigate to **Administrative Tools**, then **Services**.
3. Select the Hudson service and click **Start**.

Hudson logs are available in the following location:

```
HUDSON_HOME/logs
```

7.6 Configuring Maven After Startup

After you install Hudson, you must take several steps to configure Maven to work with Hudson.

This section contains the following topics:

- [Starting Up Hudson for the First Time](#)
- [Configuring the JDK](#)
- [Specifying the Maven Home](#)
- [Setting Up Maven for Use by Hudson](#)
- [Installing Hudson Plug-Ins](#)
- [Integrating the Repository](#)
- [Monitoring Subversion](#)

7.6.1 Starting Up Hudson for the First Time

The first time you start Hudson, go to the home page to complete the installation:

1. Open a browser and go to `http://localhost:8080` (change the port if you modified it during installation).
2. In the list of plug-ins that is presented, scroll down to find the **Subversion, Maven 3** and **Maven 3 SNAPSHOT Monitor** options and select these options.
3. Scroll down to the bottom and click **Install**.
4. Click **Finish** to move to the Hudson home page.

The rest of the configuration in this section is continued from the Hudson home page and assumes that you are logged in.

7.6.2 Configuring the JDK

You must configure the JDK that you intend to use for direct Java build configurations. To configure:

1. From the Hudson home page, navigate to **Manage Hudson**, then **Configure System**.
2. In the **Configure System** screen, scroll down to the JDK section and click **Add JDK**. Deselect the option **Install automatically** and then enter a name, for example, `jdk1.7.0` and add the complete path of your installed JDK.

For example: `/ciroot/product_binaries/jdk1.7.0`.

3. Scroll down to the bottom of the page and click **Save**.

7.6.3 Specifying the Maven Home

You must specify the Maven 3 location so that Hudson knows where Maven is located. To do so:

1. From the Hudson home page, navigate to **Manage Hudson**, then **Configure System**.
2. On the **Configure System** screen, scroll down to the section **Maven 3**.
3. Click **Add Maven**, then deselect the option **Install automatically** and enter a name and the path to the Maven installation, as shown in the following image:

Maven 3

Maven 3 installations	
<div style="display: flex; align-items: center;"> ⋮ Maven 3 ? </div> <div style="margin-top: 5px;"> <div style="display: flex; justify-content: space-between;"> Name <input type="text" value="Maven 3.0.4"/> ? </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> MAVEN_HOME <input type="text" value="/ciroot/apache-maven-3.0.4"/> ? </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Install automatically ? </div> </div>	<div style="margin-bottom: 10px;">Delete Maven 3</div> <div>Add Maven 3</div>

List of Maven 3 installations on this system

4. Scroll down to the bottom of the page and click **Save**.

7.6.4 Setting Up Maven for Use by Hudson

To utilize Maven settings from Hudson, embed the settings.xml content into a settings object in Hudson's global Maven configuration:

1. From the Hudson home page, navigate to **Manage Hudson**, then **Maven 3 Configuration**.
2. Click **Add**.
3. For Type, select **SETTINGS**.

Documents

Refresh
+ Add
- Remove

	ID	Type
📄	d3d95231-81a1-4232-8494-041c3b394c30	SETTINGS

ID

Type

Name

Description

Attributes	Key	Value
	CREATED	2012-08-23T13:36:07.394-0700
	CREATED_BY	unknown
	UPDATED	2012-08-23T13:42:26.801-0700

```

<settings>
<profiles>
<profile>
  <id>default</id>
  <repositories>
  <repository>
    <id>archiva-releases</id>
    <name>Archiva Releases</name>
    <releases>
      <enabled>true</enabled>
      <updatePolicy>always</updatePolicy>
      <checksumPolicy>warn</checksumPolicy>
    </releases>
    <snapshots>
      <enabled>false</enabled>
      <updatePolicy>never</updatePolicy>
      <checksumPolicy>fail</checksumPolicy>
    </snapshots>
    <url>http://localhost:8092/archiva/repository/internal</url>
  </repository>
  </repositories>
  <layout>default</layout>

```

Update
Revert

4. Provide a name and optional description.
5. Find the settings.xml on your file system (that you have configured in [Installing and Configuring Maven for Build Automation and Dependency Management](#)). It is located at `/$HOME/.m2/settings.xml`. Copy the contents into the large text field at the bottom of the page..

6. Click **Save**.

Note:

Oracle recommends that you replace any localhost URL references in the settings.xml with fully qualified domain names or IP addresses because Hudson builds can eventually occur on non-local build hosts.

7.6.5 Installing Hudson Plug-Ins

Hudson jobs may require job-specific customizations of environment variables. Because Hudson does not support this by default, you must install an additional plug-in. To install the plug-in:

1. From the Hudson home page, navigate to **Manage Hudson**, then **Manage Plugins**.
2. Select **Available**.
3. Select **Hudson Setenv Plugin**.
4. Click **Install**.
5. After the installation completes, use the restart option in Hudson to enable the plug-in.

7.6.6 Integrating the Repository

To configure automatic builds when changes are checked in, you must configure Hudson to monitor the artifact repository for SNAPSHOT deployment changes. Such changes trigger builds of affected components that have dependencies on the changed artifacts. To configure Hudson to monitor the artifact repository:

1. From the Hudson home page, navigate to **Manage Hudson**, then **System Configuration**.
2. In the main system configuration panel under System Configuration, select **Maven 3 SNAPSHOT Monitor**. Enter the path to Maven repository.

Maven 3 SNAPSHOT Monitor

Maven Repository URL	<input type="text" value="http://localhost:8092/archiva/internal"/>
User	<input type="text" value="hudson"/>
Password	<input type="password" value="....."/>

3. In [Installing and Configuring the Archiva Maven Repository Manager](#), you created a continuous integration specific user for continuous integration server access to the repository. Set the **User** and **Password** for the continuous integration user.

7.6.7 Monitoring Subversion

In addition to monitoring the artifact repository for updated dependencies, the continuous integration server must constantly check the source control system for updates and trigger project builds accordingly. Unlike repository monitoring, software configuration management monitoring must be uniquely configured per build

configuration. As you create new build configurations, you must set the Subversion location information for the related project. For more information, see [Automating the Build with Hudson](#).

Subversion support comes with the base Hudson distribution. Other source control systems may require separate Hudson plug-in installation.

7.7 More Information About Hudson

This document is meant as a quick guide for starting and running Hudson and does not provide extensive detail on Hudson operations.

You can find the primary source of the official documentation on Hudson in the following location:

<http://wiki.hudson-ci.org/display/HUDSON/Use+Hudson>

For new users, you can find introductory guides to Hudson in the following location:

http://wiki.eclipse.org/Hudson-ci/Using_Hudson

The Hudson book is located in the following location:

http://wiki.eclipse.org/The_Hudson_Book

About Maven Version Numbers

In a Maven environment, it is very important to understand the use of version numbers. A well thought out strategy can greatly simplify your dependency management workload. This chapter presents important concepts about how version numbers work in Maven in general, and also some specific details of how the Oracle-supplied artifacts use version numbers and how you should use them when referring to Oracle artifacts.

Topics:

- [How Version Numbers Work in Maven](#)
- [About the SNAPSHOT Qualifier](#)
- [About Version Range References](#)
- [How Maven Version Numbers Are Used in Oracle Provided Artifacts](#)

8.1 How Version Numbers Work in Maven

It is important to understand how Maven's version numbers work.

Maven's versioning scheme uses the following standards:

- MajorVersion
- MinorVersion
- IncrementalVersion
- BuildNumber
- Qualifier

For example:

- MajorVersion: 2.0
- MinorVersion: 1.2.1
- IncrementalVersion: 1.2-SNAPSHOT
- BuildNumber: 1.4.2-12
- Qualifier: 1.2-beta-2

All versions with a qualifier are older than the same version without a qualifier (release version).

For example:

1.2-beta-2 is older than 1.2.

Identical versions with different qualifier fields are compared by using basic string comparison.

For example:

1.2-beta-2 is newer than 1.2-alpha-6.

If you do not follow Maven versioning standards in your project versioning scheme, then for version comparison, Maven interprets the entire version as a simple string. Maven and its core plug-ins use version comparison for a number of tasks, most importantly, the release process.

If you use a nonstandard versioning scheme, Maven release and version plug-in goals might not yield the expected results. Because basic string comparison is performed on nonstandard versions, version comparison calculates the order of versions incorrectly in some cases.

For example, Maven arranges the version list in the following manner:

```
1.0.1.0
1.0.10.1
1.0.10.2
1.0.9.3
```

Version 1.0.9.3 should come before 1.0.10.1 and 1.0.10.2, but the unexpected fourth field (.3) forced Maven to evaluate the version as a string.

An example of this effect on Maven is found in the Maven Versions plug-in. The Maven Versions plug-in provides goals to check your project dependencies for currency in a different ways. One useful goal is `versions:dependency-updates-report`. This goal examines a project's dependency hierarchy and reports which ones have newer releases available. When you are coordinating a large release, this goal can help you to find stale references in dependency configuration. If Maven incorrectly identifies a newer release, then it is also reported incorrectly in the plug-in. Given the preceding example sequence, if your current reference was 1.0.10.2, then the plug-in would report 1.0.9.3 as a newer release.

Version resolution is also very important if you intend to use version ranges in your dependency references. See [About Version Range References](#) for information about version changes.

8.2 About the SNAPSHOT Qualifier

Maven treats the SNAPSHOT qualifier differently from all others. If a version number is followed by `-SNAPSHOT`, then Maven considers it the "as-yet-unreleased" version of the associated `MajorVersion`, `MinorVersion`, or `IncrementalVersion`.

In a continuous integration environment, the SNAPSHOT version plays a vital role in keeping the integration build up-to-date while minimizing the amount of rebuilding that is required for each integration step.

SNAPSHOT version references enable Maven to fetch the most recently deployed instance of the SNAPSHOT dependency at a dependent project build time. Note that the SNAPSHOT changes constantly. Whenever an agent deploys the artifact, it is updated in the shared repository. The SNAPSHOT dependency is refetched on a developer's machine or it is updated in every build. This ensures that dependencies are updated and integrated with the latest changes without the need for changes to the project dependency reference configuration.

Usually, only the most recently deployed SNAPSHOT, for a particular version of an artifact, is kept in the artifact repository. Although the repository can be configured to maintain a rolling archive with a number of the most recent deployments of a given artifact, the older instances are typically used only for troubleshooting purposes and do not play a role in integration.

Continuous build servers that include the ability to define and execute a job based on a Maven project, such as Hudson, can be configured to recognize when a SNAPSHOT artifact is updated and then rebuild projects that have a dependency on the updated artifact.

For example, a Hudson build configuration that maps to a Maven Project Object Model has a SNAPSHOT dependency. Hudson periodically checks the artifact repository for SNAPSHOT updates. When it detects the update of the project's dependency, it triggers a new build of the project to ensure that integration is performed with the most recent version of the dependency. If other projects have a dependency on this project, they too are rebuilt with updated dependencies.

8.3 About Version Range References

Maven enables you to specify a range of versions that are acceptable to use as dependencies.

Table 8-1 shows a range of version specifications:

Table 8-1 *Version Range References*

Range	Meaning
(,1.0]	$x \leq 1.0$
1.0	It generally means 1.0 or a later version, if 1.0 is not available. Various Maven plug-ins may interpret this differently, so it is safer to use one of the other, more specific options.
[1.0]	Exactly 1.0
[1.2,1.3]	$1.2 \leq x \leq 1.3$
[1.0,2.0)	$1.0 \leq x < 2.0$
[1.5,)	$x \geq 1.5$
(,1.0],[1.2,)	$x \leq 1.0$ or $x \geq 1.2$. Multiple sets are separated by a comma.
(,1.1),(1.1,)	This excludes 1.1 if it is known not to work in combination with the library.

When Maven encounters multiple matches for a version reference, it uses the highest matching version. Generally, version references should be only as specific as required so that Maven is free to choose a new version of dependencies where appropriate, but knows when a specific version must be used. This enables Maven to choose the most appropriate version in cases where a dependency is specified at different points in the transitive dependency graph, with different versions. When a conflict like this occurs, Maven chooses the highest version from all references.

Given the option to use version ranges, you may wonder if there is still utility in using SNAPSHOT versions. Although you can achieve some of the same results by using a

version range expression, a SNAPSHOT works better in a continuous build system for the following reasons:

- Maven artifact repository managers deal with SNAPSHOTs more efficiently than next version ranges. Because a single artifact can be deployed multiple times in a day, the number of unique instances maintained by the repository can increase very rapidly.
- Non-SNAPSHOT release versions are meant to be maintained indefinitely. If you are constantly releasing a new version and incrementing the build number or version, the storage requirements can quickly become unmanageable. Repository managers are designed to discard older SNAPSHOTs to make room for new instances so the amount of storage required stays constant.
- SNAPSHOTs are also recognized by Maven and Maven's release process, which affords you some benefits when performing a release build.

8.4 How Maven Version Numbers Are Used in Oracle Provided Artifacts

You should understand how Maven version numbers are used in Oracle provided artifacts.

The following are important scenarios where Maven version numbers are used in Oracle provided artifacts:

- In the Maven coordinates of the artifact, that is, in the `project.version` of the artifact's POM, as described in [About Version Numbers in Maven Coordinates](#)
- In the dependency section of POMs to refer to other artifacts, as described in [About Version Number Ranges in Dependencies](#)

8.4.1 About Version Numbers in Maven Coordinates

The version number of the artifact defined in the POM file is the same as the version number of the released product, for example, 12.2.1.0.0, expressed using five digits, as described in the following:

In `x.x.x-y-z`:

- `x.x.x` is the release version number, for example 12.2.1.
- `y` is the PatchSet number, for example 0, 1, 2, 3, ... with no leading zeros.
- `z` is the Bundle Patch number, for example 0, 1, 2, 3, ... with no leading zeros.
- The periods and hyphens are literals.

Note:

The version numbers of artifacts (as specified in `project.version` in the POM) use a different format than version number ranges used in dependencies (as specified in `project.dependencies.dependency.version` in the POM).

The release version number of Oracle-owned components do not change by a one-off patch. The release version number changes with a release and always matches the release, even if the component has not changed from the previous release.

The PatchSet (fourth position) changes when you apply a PatchSet. The Bundle Patch (fifth position) changes when you apply a Bundle Patch, PatchSet Update, or equivalent (the name of this type of patch varies from product to product).

Following are examples of valid version numbers:

```
12.2.1-0-0    12.2.1-1-0    12.2.1-2-0
12.2.1-0-1    12.2.1-1-1    12.2.1-2-1
              ...
12.2.1-0-10   12.2.1-1-1    12.2.1-2-1
```

8.4.2 About Version Number Ranges in Dependencies

The following are important scenarios where dependencies on Oracle-provided Maven artifacts are specified:

- Inside the POM files of artifacts that are part of the Oracle product
- Inside POM files that you include in your own projects

Specify the version number range in both scenarios. This section describes how version number ranges are specified in Oracle-provided artifacts and when you are declaring a dependency on an Oracle-provided artifact.

When specifying dependencies on other artifacts, use the most specific correct syntax to ensure that the definition does not allow an incorrect or unsuitable version of the dependency to be used.

In `[x.x.x,y.y.y)`:

- `x.x.x` is the release version number, for example 12.1.3
- `y.y.y` is the next possible release version number, for example. 12.2.1
- Brackets, periods, commands and parenthesis are literals

An example of the correct way to specify a dependency is as follows:

```
12.1.3,12.2.1)
```

As [Table 8-1](#) shows, the previous example means that the latest available version is 12.1.3 or greater, but less than 12.2.1.

The version number scheme used by Oracle-provided artifacts ensures correct sorting of version numbers, for example, Maven resolves the following versions in the order shown (from oldest to newest):

```
12.1.2-0-0, 12.1.2-0-1, 12.1.2-0-2, 12.1.2-0-10, 12.1.2-1-0, 12.1.2-1-1, 12.1.2-1-2,
12.1.2-1-10, 12.1.3-0-0 12.2.1-0-0
```

If it is necessary to specify a dependency which relies on a certain PatchSet or Bundle Patch, for example, when a new API is introduced, you must include the fourth or fourth and fifth digits respectively.

For example:

```
[12.1.2-2,12.1.3)    depends on 12.1.2 with PatchSet 2
[12.1.2-2-5,12.1.3) depends on 12.1.2 with PatchSet 2 and Bundle Patch 5
```

Customizing the Build Process with Maven POM Inheritance

Oracle provides a set of common parent Project Object Models (POMs) to enable easy customization of the build process for all projects targeted at a particular product, runtime environment, or for all projects targeted at Oracle Fusion Middleware.

Each of the Oracle-provided Maven archetypes have their parent POM set to an Oracle-provided common parent specific to the target runtime environment that the archetype is for, such as WebLogic Server and Coherence. The common parent POMs, one per product or target runtime environment, in turn have their parent POM set to an Oracle Fusion Middleware common parent.

Topics:

- [Inheritance of POMs and Archetypes](#)
- [Customizing the Build Process](#)

9.1 Inheritance of POMs and Archetypes

The common POMs and Oracle-provided archetypes form the following inheritance hierarchy:

- Provided by 12.1.2:

```
com.oracle.maven:oracle-common:12.1.2-0-0
- com.oracle.weblogic:wls-common:12.1.2-0-0
  - com.oracle.weblogic.archetype:basic-webapp:12.1.2-0-0
  - com.oracle.weblogic.archetype:basic-webapp-ejb:12.1.2-0-0
  - com.oracle.weblogic.archetype:basic-webservice:12.1.2-0-0
  - com.oracle.weblogic.archetype:basic-mdb:12.1.2-0-0
- com.oracle.coherence:gar-common:12.1.2-0-0
  - com.oracle.coherence:maven-gar-archetype:12.1.2-0-0
```

- Provided by 12.1.3:

```
com.oracle.maven:oracle-common:12.1.3-0-0
- com.oracle.weblogic:wls-common:12.1.3-0-0
  - com.oracle.weblogic.archetype:basic-webapp:12.1.3-0-0
  - com.oracle.weblogic.archetype:basic-webapp-ejb:12.1.3-0-0
  - com.oracle.weblogic.archetype:basic-webservice:12.1.3-0-0
  - com.oracle.weblogic.archetype:basic-mdb:12.1.3-0-0
- com.oracle.coherence:gar-common:12.1.3-0-0
  - com.oracle.coherence:maven-gar-archetype:12.1.3-0-0
- com.oracle.soa:sar-common:12.1.3-0-0
  - com.oracle.soa.archetype:oracle-soa-application:12.1.3-0-0
  - com.oracle.soa.archetype:oracle-soa-project:12.1.3-0-0
- com.oracle.servicebus:project:12.1.3-0-0
  - com.oracle.servicebus:sbar-project-common:12.1.3-0-0
  - com.oracle.servicebus.archetype:oracle-servicebus-project:12.1.3-0-0
```

- com.oracle.servicebus:sbar-system-common:12.1.3-0-0
- missing
- com.oracle.adf.archetype:oracle-adffaces-ejb:12.1.3-0-0

- **Provided by 12.2.1:**

- com.oracle.maven:oracle-common:12.2.1-0-0
- com.oracle.weblogic:wls-common:12.2.1-0-0
 - com.oracle.weblogic.archetype:basic-webapp:12.2.1-0-0
 - com.oracle.weblogic.archetype:basic-webapp-ejb:12.2.1-0-0
 - com.oracle.weblogic.archetype:basic-webservice:12.2.1-0-0
 - com.oracle.weblogic.archetype:basic-mdb:12.2.1-0-0
- com.oracle.coherence:gar-common:12.2.1-0-0
 - com.oracle.coherence:maven-gar-archetype:12.2.1-0-0
- com.oracle.soa:sar-common:12.2.1-0-0
 - com.oracle.soa.archetype:oracle-soa-application:12.2.1-0-0
 - com.oracle.soa.archetype:oracle-soa-project:12.2.1-0-0
- com.oracle.servicebus:project:12.2.1-0-0
 - com.oracle.servicebus:sbar-project-common:12.2.1-0-0
 - com.oracle.servicebus.archetype:oracle-servicebus-project:12.2.1-0-0
 - com.oracle.servicebus:sbar-system-common:12.2.1-0-0
- missing
 - com.oracle.adf.archetype:oracle-adffaces-ejb:12.2.1-0-0

9.2 Customizing the Build Process

If you want to customize your build process, for example, setting some default properties, setting up default settings for a particular plug-in, or defining Maven profiles, then you can add your definitions to the appropriate parent POM.

For example, if you add definitions to `com.oracle.weblogic:wls-common:12.2.1-0-0`, all projects associated with this parent are affected, which includes all projects that you have created from the WebLogic Maven archetypes (unless you modify their parents) and projects that you have created manually.

Doing this minimizes the number of settings needed in each project POM. For example, if you are going to deploy all of builds to the same test server, then you can provide the details for the test server by adding the appropriate build, plug-ins, and plug-in section for `com.oracle.weblogic:wls-maven-plugin:12.2.1-0-0` as shown in the following example of a customized parent WebLogic POM:

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/
maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>com.oracle.weblogic.archetype</groupId>
  <artifactId>wls-common</artifactId>
  <version>12.2.1-0-0</version>
  <packaging>pom</packaging>
  <name>wls-common</name>
  <parent>
    <groupId>com.oracle.maven</groupId>
    <artifactId>oracle-common</artifactId>
    <version>12.2.1-0-0</version>
  </parent>
  <build>
    <plugins>
      <plugin>
        <groupId>com.oracle.weblogic</groupId>
        <artifactId>wls-maven-plugin</artifactId>
        <version>12.2.1-0-0</version>
```



```

    <executions>
      <execution>
        <phase>pre-integration-test</phase>
        <goals>
          <goal>deploy</goal>
        </goals>
        <configuration>
          <user>weblogic</user>
          <password>welcome1</password>
          <verbose>true</verbose>
        </configuration>
      </execution>
    </executions>
    <configuration>
      <middlewareHome>/home/oracle/fmwhome</middlewareHome>
    </configuration>
  </plugin>
</plugins>
</build>
</project>

```

Similarly, if you want to affect all projects targeted at any Oracle Fusion Middleware runtime, place your customizations in `com.oracle.maven:oracle-common:12.2.1-0-0`.

If you are using a shared internal repository, then after you customize the parent POMs, publish them into your shared Maven repository or repositories.

To see how these customizations are brought into your projects, you can use the following command, from your project's directory, to see the full POM that will be used to build your project:

```
mvn help:effective-pom
```

If you want to define more than one set of shared properties in the parent POM, for example, one set for your test environment, and one for your QA environment, Oracle encourages you to explore the use of Maven profiles. For more information, see:

<http://books.sonatype.com/mvnref-book/reference/index.html>

Profiles enable you to switch various settings on for a particular build by setting a command-line argument, or based on the presence or absence of various properties in the POM.

Building Java EE Projects for WebLogic Server with Maven

You can use the WebLogic Maven archetypes to create, build, and deploy WebLogic Server Java EE applications.

Topics:

- [Introduction to Building a Java EE Project with Maven](#)
- [Using the Basic WebApp Maven Archetype](#)
- [Using the Basic WebApp with EJB Maven Archetype](#)
- [Using the Basic WebService Maven Archetype](#)
- [Using the Basic MDB Maven Archetype](#)

10.1 Introduction to Building a Java EE Project with Maven

A Maven plug-in and four archetypes are provided for Oracle WebLogic Server.

[Table 10-1](#) describes the Maven coordinates.

Table 10-1 *Maven Coordinates with WebLogic Server*

Artifact	groupId	artifactId	version
WebLogic Server plug-in	com.oracle.weblogic	weblogic-maven-plugin	12.2.1-0-0
Basic WebApp archetype	com.oracle.weblogic.archetype	basic-webapp	12.2.1-0-0
WebApp with EJB archetype	com.oracle.weblogic.archetype	basic-webapp-ejb	12.2.1-0-0
Basic MDB archetype	com.oracle.weblogic.archetype	basic-mdb	12.2.1-0-0
Basic WebServices archetype	com.oracle.weblogic.archetype	basic-webservice	12.2.1-0-0

As with Maven archetypes in general, the Oracle WebLogic Maven archetype provides a set of starting points and examples for building your own applications.

10.2 Using the Basic WebApp Maven Archetype

To build a Java EE project using the basic WebApp Maven archetype, you create the basic project, then customize, compile and package it. Then you deploy it and test it.

This section contains the following topics:

- [Creating a Basic WebApp Project](#)
- [Customizing the Project Object Model File to Suit Your Environment](#)
- [Compiling Your Java EE Project](#)
- [Packaging Your Java EE Project](#)
- [Deploying Your Java EE Project to the WebLogic Server Using Maven](#)
- [Deploying Your Java EE Project to the WebLogic Server Using Different Options](#)
- [Testing Your Basic WebApp Project](#)

10.2.1 Creating a Basic WebApp Project

To create a new Basic WebApp project using the Maven archetype, you must issue a command similar to the following:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.weblogic.archetype
  -DarchetypeArtifactId=basic-webapp
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-basic-webapp-project
  -Dversion=1.0-SNAPSHOT
```

This command runs Maven's `archetype:generate` goal which enables you to create a new project from an archetype. [Table 10-2](#) describes the parameters.

Table 10-2 Parameters for the Basic WebApp Project

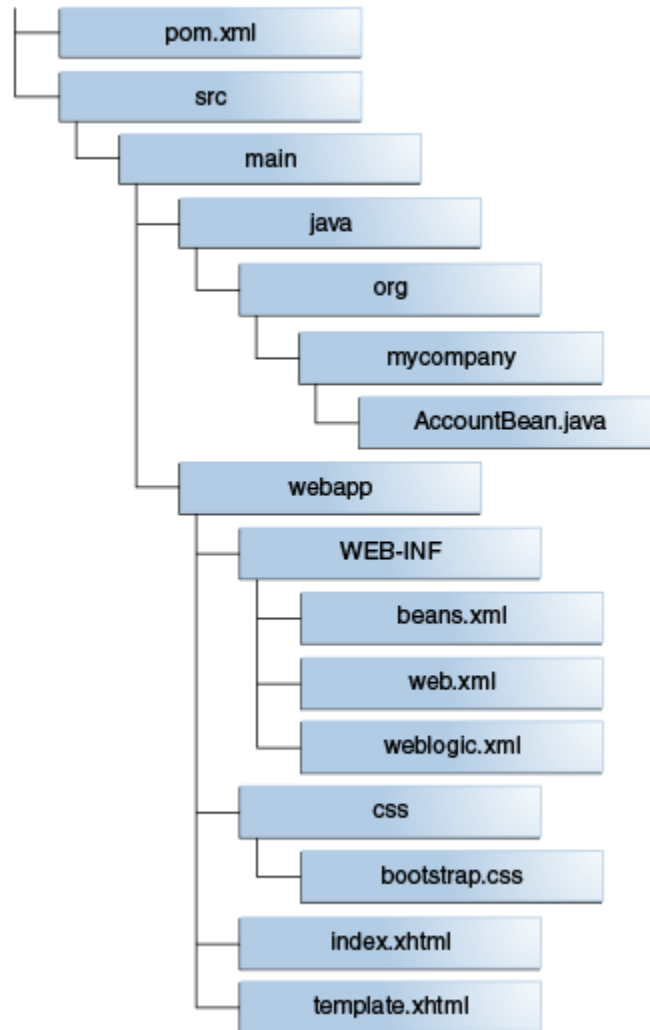
Parameter	Purpose
<code>archetypeGroupId</code>	The group ID of the archetype that you want to use to create the new project. This must be <code>com.oracle.weblogic</code> as shown in the preceding example.
<code>archetypeArtifactId</code>	The archetype artifact ID of the archetype that you want to use to create the new project. This must be <code>basic-webapp</code> as shown in the preceding example.
<code>archetypeVersion</code>	The version of the archetype that you want to use to create the new project. This must be <code>12.2.1-0-0</code> as shown in the preceding example.
<code>groupId</code>	The group ID for your new project. This usually starts with your organization's domain name in reverse format.
<code>artifactId</code>	The artifact ID for your new project. This is usually an identifier for this project.
<code>version</code>	The version number for your new project. This is usually <code>1.0-SNAPSHOT</code> for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

If you want to limit Maven to look only into a particular repository, you can specify the `-DarchetypeCatalog` option. Specify the value as `local` to look only in your local repository, or specify the `serverId` for the repository you want Maven to look in. This limits the number of archetypes that you are shown and makes the command execute much faster.

After creating your project, it contains the following files:



These files make up a small sample application, which you can deploy as is. You can use this application as a starting point for building your own application.

[Table 10-3](#) describes the files included in the project.

Table 10-3 Files Created for the Basic WebApp project

File	Purpose
pom.xml	The Maven Project Object Model (POM) file that describes your new project. It includes the Maven coordinates that you specified for your project. It also includes the appropriate plug-in definitions needed to use the WebLogic Maven plug-in to build your project.
Files under <code>src/main/java</code>	An example Enterprise Java Bean that is used by the Web application to store data.
All other files	HTML and other files that make up the web application user interface.

After you have written your project code, you can use Maven to build the project. It is also possible to build the sample as is.

10.2.2 Customizing the Project Object Model File to Suit Your Environment

The Project Object Model (POM) file that is created by the archetype is sufficient in most cases. Review the POM and update any of the settings where the provided default values differ from what you use in your environment.

If you are using an internal Maven Repository Manager, like Archiva, add a `pluginRepository` to the POM file. The following is an example; you can modify it to suit your environment:

```
<pluginRepositories>
  <pluginRepository>
    <id>archiva-internal</id>
    <name>Archiva Managed Internal Repository</name>
    <url>http://localhost:8081/archiva/repository/internal/</url>
    <releases>
      <enabled>true</enabled>
    </releases>
    <snapshots>
      <enabled>>false</enabled>
    </snapshots>
  </pluginRepository>
</pluginRepositories>
```

10.2.3 Compiling Your Java EE Project

To compile the source code in your project, such as Java Beans, Servlets, and JSPs, use the following command:

```
mvn compile
```

This command uses the standard Maven plug-ins to compile your source artifacts into class files. You can find the class files in the `target` directory of your project.

10.2.4 Packaging Your Java EE Project

To build the deployment archive, for example WAR or EAR file, use the following command:

```
mvn package
```

This command uses the standard Maven plug-ins to package your compiled artifacts and metadata into a deployment archive. When you run a Maven goal like `package`, Maven runs not just that goal, but all of the goals up to and including the goal you name. This is very similar to a standard Java EE application, except that if you have WebLogic deployment descriptors in your project, they are also packaged into the deployment archive.

The deployment archive, in this case a WAR file, is available in the `target` directory of your project.

10.2.5 Deploying Your Java EE Project to the WebLogic Server Using Maven

To deploy the deployment archive using Maven, use the following command:

```
mvn pre-integration-test
```

This command executes the `deploy` goal in the WebLogic Maven plug-in. This goal supports all standard types of deployment archives.

10.2.6 Deploying Your Java EE Project to the WebLogic Server Using Different Options

After you have packaged your project, you can also deploy it to the WebLogic Server using any of the other existing (non-Maven) mechanisms. For example, the WebLogic Administration Console, or an ANT or WLST script.

10.2.7 Testing Your Basic WebApp Project

You can test the Basic WebApp by visiting the following URL on the WebLogic Server where you deployed it:

1. Enter the following URL:

```
http://servername:7001/basicWebapp/index.xhtmll
```

The following shows the user interface for the Basic WebApp:

Basic Webapp

This project shows a basic example of a web application working with JSF and CDI to simulate the deposit functionality of bank system.

2. Provide the **Account Name** and **Amount**, then select **Deposit** to see how the application works.

10.3 Using the Basic WebApp with EJB Maven Archetype

To build a Java EE project using the basic WebApp with EJB Maven archetype, you create the basic project, then customize, compile and package it. Then you deploy it and test it.

To use the Basic WebApp with EJB project using the Maven archetype:

1. Create a new Basic WebApp project using the Maven archetype, executing a command similar to the following:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.weblogic.archetype
  -DarchetypeArtifactId=basic-webapp-ejb
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-basic-webapp-ejb-project
  -Dversion=1.0-SNAPSHOT
```

This command runs Maven's `archetype:generate` goal which enables you to create a new project from an archetype. [Table 10-4](#) describes the parameters.

Table 10-4 Parameters for the Basic WebApp with EJB Project

Parameter	Purpose
<code>archetypeGroupId</code>	The group ID of the archetype that you want to use to create the new project. This must be <code>com.oracle.weblogic</code> as shown in the preceding example.
<code>archetypeArtifactId</code>	The artifact ID of the archetype that you want to use to create the new project. This must be <code>basic-webapp-ejb</code> as shown in the preceding example.

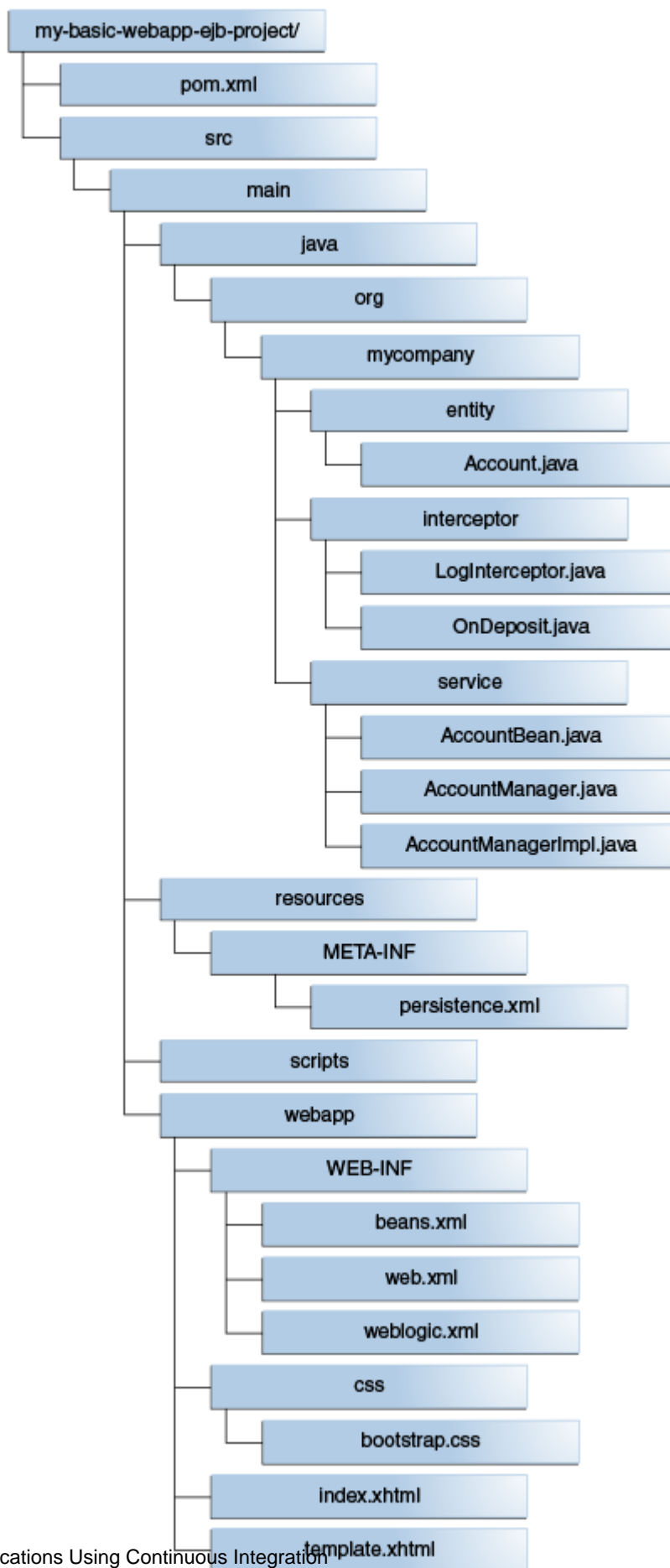
Table 10-4 (Cont.) Parameters for the Basic WebApp with EJB Project

Parameter	Purpose
archetypeVersion	The version of the archetype that you want to use to create the new project. This must be 12.2.1-0-0 as shown in the preceding example.
groupId	The group ID for your new project. This usually starts with your organization's domain name in reverse format.
artifactId	The artifact ID for your new project. This is usually an identifier for this project.
version	The version number for your new project. This is usually 1.0-SNAPSHOT for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

After creating your project, it contains the following files:



These files make up a small sample application, which you can deploy as is. You can use this application as a starting point for building your own application.

[Table 10-5](#) describes the files included in the project.

Table 10-5 Files Created for the Basic WebApp with EJB Project

File	Purpose
<code>pom.xml</code>	The Maven Project Object Model (POM) file that describes your new project. It includes the Maven coordinates that you specified for your project. It also includes the appropriate plug-in definitions to use the WebLogic Maven plug-in to build your project.
Files under <code>src/main/java</code>	An example Enterprise Java Bean that is used by the web application to store data.
All other files	HTML and other files that make up the web application user interface.

2. After you have written your project code, you can use Maven to build the project. It is also possible to build the sample as is.
3. Customize the POM to suit your environment. See [Customizing the Project Object Model File to Suit Your Environment](#).
4. Compile your Basic WebApp with EJB Project. See [Compiling Your Java EE Project](#).
5. Package your Basic WebApp with EJB Project. See [Packaging Your Java EE Project](#).
6. Deploy your Basic WebApp with EJB Project. For information about deploying it using Maven, see [Deploying Your Java EE Project to the WebLogic Server Using Maven](#). For information about deploying it using other options, see [Deploying Your Java EE Project to the WebLogic Server Using Different Options](#).
7. Test your Basic WebApp with EJB Project.

You can test the Basic WebApp with EJB by visiting the following URL on the WebLogic Server where you deployed it:

```
http://servername:7001/basicWebapp/index.xhtml
```

The following shows the user interface for the Basic WebApp with EJB:

Basic Webapp And EJB

This project shows a basic example of a web application working with JSF, EJB and JPA to simulate the deposit functionality of bank system.

8. Provide the **Account Name** and **Amount**, then select **Deposit** to see how the application works.

10.4 Using the Basic WebService Maven Archetype

To build a Java EE project using the basic WebService Maven archetype, you create the basic project, then customize, compile and package it. Then you deploy it and test it.

To use the Basic WebService project using the Maven Archetype:

1. Create a new Basic WebService project using the Maven archetype by issuing a command similar to the following:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.weblogic.archetype
  -DarchetypeArtifactId=basic-webservice
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-basic-webservice-project
  -Dversion=1.0-SNAPSHOT
```

This command runs Maven's `archetype:generate` goal, which enables you to create a new project from an archetype. [Table 10-6](#) describes the parameters.

Table 10-6 Parameters for the Basic WebService Project

Parameter	Purpose
<code>archetypeGroupId</code>	The group ID of the archetype that you want to use to create the new project. This must be <code>com.oracle.weblogic</code> as shown in the preceding example.
<code>archetypeArtifactId</code>	The artifact ID of the archetype that you want to use to create the new project. This must be <code>basic-webservice</code> as shown in the preceding example.

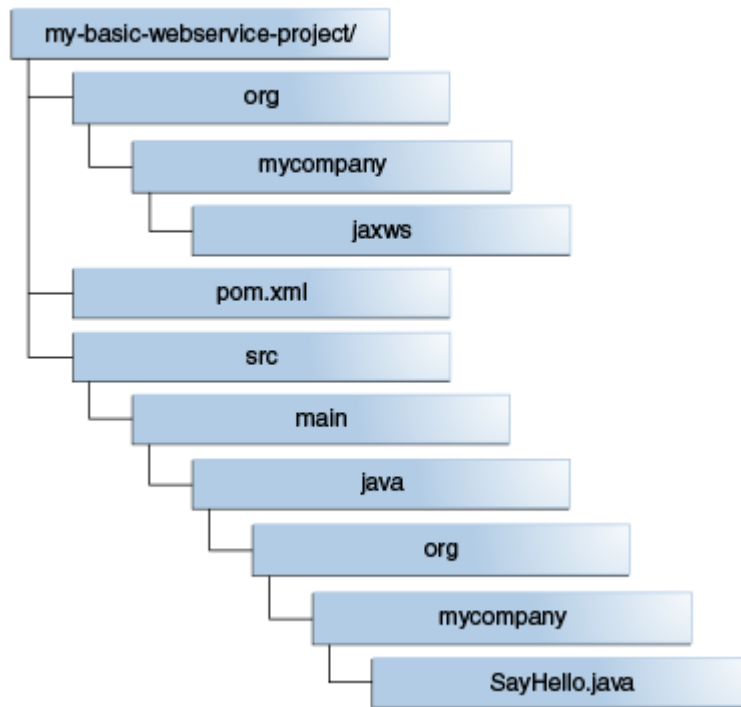
Table 10-6 (Cont.) Parameters for the Basic WebService Project

Parameter	Purpose
archetypeVersion	The version of the archetype that you want to use to create the new project. This must be 12.2.1-0-0 as shown in the preceding example.
groupId	The group ID for your new project. This usually starts with your organization's domain name in reverse format.
artifactId	The artifact ID for your new project. This is usually an identifier for this project.
version	The version number for your new project. This is usually 1.0-SNAPSHOT for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

After creating your project, it contains the following files:



These files make up a small sample application, which you can deploy as is. You can use this application as a starting point for building your own application.

[Table 10-7](#) describes the files included in the project.

Table 10-7 Files Created for the Basic WebService Project

File	Purpose
pom.xml	The Maven Project Object Model (POM) file that describes your new project. It includes the Maven coordinates that you specified for your project, and it also includes the appropriate plug-in definitions to use the WebLogic Maven plug-in to build your project.
SayHello.java	An example Web Service.

- After you have written your project code, you can use Maven to build the project. It is also possible to build the sample as is.
- Customize the POM to suit your environment. See [Customizing the Project Object Model File to Suit Your Environment](#).
- Compile your Basic WebService Project. See [Compiling Your Java EE Project](#).
- Package your Basic WebService Project. See [Packaging Your Java EE Project](#).
- Deploy your Basic WebService Project. For information about deploying it using Maven, see [Deploying Your Java EE Project to the WebLogic Server Using Maven](#). For information about deploying it using other options, see [Deploying Your Java EE Project to the WebLogic Server Using Different Options](#).
- Test your Basic WebService Project.

You can test the Basic WebService by visiting the following URL, on the WebLogic Server where you have deployed it:

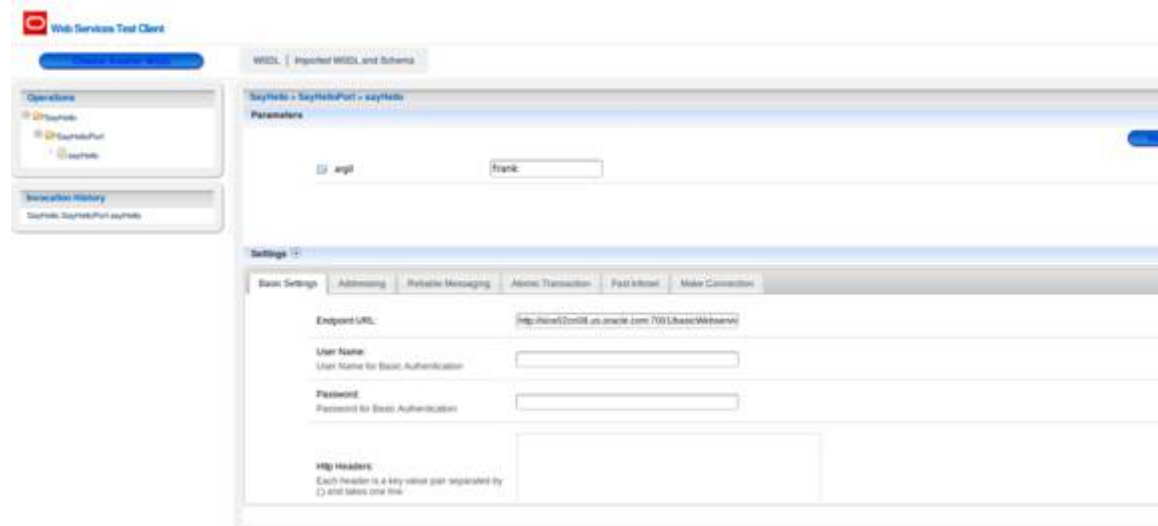
`http://servername:7001/basicWebservice/SayHello`

The following shows the user interface for the Basic WebService:

Web Services

Endpoint	Information
Service Name: {http://example.org}SayHello	Address: http://host/mycompany.com:7001/basicWebservice/Sayhello
Port Name: {http://example.org}SayHelloPort	WSDL: http://host/mycompany.com:7001/basicWebservice/SayHello?wsdl Test
	Implementation class: org.mycompany.SayHello

- You can access the WSDL for the web service, and you can open the WebLogic Web Services Test Client by selecting the **Test** link. This enables you to invoke the web service and observe the output.
- To test the web service, select **SayHello** operation in the left hand pane, then enter a value for **arg0** as shown in the following example, and select **Invoke**.



10. Scroll down to see the test results, as shown in the following example:



10.5 Using the Basic MDB Maven Archetype

To build a Java EE project using the basic MDB Maven archetype, you create the basic project, then customize, compile and package it. Then you deploy it and test it.

To use the Basic MDB project using the Maven Archetype:

1. Create a new Basic MDB project using the Maven archetype, by running a command similar to the following:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.weblogic.archetype
  -DarchetypeArtifactId=basic-mdb
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-basic-mdb-project
  -Dversion=1.0-SNAPSHOT
```

This command runs Maven's `archetype:generate` goal which enables you to create a new project from an archetype. [Table 10-8](#) describes the parameters.

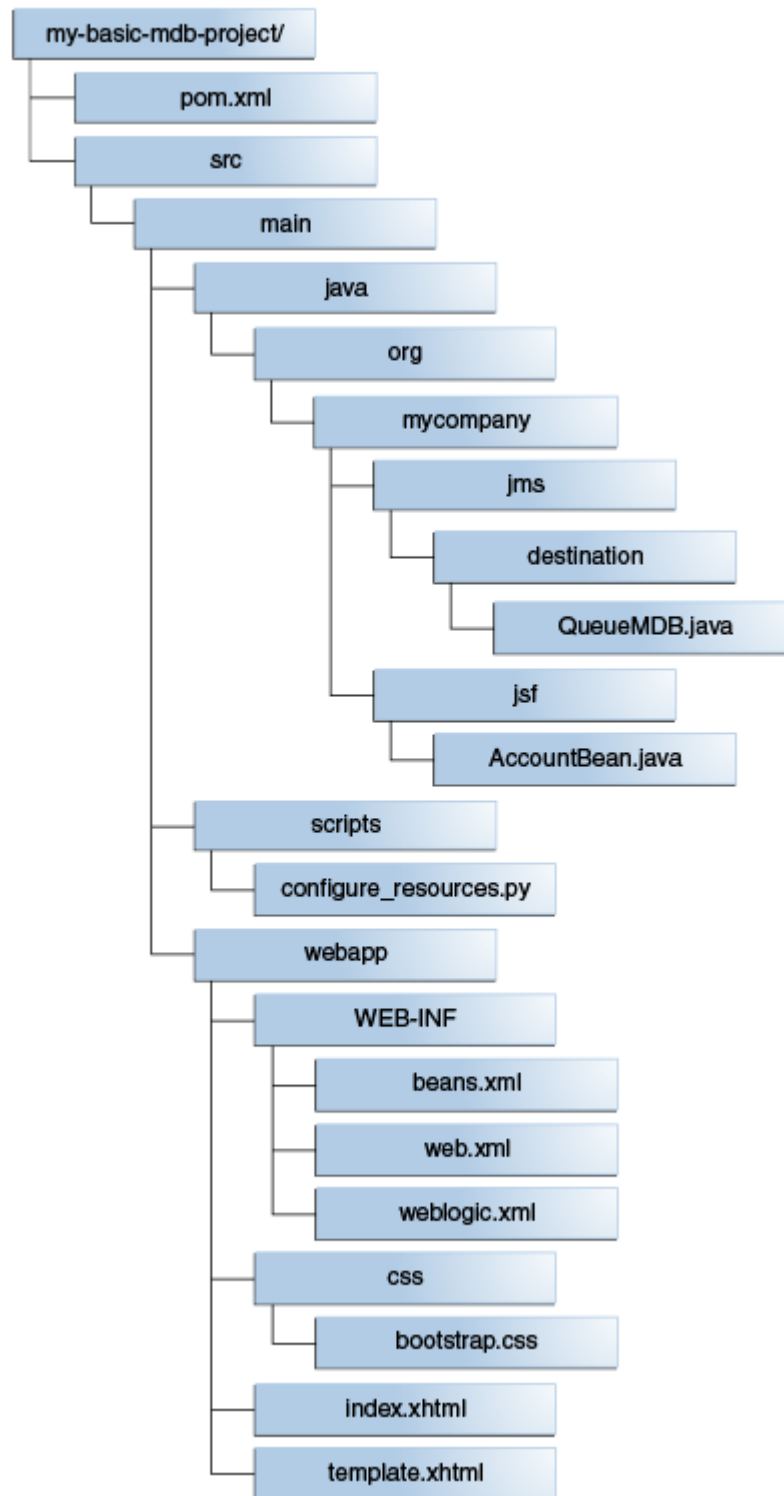
Table 10-8 Parameters for the Basic MDB Project

Parameter	Purpose
<code>archetypeGroupId</code>	The group ID of the archetype that you want to use to create the new project. This must be <code>com.oracle.weblogic</code> as shown in the preceding example.
<code>archetypeArtifactId</code>	The artifact ID of the archetype that you want to use to create the new project. This must be <code>basic-mdb</code> as shown in the preceding example.
<code>archetypeVersion</code>	The version of the archetype that you want to use to create the new project. This must be <code>12.2.1-0-0</code> as shown in the preceding example.
<code>groupId</code>	The group ID for your new project. This usually starts with your organization's domain name in reverse format.
<code>artifactId</code>	The artifact ID for your new project. This is usually an identifier for this project.
<code>version</code>	The version number for your new project. This is usually <code>1.0-SNAPSHOT</code> for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

After creating your project, it contains the following files:



These files make up a small sample application, which you can deploy as is. You can use this application as a starting point for building your own application.

[Table 10-9](#) describes the files included in the project.

Table 10-9 Files Created for the Basic MDB Project

File	Purpose
pom.xml	The Maven Project Object Model (POM) file that describes your new project. It includes the Maven coordinates that you specified for your project. It also includes the appropriate plug-in definitions to use the WebLogic Maven plug-in to build your project.
Files under src/main/java	An example Message Driven Bean that is used by the web application to store data.
All other files	HTML files that make up the web application user interface.

2. After you have written your project code, you can use Maven to build the project. It is also possible to build the sample as is.
3. Customize the POM to suit your environment. See [Customizing the Project Object Model File to Suit Your Environment](#).
4. Compile your Basic MDB Project. See [Compiling Your Java EE Project](#).
5. Package your Basic MDB Project. See [Packaging Your Java EE Project](#).
6. Deploy your Basic MDB Project. For information about deploying it using Maven, see [Deploying Your Java EE Project to the WebLogic Server Using Maven](#). For information about deploying it using other options, see [Deploying Your Java EE Project to the WebLogic Server Using Different Options](#).
7. Test your Basic MDB Project.

You can test the Basic MDB by visiting the following URL on the WebLogic Server where you deployed it:

```
http://servername:7001/basicMDB/index.xhtml
```

The following shows the user interface for the Basic MDB:

Basic MDB

This project shows a basic example of a web application working with JSF, CDI, JMS and M simulate the deposit functionality of bank system.



Please Enter Your Account Name and Amount

Account Name

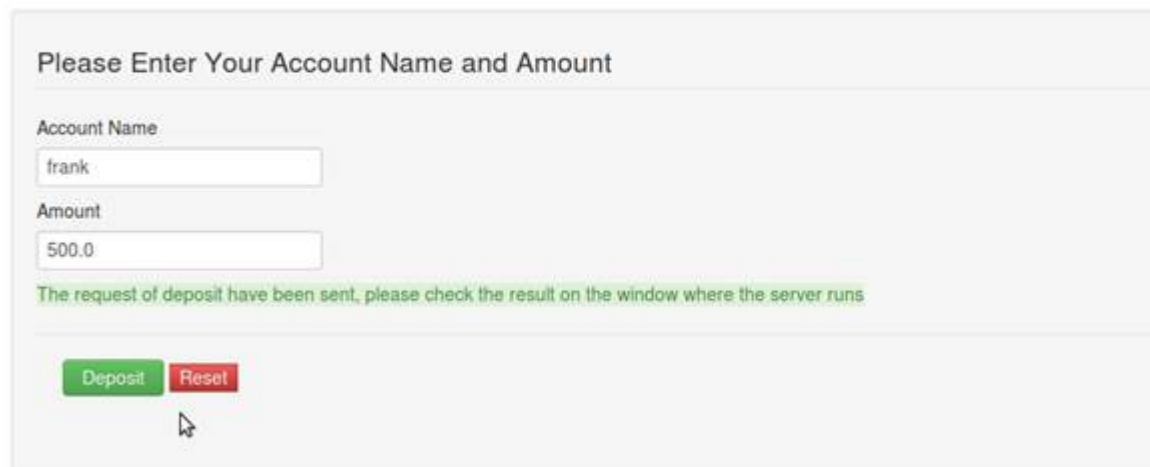
Amount

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8. Provide the **Account Name** and **Amount**, then select **Deposit**:

Basic MDB

This project shows a basic example of a web application working with JSF, CDI, JMS and M simulate the deposit functionality of bank system.



Please Enter Your Account Name and Amount

Account Name

Amount

The request of deposit have been sent, please check the result on the window where the server runs

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9. As indicated in the user interface, you must check the WebLogic Server output to find the message printed by the MDB. It looks like the following example:

The money has been deposited to frank, the balance of the account is 500.0

Building Oracle Coherence Projects with Maven

You can use the Oracle Coherence archetypes to create, build, and deploy Oracle Coherence applications.

Topics:

- [Introduction to Building Oracle Coherence Projects with Maven](#)
- [Creating a Coherence Project from a Maven Archetype](#)
- [Building Your Coherence Project with Maven](#)
- [Deploying Your Coherence Project to the WebLogic Server Coherence Container with Maven](#)
- [Building a More Complete Coherence Example](#)

11.1 Introduction to Building Oracle Coherence Projects with Maven

Oracle Fusion Middleware provides a Maven plug-in and an archetype is provided for Oracle Coherence Grid Archive (GAR) projects.

[Table 11-1](#) describes the Maven coordinates.

Table 11-1 Maven Coordinates with Coherence

artifacts	groupId	artifactId	version
GAR Plugin	com.oracle.coherence	gar-maven-plugin	12.2.1-0-0
GAR Archetype	com.oracle.coherence.archetype	gar-maven-archetype	12.2.1-0-0

[Table 11-2](#) describes the goals supported by the Oracle Coherence plug-in.

Table 11-2 Oracle Coherence Goals

Goal	Purpose
generate-descriptor	Generates the project's POF configuration file.
package	Packages the basic GAR assets, including library dependencies into a JAR archive.
repackage	Repackages the packaged JAR archive with optional metadata and GAR extension.

11.2 Creating a Coherence Project from a Maven Archetype

You can create a new Coherence project using the Coherence Maven archetype.

1. To create a new Coherence project using the Coherence Maven archetype, issue a command similar to the following:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.coherence.archetype
  -DarchetypeArtifactId=gar-maven-archetype
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-gar-project
  -Dversion=1.0-SNAPSHOT
```

This command runs Maven's `archetype:generate` goal which lets you create a new project from an archetype. [Table 11-3](#) describes the parameters.

Table 11-3 Parameters for the Coherence Projects

Parameter	Purpose
<code>archetypeGroupId</code>	The group ID of the archetype that you want to use to create the new project. This must be <code>com.oracle.coherence.archetype</code> .
<code>archetypeArtifactId</code>	The artifact ID of the archetype that you want to use to create the new project. This must be <code>gar-maven-archetype</code> .
<code>archetypeVersion</code>	The version of the archetype that you want to use to create the new project. This must be <code>12.2.1-0-0</code> .
<code>groupId</code>	The group ID for your new project. This usually starts with your organization's domain name in reverse format.
<code>artifactId</code>	The artifact ID for your new project. This is usually an identifier for this project.
<code>version</code>	The version for your new project. This is usually <code>1.0-SNAPSHOT</code> for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

After creating your project, it contains the following files:

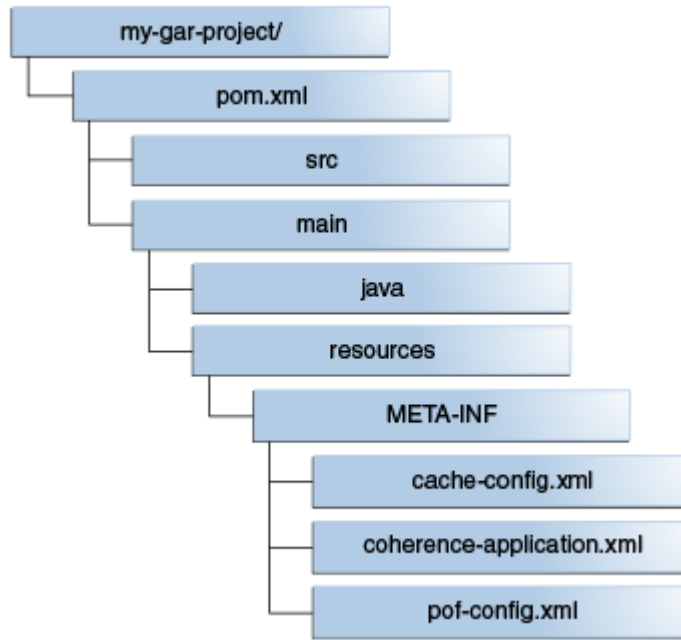


Table 11-4 describes the files included in the project.

Table 11-4 Files Created for the Coherence Project

File	Purpose
pom.xml	The Maven Project Object Model (POM) file that describes your new project. It includes the Maven coordinates that you specified for your project and the appropriate plug-in definitions to use the Coherence Maven plug-in to build your project into a gar file.
cache-config.xml	A starter Coherence cache configuration file.
coherence-application.xml	A starter Coherence GAR deployment descriptor for your GAR file.
pof-config.xml	A starter Coherence Portable Object Format (POF) configuration file. The POF configuration file is processed and inserted into the final GAR file if the plug-in option <code>generatePof</code> is set to <code>true</code> . By default, POF configuration metadata will not be generated.

- If you are using POF in your project, you must add the following parameter into your project's POM file:

Parameter	Purpose
<code>generatePof</code>	The POF configuration file is generated and inserted into the final GAR file if this plug-in option is <code>true</code> . The configuration file is generated by scanning all classes in the GAR's classpath annotated with the class <code>com.tangosol.io.pof.annotation.Portable</code> . By default, POF configuration metadata is not generated.

- To generate a GAR with correctly generated `pof-config.xml`, add the following to your GAR plug-in configuration in the POM:

```
<build>
<plugins>
...
  <plugin>
    <groupId>com.oracle.coherence</groupId>
    <artifactId>gar-maven-plugin</artifactId>
    <version>12.2.1-0-0</version>
    <extensions>true</extensions>
    <configuration>
      <generatePof>true</generatePof>
    </configuration>
  </plugin>
...
</plugins>
</build>
```

11.3 Building Your Coherence Project with Maven

After you have written your project code, you can use Maven to build the project:

- To compile the source code in your project, execute the following command:

```
mvn compile
```

- To package the compiled source into a GAR, execute the following command. Note that this command runs all steps up to package, including the compile.

```
mvn package
```

11.4 Deploying Your Coherence Project to the WebLogic Server Coherence Container with Maven

To deploy your GAR to a Coherence Container in a WebLogic Server environment, you must add some additional configuration to your project's POM file.

Take these steps:

- Add instructions to use the Oracle WebLogic Maven plug-in to deploy the GAR, as shown in the following example:

```
<plugin>
  <groupId>com.oracle.weblogic</groupId>
  <artifactId>weblogic-maven-plugin</artifactId>
  <version>12.2.1-0-0</version>
  <executions>
    <!--Deploy the application to the server-->
    <execution>
      <phase>pre-integration-test</phase>
      <goals>
        <goal>deploy</goal>
      </goals>
      <configuration>
        <adminurl>t3://localhost:7001</adminurl>
        <user>weblogic</user>
        <password>welcome1</password>
        <!--The location of the file or directory to be deployed-->
        <source>${project.build.directory}/${project.build.finalName}.${
project.packaging}</source>
```



```
        <!--The target servers where the application is deployed-->
        <targets>AdminServer</targets>
        <verbose>true</verbose>
        <name>${project.build.finalName}</name>
    </configuration>
</execution>
</executions>
</plugin>
```

2. After you have added this section to your POM, use the following command to compile, package, and deploy your GAR to the WebLogic Server:

```
mvn verify
```

11.5 Building a More Complete Coherence Example

In a real application, you are likely to have not just a GAR project, but also some kind of client project that interacts with the Coherence cache established by the GAR.

Refer to [Building a Real Application with Maven](#) to see an example that includes a Coherence GAR and a web application (WAR) that interacts with it.

Building ADF Projects with Maven

You can use the Oracle Application Development Framework Maven archetypes to create, build, and deploy Oracle Application Development Framework applications.

Topics:

- [Introduction to Building Oracle ADF Projects with Maven](#)
- [Creating an ADF Application Using the Maven Archetype](#)
- [Building Your Oracle ADF Project with Maven](#)

For more information about using the Oracle ADF development plug-in with Maven, see "Building and Running with Apache Maven" in *Developing Applications with Oracle JDeveloper*.

12.1 Introduction to Building Oracle ADF Projects with Maven

Oracle Fusion Middleware provides two Maven plug-ins and an archetype for Oracle ADF projects.

[Table 12-1](#) describes the Maven coordinates.

Table 12-1 Maven Coordinates with Oracle ADF

Artifact	groupId	artifactId	Version
ADF ojmakes plug-in	com.oracle.adf.plugin	ojmake	12.2.1-0-0
ADF ojdeploy plug-in	com.oracle.adf.plugin	ojdeploy	12.2.1-0-0
ADF archetype	com.oracle.adf.archetype	oracle-adffaces-ejb	12.2.1-0-0

JDeveloper also has extensive support for Maven. This documentation covers Maven use outside of JDeveloper. Refer to "Building and Running with Apache Maven" in *Developing Applications with Oracle JDeveloper* for more details about using Maven within JDeveloper.

12.2 Creating an ADF Application Using the Maven Archetype

You can create a new Oracle ADF application using the Oracle ADF application Maven archetype

To do so, issue a command similar to the following:

```
mvn archetype:generate
-DarchetypeGroupId=com.oracle.adf.archetype
-DarchetypeArtifactId=oracle-adffaces-ejb
-DarchetypeVersion=12.2.1-0-0
-DgroupId=org.mycompany
```

```
-DartifactId=my-adf-application
-Dversion=1.0-SNAPSHOT
```

This command runs Maven's `archetype:generate` goal which allows you to create a new project from an archetype. [Table 12-2](#) describes the parameters.

Table 12-2 Parameters for the Oracle ADF Project

Parameter	Purpose
<code>archetypeGroupId</code>	The <code>groupId</code> of the archetype that you want to use to create the new project. This must be <code>com.oracle.adf.archetype</code> in the example.
<code>archetypeArtifactId</code>	The <code>artifactId</code> of the archetype that you want to use to create the new project. This must be <code>oracle-adffaces-ejb</code> as shown in the example.
<code>archetypeVersion</code>	The version of the archetype that you want to use to create the new project. This must be <code>12.2.1-0-0</code> as shown in the example.
<code>groupId</code>	The <code>groupId</code> for your new project. This usually starts with your organization's domain name in reverse format.
<code>artifactId</code>	The <code>artifactId</code> for your new project. This is usually an identifier for this project.
<code>version</code>	The version for your new project. This is usually <code>1.0-SNAPSHOT</code> for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

12.3 Building Your Oracle ADF Project with Maven

After you have written your code, you can use Maven to build the project.

1. To compile your project, execute the following command:

```
mvn compile
```

This command runs the **ojmake** plug-in.

2. To package the project into an EAR file, execute the following command (note that this actually runs all steps up to package, including the compile again):

```
mvn package
```

This command runs the **ojdeploy** plug-in.

Building Oracle SOA Suite and Oracle Business Process Management Projects with Maven

You can use the Oracle SOA Suite and Oracle Business Process Management Maven archetypes to create, build, and deploy Oracle SOA Suite and Oracle Business Process Management applications.

Topics:

- [Introduction to Building Oracle SOA Suite and Oracle Business Process Management Projects with Maven](#)
- [Creating a New SOA Application and Project from a Maven Archetype](#)
- [Creating a SOA Project in an Existing SOA Application from a Maven Archetype](#)
- [Editing Your SOA Application in Oracle JDeveloper](#)
- [Building Your SOA Project with Maven](#)
- [What You May Need to Know About Building SOA Projects](#)
- [Deploying Your SOA Project to the SOA Server with Maven](#)
- [Running SCA Test Suites with Maven](#)
- [What You May Need to Know About Deploying SOA Composites](#)
- [What You May Need to Know About ADF Human Task User Interface Projects](#)
- [Undeploying Your SOA Project](#)
- [What You May Need to Know About the SOA Parent POM](#)

For more information about using the Oracle SOA Suite development plug-in with Maven, see "Using the Oracle SOA Suite Development Maven Plug-In" in *Developing SOA Applications with Oracle SOA Suite*.

13.1 Introduction to Building Oracle SOA Suite and Oracle Business Process Management Projects with Maven

Oracle Fusion Middleware provides a Maven plug-in and two archetypes are provided for Oracle SOA Suite and Oracle Business Process Management

[Table 13-1](#) describes the Maven coordinates.

Table 13-1 Maven Coordinates with Oracle SOA Suite

Artifact	groupId	artifactId	version
SOA plug-in	com.oracle.soa.plugin	oracle-soa-plugin	12.2.1-0-0
SOA Application archetype	com.oracle.soa.archetype	oracle-soa-application	12.2.1-0-0
SOA Project archetype	com.oracle.soa.archetype	oracle-soa-project	12.2.1-0-0

Table 13-2 describes the goals supported by the Oracle SOA Suite plug-in.

Table 13-2 Oracle SOA Suite Plug-In Goals

Goal	Purpose
compile	Runs the SCA composite validation routine on your project--this is somewhat equivalent to a traditional compile operation in that it inspects the source artifacts and produces errors and warnings. However, it does not produce any compiled version of the source artifacts.
sar	Creates a SOA archive (SAR) file from the project.
deploy	Deploys the SAR file to a runtime environment. Note that this goal is mapped to the pre-integration-test phase in the default lifecycle, not the deploy phase, as deployment to a runtime environment is normally done in the pre-integration-test phase in Maven.
test	Executes SCA tests in the composite. Note that this goal is mapped to the integration-test phase, not the test phase, as it depends on the composite (SAR) having been deployed to a runtime environment.
undeploy	Undeploys a composite (SAR) from a runtime environment. Note that this goal is not mapped to any phase in the default Maven lifecycle.

The SOA Application archetype allows you to create a new SOA application with a single SOA Project in it. This can be imported in JDeveloper for editing.

The SOA Project archetype allows you to add a new SOA Project to an existing SOA Application.

13.2 Creating a New SOA Application and Project from a Maven Archetype

You can create a new SOA application (containing a single SOA project) using the SOA Maven archetype.

To do so, execute a command similar to the following:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.soa.archetype
  -DarchetypeArtifactId=oracle-soa-application
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-soa-app
  -Dversion=1.0-SNAPSHOT
  -DprojectName=my-project
```

This command runs Maven's **archetype:generate** goal which allows you to create a new SOA Application from an archetype. [Table 13-3](#) describes the parameters.

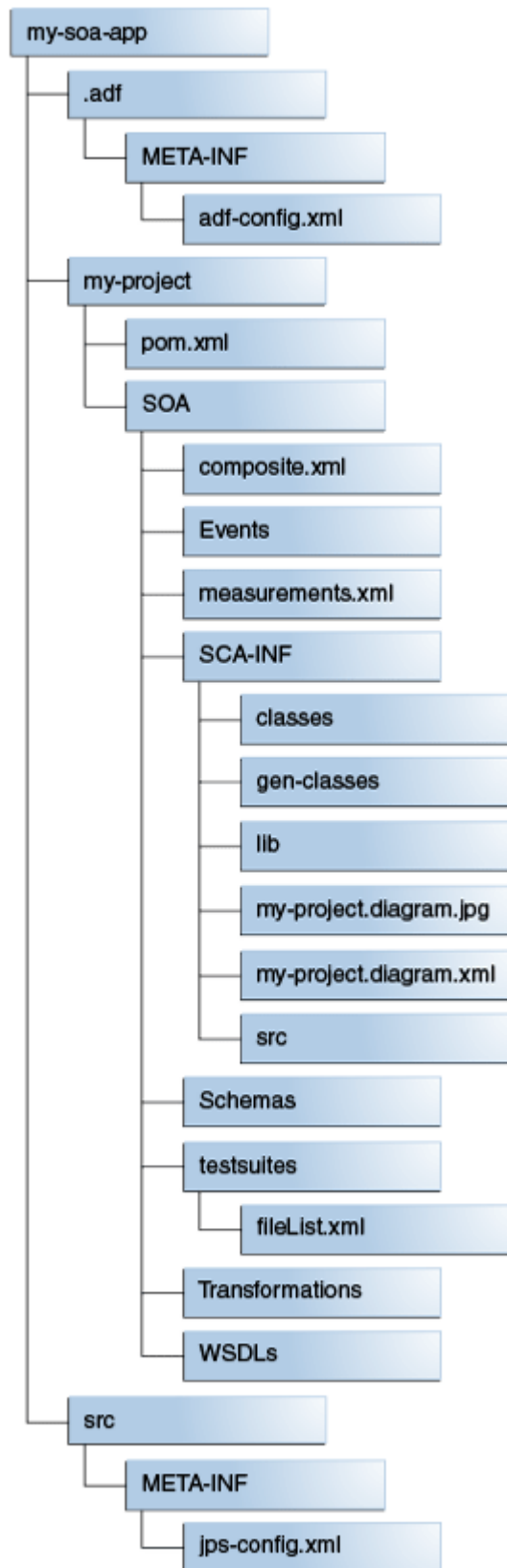
Table 13-3 Parameters for the Oracle SOA Suite Application

Parameter	Purpose
archetypeGroupId	The groupId of the archetype that you want to use to create the new SOA application. This must be <code>com.oracle.soa</code> as shown in the previous example.
archetypeArtifactId	The artifactId of the archetype that you want to use to create the new SOA application. This must be <code>oracle-soa-application</code> as shown in the previous example.
archetypeVersion	The version of the archetype that you want to use to create the new SOA application. This must be <code>12.2.1.0.0</code> as shown in the previous example.
groupId	The groupId for your new SOA application. This would normally start with your organization's domain name in reverse format.
artifactId	The artifactId for your new SOA application. This would normally be an identifier for this SOA application.
version	The version for your new SOA application. This would normally be <code>1.0-SNAPSHOT</code> for a new project.
projectName	The name for the SOA project inside your new SOA application. This should be different to the name of the SOA application (<code>artifactId</code>).

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

After creating your application, it contains the following files, assuming you named your application *my-soa-app* and your project *my-project*, as shown in the previous example:



The generated project contains files and a handful of empty directories. The files are described in [Table 13-4](#).

Table 13-4 Files Created for the Oracle SOA Suite Application and Project

File	Purpose
pom.xml	The Maven Project Object Model (POM) file that describes your new application. It includes the Maven coordinates that you specified for your application, and a reference to the SOA project inside the application.
<i>PROJECT</i> /pom.xml	The Maven POM file that describes your new project. It includes the Maven coordinates that you specified for your project, and the appropriate plug-in definitions to use the SOA Maven Plug-in to build your project into a SAR file.
<i>PROJECT</i> /composite.xml	Composite metadata.
.adf/META-INF/adf-config.xml	The definitions for MDS repositories that may be needed to build your composites.
Others	The remainder are the standard files that are created in any new composite. These are the same files as you would find in a new SOA Application and SOA Project created in JDeveloper.

13.3 Creating a SOA Project in an Existing SOA Application from a Maven Archetype

You can create a new SOA project (in an existing SOA application) using the SOA Maven archetype.

To do so, execute a command similar to the following, while in the SOA application directory:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.soa.archetype
  -DarchetypeArtifactId=oracle-soa-project
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-second-project
  -Dversion=1.0-SNAPSHOT
```

This command runs Maven's **archetype:generate** goal which allows you to create a new SOA Project from an archetype. [Table 13-5](#) describes the parameters:

Table 13-5 Parameters for the Oracle SOA Suite Project

Parameter	Purpose
archetypeGroupId	The groupId of the archetype that you want to use to create the new SOA application. This must be <code>com.oracle.soa</code> as shown in the previous example.
archetypeArtifactId	The artifactId of the archetype that you want to use to create the new SOA application. This must be <code>oracle-soa-project</code> as shown in the previous example.

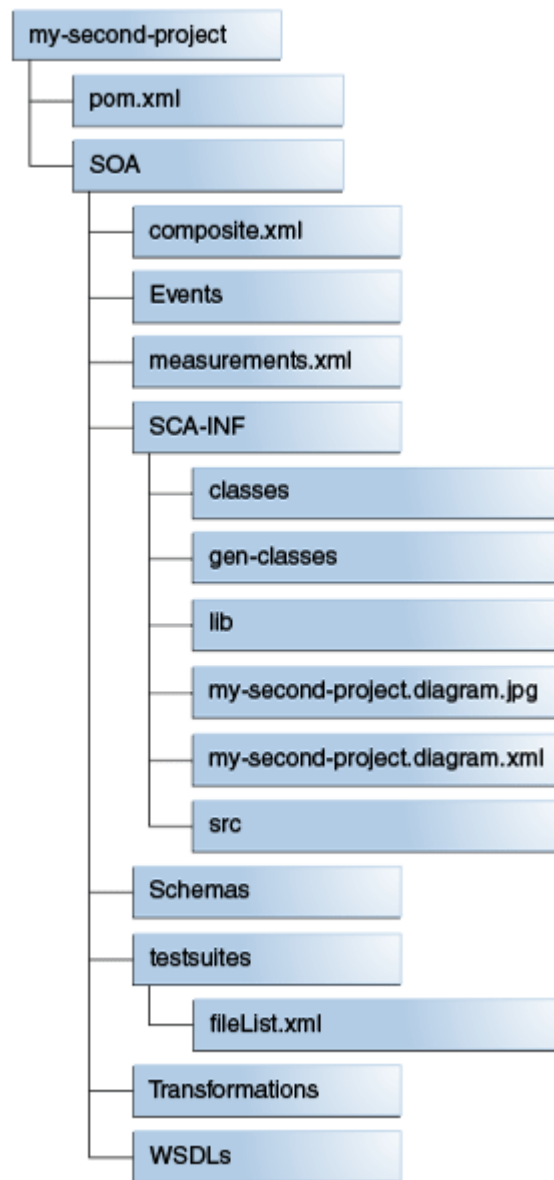
Table 13-5 (Cont.) Parameters for the Oracle SOA Suite Project

Parameter	Purpose
archetypeVersion	The version of the archetype that you want to use to create the new SOA application. This must be 12.2.1.0.0 as shown in the previous example.
groupId	The groupId for your new SOA project. This would normally start with your organization's domain name in reverse format.
artifactId	The artifactId for your new SOA project. This would normally be an identifier for this SOA project.
version	The version for your new SOA project. This would normally be 1.0-SNAPSHOT for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

After creating your new project, it contains the following files, assuming that you named your project *my-second-project*:



The generated project contains files and a handful of empty directories. The files are described in [Table 13-4](#).

The `mvn generate` command also updates your SOA Application POM to add the new project. For example, if you created this project in the application in [Creating a New SOA Application and Project from a Maven Archetype](#), you would see the following list in the SOA Application POM:

```

<modules>
  <module>my-project</module>
  <module>my-second-project</module>
</modules>

```

When you have a SOA Application with multiple SOA Projects like this (a Maven *multi-module* project), Maven builds your projects one by one, in the order they are listed in the SOA Application POM.

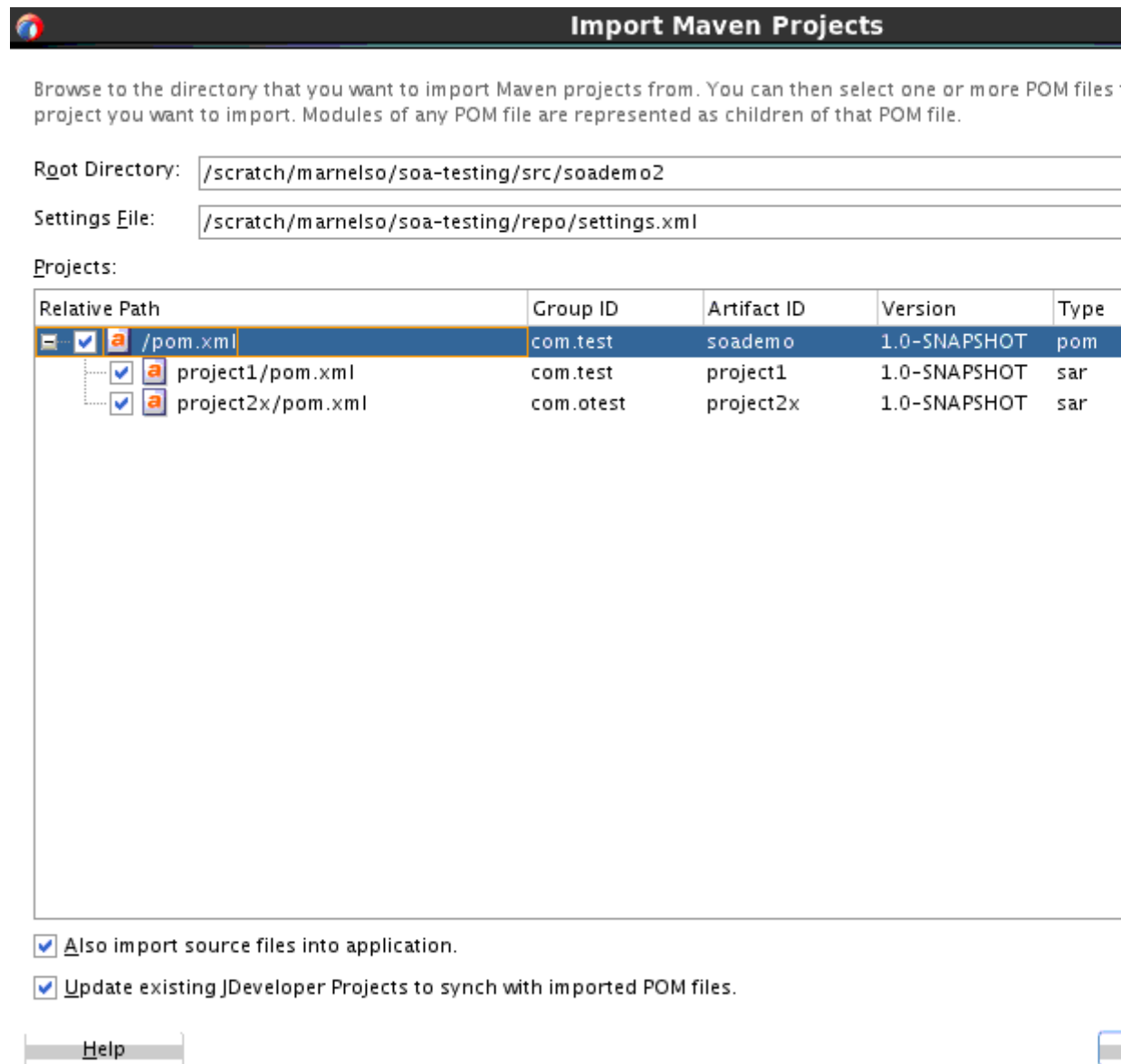
13.4 Editing Your SOA Application in Oracle JDeveloper

You can edit your SOA application in Oracle JDeveloper to configure SOA composites.

To edit your application, you open the project in Oracle JDeveloper, then edit the application:

1. Open the **File** menu, then select **Import...**
2. In the **Import** dialog box, select the **Maven Project** option and click **OK**.

The **Import Maven Projects** dialog appears:



3. In the **Root Directory** field, enter the path to the application you want to import into JDeveloper.

4. In the **Settings File** field, enter the path to your Maven settings.xml file. The default value is most likely correct unless you are using a non-standard location for your Maven settings file.
5. Click **Refresh** to load a list of projects available at that location.
6. Select the projects that you want to import. Also, select **Also import source files into application** and **Update existing JDeveloper Projects to synch with imported POM files**.
7. Click **OK** to complete the import.

Your projects are then opened in JDeveloper.

13.5 Building Your SOA Project with Maven

After you have written your project code, you can use Maven to build the project.

To do so:

1. To run the SCA validation on your project, execute this command:

```
mvn compile
```

2. To build the SAR file, execute this command:

```
mvn package
```

13.6 What You May Need to Know About Building SOA Projects

Some SOA composite projects require access to an MDS repository in order to be built. This includes all composites that contain a Human Task or Business Rule component. These components refer to WSDL or XSD files, or both, in MDS.

To build these projects, you need to provide the build with access to an MDS repository. This can be either a file-based or a database-based MDS repository.

The MDS repository connection details are specified in the *SOA Application/.adf/META-INF/adf-config.xml* file. This means that any SOA Project which requires access to MDS must be located inside a SOA Application.

If you create a new project using the SOA Maven Application archetype or using JDeveloper, the *adf-config.xml* will contain the following default MDS repository configuration:

```
<metadata-store-usages>
  <metadata-store-usage id="mstore-usage_1">
    <metadata-store class-
name="oracle.mds.persistence.stores.file.FileMetadataStore">
      <property name="metadata-path" value="{oracleHome}/integration"/>
      <property name="partition-name" value="seed"/>
    </metadata-store>
  </metadata-store-usage>
</metadata-store-usages>
```

This example defines a file-based MDS repository in the location `{oracleHome}/integration`. If you run this build in Maven, the `oracleHome` variable may not be defined. In that case, you need to specify it on the Maven command line, as shown in the following example:

```
mvn compile -DoracleHome=MW_HOME/soa -DappHome=dir_for_application_for_proj
```

Notice that the value of `oracleHome` points to the `soa` directory in the Oracle Home in which you installed the SOA Quickstart or JDeveloper. That directory contains the *seed* MDS repository.

Alternatively, you can just update the `adf-config.xml` file to provide the full path to the MDS repository that you want to use.

If you want to use a database-based MDS repository, you must alter the configuration to specify the JDBC values, similar to that shown in the following example:

```
<metadata-store-usage id="mstore-usage_1">
  <metadata-store class-name="oracle.mds.persistence.stores.db.DBMetadataStore">
    <property name="jdbc-userid" value="your_prefix_mds"/>
    <property name="jdbc-password" value="welcome1"/>
    <property name="jdbc-url"
      value="jdbc:oracle:thin://@database.server:1521/service_name"/>
    <property name="partition-name" value="soa-infra"/>
  </metadata-store>
</metadata-store-usage>
```

13.7 Deploying Your SOA Project to the SOA Server with Maven

To deploy your SOA project to the SOA server with Maven, you deploy the SAR file and edit the project POM.

To deploy the SAR file, execute the following command:

```
mvn pre-integration-test
```

[Table 13-6](#) describes the parameters that you can specify for the deployment. These may be specified either in the POM file for the project or on the command line.

Table 13-6 Parameters for Deploying a SOA Project

Parameter	Purpose
<code>serverURL</code>	The URL of the Administration Server in the SOA domain.
<code>sarLocation</code>	The location of the SAR file.
<code>overwrite</code>	Whether deployment should overwrite any existing composite with the same revision.
<code>configplan</code>	(Optional) The name of the SOA configuration plan to use, if any.
<code>forceDefault</code>	Whether deployment should make this revision the default revision.
<code>regenerateRuleBase</code>	Whether the base rule dictionary should be regenerated.
<code>composite.partition</code>	The SOA partition that the composite will be deployed into.
<code>user</code>	User name to be used for deployment.
<code>password</code>	Password to be used for deployment.

To specify the parameters:

- On the command line: Use the format `-Dparameter=value`, as shown in this example (note that the whole command would be entered on one line):

```

mvn pre-integration-test -DserverURL=http://test.server:7001
                        -DsarLocation=deploy/sca_my-project_rev1.0.sar
                        -Doverwrite=true
                        -DforceDefault=true
                        -Dcomposite.partition=test
                        -Duser=weblogic
                        -Dpassword=welcome1

```

- In your project POM file: Specify replacement values for the defaults already specified in the parameters section of the project POM:

```

<properties>
  <!-- these parameters are used by the compile goal -->
  <scac.input.dir>${project.basedir}/SOA/</scac.input.dir>
  <scac.output.dir>${project.basedir}/target</scac.output.dir>
  <scac.input>${scac.input.dir}/composite.xml</scac.input>
  <scac.output>${scac.output.dir}/out.xml</scac.output>
  <scac.error>${scac.output.dir}/error.txt</scac.error>
  <scac.displayLevel>1</scac.displayLevel>
  <!-- if you are using a config plan, uncomment the following line and
update to point
       to your config plan -->
  <!--<configplan>${scac.input.dir}/configplan.xml</configplan>-->
  <!-- these parameters are used by the deploy and undeploy goals -->
  <composite.name>${project.artifactId}</composite.name>
  <composite.revision>1.0</composite.revision>
  <composite.partition>default</composite.partition>
  <serverUrl>${oracleServerUrl}</serverUrl>
  <user>${oracleUsername}</user>
  <password>${oraclePassword}</password>
  <overwrite>true</overwrite>
  <forceDefault>true</forceDefault>
  <regenerateRulebase>false</regenerateRulebase>
  <keepInstancesOnRedeploy>false</keepInstancesOnRedeploy>
  <!-- these parameters are used by the test goal -->
  <!-- if you are using the sca-test (test) goal, you need to uncomment
       the following line and point it to your jndi.properties file. -->
  <!--<jndi.properties.input>${basedir}/jndi.properties</
jndi.properties.input>-->
  <scatest.result>${scac.output.dir}/testResult</scatest.result>
  <!-- input is the name of the composite to run test suites against -->
  <input>project12</input>
</properties>

```

13.8 Running SCA Test Suites with Maven

You can run SCA test suites with Maven.

To execute your SCA Test Suites as part of the Maven build process:

1. Create a `jndi.properties` file (as you would if you were executing SCA Test Suites from ANT, for example) in your SOA composite project directory. This file contains the following information:

```

java.naming.factory.initial=weblogic.jndi.WLInitialContextFactory
java.naming.provider.url=t3://test.server:7003/soa-infra
java.naming.security.principal=weblogic
java.naming.security.credentials=welcome1
dedicated.connection=true
dedicated.rmicontext=true

```

2. Uncomment the `jndi.properties` entry in the SOA composite project POM (`pom.xml`) and ensure that it points to the file you just created.
3. The SOA Maven Plug-in executes the SCA Tests in the integration-test phase. To compile and package your composite, deploy it to a server and run the SCA Tests, execute this command:

```
mvn verify
```

13.9 What You May Need to Know About Deploying SOA Composites

When you create a SOA composite, you may use new resources, such as WebLogic data sources, JMS queues, and Topics. These resources may not be present in the runtime environment where you want to deploy your composite. This means that you may not be able to successfully execute any instances of your composite, for example to run test cases.

While it is possible to manually create these resources through the WebLogic console, this would not be appropriate for an automated build environment. To address this issue, you can create WLST scripts and execute them as part of the build to ensure that any necessary resources are created and configured on the runtime environment. You can execute the WLST scripts at the appropriate time in your build using the `weblogic-maven-plugin:wlst` goal.

The following is an example of a WLST script to create a data source. You could add it to your project as `misc/create-datasource.py`:

```
# Copyright 2012, 2014 Oracle Corporation.
# All Rights Reserved.
#
# Provided on an 'as is' basis, without warranties or conditions of any kind,
# either express or implied, including, without limitation, any warranties or
# conditions of title, non-infringement, merchantability, or fitness for a
# particular purpose. You are solely responsible for determining the
# appropriateness of using and assume any risks. You may not redistribute.
#
# This WLST script can be used as part of a continuous integration build process
# before deploying a SCA composite, to create any necessary Java EE data sources
# on the WebLogic Server.
#
# In addition to creating the data source, this script will also update the
# resource adapter and redeploy it.

import time

#
# These are the parameters that you need to edit before running this script
#

# admin server url
url = 't3://localhost:7001'
# username to connect to the admin server
username = 'weblogic'
# password to connect to the admin server
password = 'mypassword'
# the name for the EIS - as defined in the DB Adapter wizard in JDEV
eisName = 'eis/db/myDS'
# the admin or managed server to target where the DbAdapter is deployed
serverName = 'soa_server1'
# the name for the data source
dsName = 'myDS'
```



```

# the JNDI name for the data source
jndiName          = 'jdbc/myDS'
# the database url for the data source
dbUrl             = 'jdbc:oracle:thin:@localhost:1521:orcl'
# the database user
dbUser           = 'mark'
# the database password
dbPassword       = 'mypassword'
# the database driver to use
dbDriver         = 'oracle.jdbc.xa.client.OracleXADataSource'
# the host where node manager is running
nmHost           = 'localhost'
# the port to connect to node manager (5556 is default for plain mode)
nmPort           = '5556'
# the user to connect to node manager
nmUser           = 'weblogic'
# the password to connection to node manager
nmPassword       = 'mypassword'
# the name of the weblogic domain
domain           = 'base_domain'

# don't change these ones
uniqueString     = ''
appName         = 'DbAdapter'
moduleOverrideName = appName+'.rar'
moduleDescriptorName = 'META-INF/weblogic-ra.xml'

#
# method definitions
#
def makeDeploymentPlanVariable(wlstPlan, name, value, xpath, origin='planbased'):
    """Create a variable in the Plan.
    This method is used to create the variables that are needed in the Plan in order
    to add an entry for the outbound connection pool for the new data source.
    """

    try:
        variableAssignment = wlstPlan.createVariableAssignment(name, moduleOverrideName,
moduleDescriptorName)
        variableAssignment.setXpath(xpath)
        variableAssignment.setOrigin(origin)
        wlstPlan.createVariable(name, value)

    except:
        print('--> was not able to create deployment plan variables successfully')

def main():

    print ' Copyright 2012, 2014 Oracle Corporation. '
    print ' All Rights Reserved. '
    print ''
    print ' Provided on an ''as is'' basis, without warranties or conditions of any
kind, '
    print ' either express or implied, including, without limitation, any warranties
or '
    print ' conditions of title, non-infringement, merchantability, or fitness for a '
    print ' particular purpose. You are solely responsible for determining the '
    print ' appropriateness of using and assume any risks. You may not redistribute.'
    print ''
    print ' This WLST script can be used as part of a continuous integration build
process'

```

```

print ' before deploying a SCA composite, to create any necessary Java EE data
sources'
print ' on the WebLogic Server.'
print ''
print ' In addition to creating the data source, this script will also update the '
print ' resource adapter and redeploy it.'
print ''
print ' !!! WARNING !!! WARNING !!! WARNING !!! WARNING !!! WARNING !!!
WARNING !!!'
print ''
print ' This script will make changes to your WebLogic domain. Make sure you know
,
print ' what you are doing. There is no support for this script. If something
bad '
print ' happens, you are on your own! You have been warned.'

#
# generate a unique string to use in the names
#

uniqueString = str(int(time.time()))

#
# Create a JDBC Data Source.
#
try:
    print('--> about to connect to weblogic')
    connect(username, password, url)
    print('--> about to create a data source ' + dsName)
    edit()
    startEdit()
    cmo.createJDBCSystemResource(dsName)
    cd('/JDBCSystemResources/' + dsName + '/JDBCResource/' + dsName)
    cmo.setName(dsName)
    cd('/JDBCSystemResources/' + dsName + '/JDBCResource/' + dsName + '/'
JDBCDataSourceParams/' + dsName)
    set('JNDINames',jarray.array([String(jndiName)], String))
    cd('/JDBCSystemResources/' + dsName + '/JDBCResource/' + dsName + '/'
JDBCdriverParams/' + dsName)
    cmo.setUrl(dbUrl)
    cmo.setDriverName(dbDriver)
    cmo.setPassword(dbPassword)
    cd('/JDBCSystemResources/' + dsName + '/JDBCResource/' + dsName + '/'
JDBCConnectionPoolParams/' + dsName)
    cmo.setTestTableName('DUAL')
    cd('/JDBCSystemResources/' + dsName + '/JDBCResource/' + dsName + '/'
JDBCdriverParams/' + dsName + '/Properties/' + dsName)
    cmo.createProperty('user')
    cd('/JDBCSystemResources/' + dsName + '/JDBCResource/' + dsName + '/'
JDBCdriverParams/' + dsName + '/Properties/' + dsName + '/Properties/user')
    cmo.setValue(dbUser)
    cd('/JDBCSystemResources/' + dsName + '/JDBCResource/' + dsName + '/'
JDBCDataSourceParams/' + dsName)
    cmo.setGlobalTransactionsProtocol('TwoPhaseCommit')
    cd('/JDBCSystemResources/' + dsName)
    set('Targets',jarray.array([ObjectName('com.bea:Name=' + serverName +
',Type=Server')], ObjectName))
    save()
    print('--> activating changes')
    activate()

```

```

        print('--> done')

#
# update the deployment plan
#
    print('--> about to update the deployment plan for the DbAdapter')
    startEdit()
    planPath = get('/AppDeployments/DbAdapter/PlanPath')
    appPath = get('/AppDeployments/DbAdapter/SourcePath')
    print('--> Using plan ' + planPath)
    plan = loadApplication(appPath, planPath)
    print('--> adding variables to plan')
    makeDeploymentPlanVariable(plan, 'ConnectionInstance_eis/DB/' + dsName +
'_JNDIName_' + uniqueString, eisName, '/weblogic-connector/outbound-resource-adapter/
connection-definition-group/[connection-factory-
interface="javax.resource.cci.ConnectionFactory"]/connection-instance/[jndi-name="'
+ eisName + '"]/jndi-name')
    makeDeploymentPlanVariable(plan, 'ConfigProperty_xADataSourceName_Value_' +
uniqueString, eisName, '/weblogic-connector/outbound-resource-adapter/connection-
definition-group/[connection-factory-
interface="javax.resource.cci.ConnectionFactory"]/connection-instance/[jndi-name="'
+ eisName + '"]/connection-properties/properties/property/[name="xADataSourceName"]/
value')
    print('--> saving plan')
    plan.save();
    save();
    print('--> activating changes')
    activate(block='true');
    cd('/AppDeployments/DbAdapter/Targets');
    print('--> redeploying the DbAdapter')
    redeploy(appName, planPath, targets=cmo.getTargets());
    print('--> done')

except:
    print('--> something went wrong, bailing out')
    stopEdit('y')
    raise SystemExit

#
# disconnect from the admin server
#

print('--> disconnecting from admin server now')
disconnect()

#
# this is the main entry point

main()

```

To execute this script during the `pre-integration-test` phase of your build, you would include a plugin section similar to the following in your SOA Project POM:

```

<plugin>
  <groupId>com.oracle.weblogic</groupId>
  <artifactId>weblogic-maven-plugin</artifactId>
  <version>12.2.1-0-0</version>
  <executions>
    <execution>
      <id>wlst-create-datasource</id>
      <phase>pre-integration-test</phase>
    </execution>
  </executions>
</plugin>

```

```
<goals>
  <goal>wlst</goal>
</goals>
<configuration>
  <middlewareHome>c:/wls1212</middlewareHome>
  <fileName>${project.basedir}/misc/create-datasource.py</fileName>
</configuration>
</execution>
</executions>
</plugin>
```

13.10 What You May Need to Know About ADF Human Task User Interface Projects

If you add an ADF Human Task User Interface project to your SOA Application in JDeveloper, the application level POM is updated to add the new ADF project as a module and some `<plugin>` definitions are added to the `<build>` section to build the ADF project.

When you create an ADF Human Task project, some JDeveloper libraries are added to the build path for that project in JDeveloper. Additionally, JDeveloper checks to see if there are matching POMs for those libraries in your local Maven repository. If not, it creates those POMs for you. These new library POMs (if any are needed) are created with the Maven `groupId = com.oracle.adf.library`.

Note that the Maven repository used by JDeveloper can be specified in `Tools/Preferences/Maven/Repository`; it may not be the default repository in `$HOME/.m2`.

Note the following:

- If you want to build these ADF Human Task projects on another machine, for example, a build server, which is using a different Maven repository (local or remote), copy these new POMs to that Maven repository.
- The server on which you build the ADF Human Task projects must have access to a JDeveloper installation, because the `ojsdeploy` Maven plug-in, which is used to package the ADF project into an EAR file, depends on the JDeveloper Oracle Home being present.
- If you want to deploy the EAR file as part of the application build, you need to add a new `<plugin>` section to invoke the `weblogic-maven-plugin:deploy` goal in the appropriate phase of your build, most likely `pre-integration-test`. Note that the EAR file is located in the `appHome/deploy` directory, not in the ADF project's directory. This is due to the fact that a single EAR file may contain multiple ADF Human Task project WAR files.
- If you target the deployment to the SOA server (as shown in the following example), the ADF URI is automatically registered in the appropriate MBean so that the SOA or BPM Workspace application can find it.

```
<plugin>
  <groupId>com.oracle.weblogic</groupId>
  <artifactId>weblogic-maven-plugin</artifactId>
  <version>12.2.1-0-0</version>
  <executions>
    <execution>
      <goals>
        <goal>deploy</goal>
      </goals>
    </execution>
  </executions>
</plugin>
```

```

<phase>pre-integration-test</phase>
<configuration>
  <adminurl>t3://localhost:7001</adminurl>
  <user>weblogic</user>
  <password>password</password>
  <source>${project.basedir}/deploy/adfl.ear</source>
  <verbose>true</verbose>
  <name>${project.build.finalName}</name>
  <targets>soa_server1</targets>
</configuration>
</execution>
</executions>
</plugin>

```

- To be able to deploy the EAR file, you also need to set up the appropriate MDS configuration in `appHome/.adf/META-INF/adf-config.xml`. This is most likely a database-based MDS store, as shown in [What You May Need to Know About Building SOA Projects](#). For the build to work correctly, and the deployed application to function correctly, this database must be accessible from both the build server and the runtime server. This may not be practical in production environments, so you may need to define multiple deployment profiles for the ADF project.

13.11 Undeploying Your SOA Project

You can undeploy your composite using the **undeploy** goal.

[Table 13-7](#) describes the parameters for the undeploy command:

Table 13-7 Parameters for the Undeploy Goal

Parameters	Purpose
composite.name	The name of the composite you want to undeploy.
composite.revision	The revision of the composite you want to undeploy.
composite.partition	The partition that holds the composite you want to undeploy.
user	User name to be used for undeployment.
password	Password to be used for undeployment.

To undeploy a SAR file, execute the following command, specifying the appropriate values for your environment. Enter this command on one line.

```

mvn com.oracle.soa.plugin:oracle-soa-plugin:undeploy
  -DserverURL=http://test.server:7001
  -Dcomposite.name=my-project
  -Dcomposite.revision=1.0
  -Dcomposite.partition=test
  -Duser=weblogic
  -Dpassword=welcome1

```

You should run the **undeploy** goal against a SOA Project, not a SOA Application.

13.12 What You May Need to Know About the SOA Parent POM

The SOA Parent POM is provided as a point of customization. It has Maven coordinates `com.oracle.soa:sar-common:12.2.1-0-0`. If you want to set some environment-wide defaults, for example, the URL, user name, and password for your test server, then you can put these in the SOA Parent POM. The SOA Parent POM is provided as a point of customization. It has Maven coordinates `com.oracle.soa:sar-common:12.2.1-0-0`. If you want to set some environment-wide defaults, for example, the URL, user name, and password for your test server, then you can put these in the SOA Parent POM.

The SOA Parent POM contains the following properties:

```
<properties>
  <!--
    These two properties are defined in com.oracle.maven:oracle-common, you can
    overwrite them here.
    Users who do not want to add plain text password in their properties or pom
    file, should use the userConfigFile and userKeyFile options for deployment.
    <oracleUsername>USERNAME</oracleUsername>
    <oraclePassword>PASSWORD</oraclePassword>
  -->

  <!-- Change the default values according to your environment -->
  <oracleServerUrl>http://localhost:8001</oracleServerUrl>
  <oracleServerName>soa_server1</oracleServerName>
  <oracleMiddlewareHome>/home/myhome/Oracle/Middleware</oracleMiddlewareHome>
</properties>
```

You can set these properties, or define any other properties that you want to have available to SOA Projects. To refer to a property in your SOA Project POM, use the syntax `$propertyName`, for example. `$oracleServerName` would be replaced with `soa_server1` in the previous example.

Building Oracle Service Bus Projects with Maven

You can use the Oracle Service Bus Maven archetypes to create, build, and deploy Oracle Service Bus applications.

Topics:

- [Introduction to Building Oracle Service Bus Projects with Maven](#)
- [Creating an Oracle Service Bus Application from a Maven Archetype](#)
- [Editing Your OSB Application in Oracle JDeveloper](#)
- [Creating an Oracle Service Bus Project from a Maven Archetype](#)
- [Building Your OSB Project with Maven](#)
- [Deploying Your Project to the Oracle Service Bus Server with Maven](#)
- [What You May Need to Know About the Oracle Service Bus Parent POM](#)

For more information about using the Oracle Service Bus development plug-in with Maven, see "Using the Oracle Service Bus Development Maven Plug-In" in *Developing Services with Oracle Service Bus*.

14.1 Introduction to Building Oracle Service Bus Projects with Maven

Oracle Service Bus provides a Maven plug-in and three archetypes.

The Maven coordinates are described in [Table 14-1](#).

Table 14-1 *Maven Coordinates with Oracle Service Bus*

Artifact	groupid	artifactId	version
OSB plug-in	com.oracle.servicebus	oracle-servicebus-plugin	12.2.1-0-0
OSB Application archetype	com.oracle.servicebus	oracle-servicebus-application	12.2.1-0-0
OSB Project archetype	com.oracle.servicebus	oracle-servicebus-project	12.2.1-0-0
OSB System Resources archetype	com.oracle.servicebus	oracle-servicebus-system	12.2.1-0-0

The Oracle Service Bus plug-in supports the following goals:

Goal	Purpose
package	Creates a service bus archive (SBAR) file from the project.
deploy	Deploys the SBAR file to a runtime environment. Note that this goal is mapped to the pre-integration-test phase in the default lifecycle, not the deploy phase, as deployment to a runtime environment is usually done in the pre-integration-test phase in Maven.

The custom packaging type `sbar` is defined, representing an Oracle Service Bus archive.

14.2 Creating an Oracle Service Bus Application from a Maven Archetype

You can create a new Oracle Service Bus application (containing an OSB Project and an OSB System Resources project) using the OSB Application Maven archetype.

To do so, execute a command similar to the following:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.servicebus.archetype
  -DarchetypeArtifactId=oracle-servicebus-application
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-servicebus-application
  -Dversion=1.0-SNAPSHOT
  -DprojectName=my-project
  -DconfigJar=myjar.jar
```

This command runs Maven's `archetype:generate` goal which allows you to create a new project from an archetype. [Table 14-4](#) describes the parameters.

Table 14-2 Parameters for the Oracle Service Bus Project

Parameter	Purpose
<code>archetypeGroupId</code>	The <code>groupId</code> of the archetype that you want to use to create the new project. This must be <code>com.oracle.servicebus</code> as shown in the preceding example.
<code>archetypeArtifactId</code>	The <code>artifactId</code> of the archetype that you want to use to create the new project. This must be <code>oracle-servicebus-application</code> as shown in the preceding example.
<code>archetypeVersion</code>	The version of the archetype that you want to use to create the new project. This must be <code>12.2.1-0-0</code> , as shown in the preceding example.
<code>groupId</code>	The <code>groupId</code> for your new project. This usually starts with your organization's domain name in reverse format.
<code>artifactId</code>	The <code>artifactId</code> for your new project. This is usually an identifier for this project.
<code>version</code>	The version for your new project. This is usually <code>1.0-SNAPSHOT</code> for a new project.

Table 14-2 (Cont.) Parameters for the Oracle Service Bus Project

Parameter	Purpose
projectName	The name for the OSB project to create inside the application. This should be different from the name of the application (that is, <code>artifactId</code>), and it cannot be <code>System</code> , which is reserved for system resources.
-DconfigJar	Used to specify a precompiled <code>sbconfig.jar</code> or <code>.sbar</code> file. This setting allows deployment of individual jar files without previous fresh build. It can be an absolute path. This setting requires <code>-DprojectName</code> to be set as well.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

After creating your application, it contains the following files:

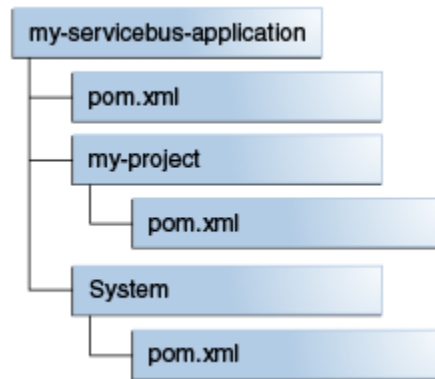


Table 14-3 describes the files included in the project.

Table 14-3 Files Created for the Oracle Service Bus Project

File	Purpose
pom.xml	The Maven Project Object Model (POM) file that describes your new application. It includes the Maven coordinates that you specified for your application. This POM is used to group all of the OSB projects that form part of this application.
my-project/pom.xml	The Maven POM file that describes your new project. It includes the Maven coordinates that you specified for your project, and the appropriate plug-in definitions to use the Oracle Service Bus Maven plug-in to build your project into an <code>sbar</code> file.
System/pom.xml	A Maven Project Object Model (POM) file for building OSB system resources into a <code>sbar</code> file.

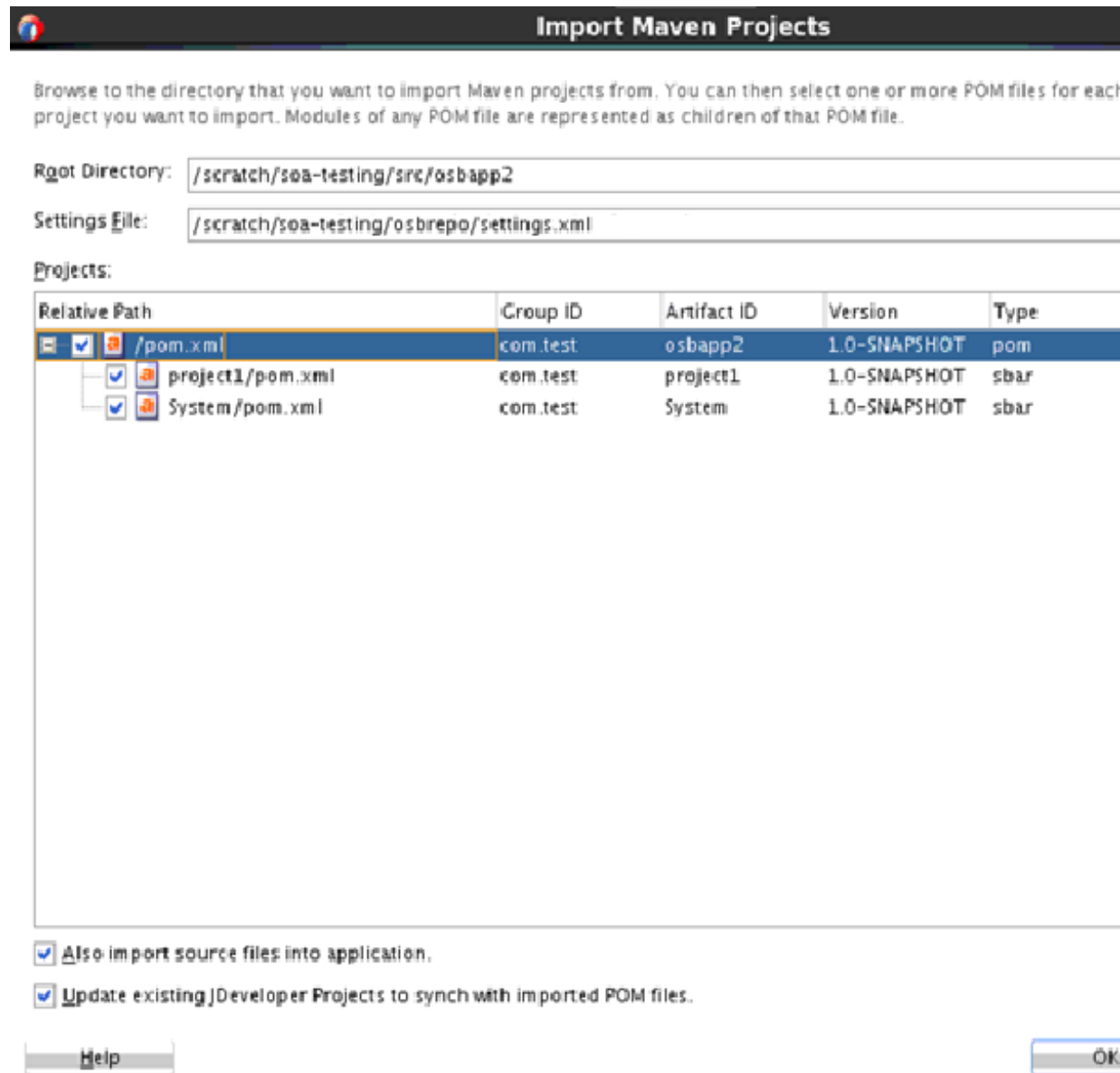
14.3 Editing Your OSB Application in Oracle JDeveloper

You can edit your application in Oracle JDeveloper to define OSB resources.

To edit your application, first open the application in JDeveloper:

1. Open the **File** menu, then select **Import...**
2. In the **Import** dialog box, select the **Maven Project** option and click **OK**.

The **Import Maven Projects** dialog appears, as shown in the following figure:



3. In the **Root Directory** field, enter the path to the application you want to import into JDeveloper.
4. In the **Settings File** field, enter the path to your Maven settings.xml file. The default value is most likely correct unless you are using a non-standard location for your Maven settings file.

5. Click **Refresh** to load a list of projects available at that location.
6. Select the projects that you want to import. Also select **Update existing JDeveloper Projects to synch with imported POM files**.
7. Click **OK** to complete the import.

Your applications are opened in JDeveloper.

When you import an Oracle Service Bus application (or project) into JDeveloper, you have the choice of creating a new application (or project) directory, or simply creating the JDeveloper project files (jws and jpr files) in the existing location:

- To create a new copy of the application (or project) in a new directory, select the **Also import source files into application** option and provide a new directory in the import dialog box.
- To create the JDeveloper files in the existing directory, do not select the **Also import source files into application** option, and select the existing directory when prompted for the project location.

14.4 Creating an Oracle Service Bus Project from a Maven Archetype

You can create a new Oracle Service Bus Project inside an existing OSB application using the OSB Project Maven archetype.

To do so, execute a command similar to the following, from your OSB Application root directory:

```
mvn archetype:generate
-DarchetypeGroupId=com.oracle.servicebus.archetype
-DarchetypeArtifactId=oracle-servicebus-project
-DarchetypeVersion=12.2.1-0-0
-DgroupId=org.mycompany
-DartifactId=my-second-project
-Dversion=1.0-SNAPSHOT
```

This command runs Maven's **archetype:generate** goal, which allows you to create a new project from an archetype. [Table 14-4](#) describes the parameters.

Table 14-4 Parameters for the Oracle Service Bus Project from a Maven Archetype

Parameter	Purpose
archetypeGroupId	The groupId of the archetype that you want to use to create the new project. This must be <code>com.oracle.servicebus</code> as shown in the preceding example.
archetypeArtifactId	The artifactId of the archetype that you want to use to create the new project. This must be <code>oracle-servicebus-project</code> as shown in the preceding example.
archetypeVersion	The version of the archetype that you want to use to create the new project. This must be <code>12.2.1-0-0</code> as shown in the preceding example.
groupId	The groupId for your new project. This usually starts with your organization's domain name in reverse format.

Table 14-4 (Cont.) Parameters for the Oracle Service Bus Project from a Maven Archetype

Parameter	Purpose
artifactId	The artifactId for your new project. This is usually an identifier for this project. It cannot be System, which is reserved for system resources.
version	The version for your new project. This usually is 1.0-SNAPSHOT for a new project.

You can also run the command without any arguments, as shown in the following example. In this case, Maven displays a list of available archetypes and prompts you to enter the required information.

```
mvn archetype:generate
```

Note that OSB Projects must be located inside an OSB Application.

After creating your project, it contains the following files:

```
my-second-project/  
|-- pom.xml
```

The following table describes the file included in the project:

File	Purpose
pom.xml	The Maven Project Object Model (POM) file that describes your new project, it includes the Maven coordinates that you specified for your project, and it also includes the appropriate plug-in definitions to use the OSB Maven Plug-in to build your project into a sbar file.

Maven also updates the OSB Application POM file to include this new project. If you ran the preceding command in the application you created in [Creating an Oracle Service Bus Application from a Maven Archetype](#), you would see the following in your OSB Application POM:

```
<modules>  
  <module>my-project</module>  
  <module>my-servicebus-project</module>  
  <module>my-second-project</module>  
</modules>
```

14.5 Building Your OSB Project with Maven

After you have written your project code, you can use Maven to build the your OSB project.

To build the SBAR file, execute the following command:

```
mvn package -DoracleHome=/path/to/osbhome
```

The preceding command creates a SBAR file from your project and places it in:

```
project/.data/maven/sbconfig.sbar
```

The following parameter may be specified for the packaging. You can specify it either in the POM file for the project or on the command line as shown in the preceding example.

Parameter	Purpose
<code>oracleHome</code>	The location of the Oracle Home for Oracle Fusion Middleware.

14.6 Deploying Your Project to the Oracle Service Bus Server with Maven

You can deploy your OSB project to the Oracle Service Bus server with Maven.

To deploy the SBAR file, execute the following command:

```
mvn pre-integration-test
```

You can specify the following parameters for the deployment. You can specify them either in the POM file for the project or on the command line.

Parameter	Purpose
<code>oracleHome</code>	The location of the Oracle Fusion Middleware Oracle Home where OSB is installed.
<code>oracleServerUrl</code>	The URL of the server in the OSB domain.
<code>customization</code>	(optional) The name of the OSB customization file to use, if any.
<code>oracleUsername</code>	User name to be used for deployment.
<code>oraclePassword</code>	Password to be used for deployment.
<code>configJar</code>	The name of the <code>.sbar</code> or <code>sbconfig.jar</code> file to be deployed. Use this parameter to specify a precompiled <code>sbconfig.jar</code> or <code>.sbar</code> file. You can use an absolute path. This setting allows deployment of individual jar files without needing to build the file. If you use this setting, you must also specify the <code>projectName</code> parameter.
<code>projectName</code>	The name of the project. Use this parameter to specify the project for which the <code>sbconfig.jar</code> set by the <code>configJar</code> parameter is deployed. This parameter matches the <code>artifactId</code> in the POM file of the respective project. This setting is ignored when <code>DconfigJar</code> is not present.

To specify the parameters:

- On the command line: Use the format `-Dparameter=value`, as shown in this example (note that you enter the whole command on one line):

```
mvn pre-integration-test
-DoracleServerUrl=http://test.server:7001
-DoracleUsername=weblogic
-DoraclePassword=welcome1
-DconfigJar=D:\ServicebusApp\SBProject\.data\maven\sbconfig.sbar
-DprojectName=SBProject
```

- In your project POM file: Add a `plugin` section as shown in the following example:

```
<plugins>

  <plugin>
    <groupId>com.oracle.servicebus</groupId>
    <artifactId>oracle-servicebus-plugin</artifactId>
    <version>12.2.1-0-0</version>
    <extensions>true</extensions>
    <configuration>
      <oracleHome>/u01/osbhome</oracleHome>
      <oracleServerUrl>http://test.server:7001</oracleServerUrl>
      <oracleUsername>weblogic</oracleUsername>
      <oraclePassword>welcome1</oraclePassword>
    </configuration>
  </plugin>
</plugins>
```

14.7 What You May Need to Know About the Oracle Service Bus Parent POM

The OSB Parent POM is provided as a point of customization. For example, you can use it to set some environment-wide defaults, such as the URL, user name, and password for your test server, then you may want to put these in the OSB Parent POM.

You can set these properties or define any other properties that you want to have available to OSB Projects. To refer to a property in your OSB Project POM, use the syntax **\$propertyName**. For example, **\$oracleServerName** would be replaced with **osb_server1** in the following example.

Projects that are created from the OSB archetypes automatically use values from the OSB Parent POM if you do not override them.

The following is an example of an OSB Parent POM which defines some properties:

```
<properties>
  <!--
    These two properties are defined in com.oracle.maven:oracle-common, you can
    overwrite them here.
    Users who do not want to add plain text password in their properties or
    pom file, should use the userConfigFile and userKeyFile options for deployment.
  <oracleUsername>USERNAME</oracleUsername>
  <oraclePassword>PASSWORD</oraclePassword>
  -->

  <!-- Change the default values according to your environment -->
  <oracleServerUrl>t3://localhost:7001</oracleServerUrl>
  <oracleServerName>osb_server1</oracleServerName>
  <oracleHome>/u01/osbhome</oracleHome>
</properties>
```

Building a Real Application with Maven

Many real world applications include modules that are targeted to be deployed on different runtime environments. For example, you may have a web application that uses data stored in a Coherence cache.

This chapter describes how to build such a web application.

Topics:

- [Introducing the Maven Example Application](#)
- [About Multi-Module Maven Projects](#)
- [Building a Maven Project](#)

15.1 Introducing the Maven Example Application

The example application that you build in this chapter displays a list of people, with their names and age, on a web page. It also allows you to add a new person. The details of the people are stored in a Coherence cache.

This application contains the following parts:

- A Coherence GAR project, which contains a Person POJO (Plain Old Java Object), which you need to build into a Portable Object, a utility class to access the cache, and Coherence cache definitions
- A Java EE web application, which you need to build into a WAR, which contains a servlet and a deployment descriptor
- A project to assemble the GAR and WAR into an EAR and deploy that EAR to WebLogic Server

In this example, you can see how to build a multi-module Maven project, with dependencies between modules, and how to assemble our application components into a deployable EAR file that contains the whole application.

The aim of this chapter is to show how to use Maven to build whole applications, not to demonstrate how to write web or Coherence applications, so the content of the example itself, in terms of the servlet and the coherence code, is quite basic. For more information, refer to [Building Java EE Projects for WebLogic Server with Maven](#) and [Building Oracle Coherence Projects with Maven](#).

15.2 About Multi-Module Maven Projects

Maven lets you create projects with multiple modules. Each module is in effect another Maven project. At the highest level, you have a POM file that tells Maven about the modules and lets you build the whole application with one Maven command.

Each of the modules are placed in a subdirectory of the root of the top-level project. In the example, the top-level project is called `my-real-app` and the three modules are `my-real-app-gar`, `my-real-app-war` and `my-real-app-ear`. The Maven coordinates of the projects are as follows:

GroupId	ArtifactId	Version	Packaging
org.mycompany	my-real-app	1.0-SNAPSHOT	pom
org.mycompany	my-real-app-gar	1.0-SNAPSHOT	gar
org.mycompany	my-real-app-war	1.0-SNAPSHOT	war
org.mycompany	my-real-app-ear	1.0-SNAPSHOT	ear

The following are the files that make up the application:

`pom.xml`

`my-real-app-gar/pom.xml`

`my-real-app-gar/src/main/resources/META-INF/pof-config.xml`

`my-real-app-gar/src/main/resources/META-INF/coherence-application.xml`

`my-real-app-gar/src/main/resources/META-INF/cache-config.xml`

`my-real-app-gar/src/main/java/org/mycompany/CacheWrapper.java`

`my-real-app-gar/src/main/java/org/mycompany/Person.java`

`my-real-app-war/pom.xml`

`my-real-app-war/src/main/webapp/WEB-INF/web.xml`

`my-real-app-war/src/main/java/org/mycompany/servlets/MyServlet.java`

`my-real-app-ear/pom.xml`

`my-real-app-ear/src/main/application/META-INF/weblogic-application.xml`

At the highest level, the POM file points to the three modules.

- The `my-real-app-gar` directory contains the Coherence GAR project. It contains its own POM, the Coherence configuration files, a POJO/POF class definition (`Person.java`) and a utility class that is needed to access the cache (`CacheWrapper.java`).
- The `my-real-app-war` directory contains the web application. It contains its own POM, a Servlet and a deployment descriptor. This project depends on the `my-real-app-gar` project.
- The `my-real-app-ear` directory contains the deployment descriptor for the EAR file and a POM file to build and deploy the EAR.

15.3 Building a Maven Project

To build the example project, you create the directory, and then create the GAR, WAR, and EAR projects.

This section includes the following topics:

- [Creating a Directory for the Projects](#)
- [Creating the GAR Project](#)
- [Creating the WAR Project](#)

- [Creating the EAR Project](#)
- [Creating the Top-Level POM](#)
- [Building the Application Using Maven](#)

15.3.1 Creating a Directory for the Projects

Create a directory to hold the projects, using the following command:

```
mkdir my-real-app
```

Throughout the rest of this chapter, paths shown are relative to this directory.

15.3.2 Creating the GAR Project

This section includes the following topics:

- [Creating the Initial GAR Project](#)
- [Creating or Modifying the POM File](#)
- [Creating or Modifying the Coherence Configuration Files](#)
- [Creating the Portable Objects](#)
- [Creating a Wrapper Class to Access the Cache](#)

15.3.2.1 Creating the Initial GAR Project

You can create the GAR project either using an archetype, as described in [Creating a Coherence Project from a Maven Archetype](#), or you can create the directories and files manually:

- To use the archetype, run the following command:

```
mvn archetype:generate
  -DarchetypeGroupId=com.oracle.coherence.archetype
  -DarchetypeArtifactId=gar-maven-archetype
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-real-app-gar
  -Dversion=1.0-SNAPSHOT
```

- To create the project manually, use the following commands to create the necessary directories:

```
mkdir -p my-real-app-gar/src/main/resources/META-INF
mkdir -p my-real-app-gar/src/main/java/org/mycompany
```

15.3.2.2 Creating or Modifying the POM File

If you use the archetype, you already have a POM file. Modify that file to match the following example. If you create the project manually, create the POM file (`my-real-app-gar/pom.xml`) with the following contents:

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/
maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>org.mycompany</groupId>
```

```
<artifactId>my-real-app-gar</artifactId>
<version>1.0-SNAPSHOT</version>
<packaging>gar</packaging>
<parent>
  <groupId>org.mycompany</groupId>
  <artifactId>my-real-app</artifactId>
  <version>1.0-SNAPSHOT</version>
</parent>
<dependencies>
  <dependency>
    <groupId>com.oracle.coherence</groupId>
    <artifactId>gar-maven-plugin</artifactId>
    <version>12.2.1-0</version>
    <scope>provided</scope>
  </dependency>
</dependencies>
<build>
  <pluginManagement>
    <plugins>
      <plugin>
        <groupId>com.oracle.coherence</groupId>
        <artifactId>gar-maven-plugin</artifactId>
        <version>${coherence.version}</version>
        <extensions>true</extensions>
      </plugin>
    </plugins>
  </pluginManagement>
  <plugins>
    <plugin>
      <groupId>com.oracle.coherence</groupId>
      <artifactId>gar-maven-plugin</artifactId>
      <extensions>true</extensions>
      <configuration>
        <generatePof>true</generatePof>
      </configuration>
    </plugin>
  </plugins>
</build>
</project>
```

Examine the POM file to understand each part of the file:

- The Maven coordinates for this project are set:

```
<groupId>org.mycompany</groupId>
<artifactId>my-real-app-gar</artifactId>
<version>1.0-SNAPSHOT</version>
<packaging>gar</packaging>
```

Notice that the packaging is `gar` because you use the Coherence Maven plug-in to build this project into a Coherence GAR file.

- The coordinates of the parent project are set. These coordinates point back to the top-level project. You need to create the POM for the top-level project in a later step.

```
<parent>
  <groupId>org.mycompany</groupId>
  <artifactId>my-real-app</artifactId>
  <version>1.0-SNAPSHOT</version>
</parent>
```

- The `dependencies` section identifies any dependencies that this project has. In this case, you depend only on the Coherence library, that is, `com.oracle.coherence:coherence:12.2.1-0-0`. The scope provided means that this library is just for compilation and does not need to be packaged in the artifact that you build (the GAR file) as it is already provided in the runtime environment.

```
<dependencies>
  <dependency>
    <groupId>com.oracle.coherence</groupId>
    <artifactId>gar-maven-plugin</artifactId>
    <version>12.2.1-0-0</version>
    <scope>provided</scope>
  </dependency>
</dependencies>
```

- The `pluginManagement` section tells Maven to enable extensions for this plug-in. This is necessary to allow Maven to recognize GAR files as a target artefact type.

```
<pluginManagement>
  <plugins>
    <plugin>
      <groupId>com.oracle.coherence</groupId>
      <artifactId>gar-maven-plugin</artifactId>
      <version>${coherence.version}</version>
      <extensions>true</extensions>
    </plugin>
  </plugins>
</pluginManagement>
```

- The `plugins` section includes any information that you must pass to the Coherence GAR plug-in. In this case, you must set `generatePof` to `true` so that the plug-in looks for POJOs with POF annotations and generate the necessary artifacts.

```
<plugins>
  <plugin>
    <groupId>com.oracle.coherence</groupId>
    <artifactId>gar-maven-plugin</artifactId>
    <extensions>true</extensions>
    <configuration>
      <generatePof>true</generatePof>
    </configuration>
  </plugin>
</plugins>
```

15.3.2.3 Creating or Modifying the Coherence Configuration Files

There are three Coherence configuration files that you need in your GAR project. If you use the archetype, the files already exist, but you need to modify them to match the following examples. If you create the project manually, create these files in the following locations:

```
my-real-app-gar/src/main/resources/META-INF/pof-config.xml
my-real-app-gar/src/main/resources/META-INF/coherence-application.xml
my-real-app-gar/src/main/resources/META-INF/cache-config.xml
```

- The following example shows the contents for the `pof-config.xml` file:

```
<?xml version="1.0"?>
<pof-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://xmlns.oracle.com/coherence/coherence-pof-config"
```

```

        xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-pof
config coherence-pof-config.xsd">
<user-type-list>
  <!-- by default just include coherence POF user types -->
  <include>coherence-pof-config.xml</include>
</user-type-list>
</pof-config>

```

This file requires little or no modification if you created it with the archetype.

- The following example shows the contents for the coherence-application.xml file:

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<coherence-application xmlns="http://xmlns.oracle.com/weblogic/coherence-
application">
  <cache-configuration-ref>META-INF/cache-config.xml</cache-configuration-ref>
  <pof-configuration-ref>META-INF/pof-config.xml</pof-configuration-ref>
</coherence-application>

```

This file requires little or no modification if you created it with the archetype.

- The cache-config.xml file must be updated if you have used the archetype.

In this file, create a cache named People, with a caching scheme named real-distributed-gar and a service name of RealDistributedCache, which uses the local backing scheme and is automatically started. If you are not familiar with these terms, see [Building Oracle Coherence Projects with Maven](#). The following shows an example of the file:

```

<?xml version="1.0"?>
<cache-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://xmlns.oracle.com/coherence/coherence-cache-config"
  xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-
cache-config coherence-cache-config.xsd">

  <caching-scheme-mapping>
    <cache-mapping>
      <cache-name>People</cache-name>
      <scheme-name>real-distributed-gar</scheme-name>
    </cache-mapping>
  </caching-scheme-mapping>

  <caching-schemes>
    <distributed-scheme>
      <scheme-name>real-distributed-gar</scheme-name>
      <service-name>RealDistributedCache</service-name>
      <backing-map-scheme>
        <local-scheme/>
      </backing-map-scheme>
      <autostart>true</autostart>
    </distributed-scheme>
  </caching-schemes>
</cache-config>

```

15.3.2.4 Creating the Portable Objects

Create the Person object, which will store information in the cache. Create a new Java class in the following location:

```
my-real-app-gar/src/main/java/org/mycompany/Person.java
```

The following is the content for this class:

```

package org.mycompany;

import com.tangosol.io.pof.annotation.Portable;
import com.tangosol.io.pof.annotation.PortableProperty;

@Portable
public class Person {
    @PortableProperty(0)
    public String name;
    @PortableProperty(1)
    public int age;

    public Person() {}

    public Person(String name, int age) {
        this.name = name;
        this.age = age;
    }

    public String getName() { return this.name; }
    public int    getAge()  { return this.age; }
}

```

This POJO tells Coherence what to do with the class. Because the focus of this chapter is on building applications with Maven, it does not go into the details of writing Coherence applications. For more information on Coherence, refer to [Building Oracle Coherence Projects with Maven](#).

15.3.2.5 Creating a Wrapper Class to Access the Cache

Create a small wrapper class that you can use to access the cache. Create another Java class in this location:

```
my-real-app-gar/src/main/java/org/mycompany/CacheWrapper.java
```

The following is the content for this class:

```

package org.mycompany;

import org.mycompany.Person;
import com.tangosol.net.CacheFactory;
import java.util.Set;

public class CacheWrapper {
    private static CacheWrapper INSTANCE;

    public Set getPeople() {
        return CacheFactory.getCache("People").entrySet();
    }

    public void addPerson(int personid, String name, int age) {
        CacheFactory.getCache("People").put(personid, new Person(name, age));
    }

    public static final CacheWrapper getInstance() {
        if(INSTANCE == null) INSTANCE = new CacheWrapper();
        return INSTANCE;
    }
}

```

Later, you can use this class in a Servlet to get data from the cache and to add new data to the cache.

15.3.3 Creating the WAR Project

This section includes the following topics:

- [Creating the Initial WAR Project](#)
- [Creating or Modifying the POM File](#)
- [Creating the Deployment Descriptor](#)
- [Creating the Servlet](#)

15.3.3.1 Creating the Initial WAR Project

You can create the WAR project either using an archetype as described in [Building Java EE Projects for WebLogic Server with Maven](#), or you can create the directories and files manually.

- To use the archetype, run the following command:

```
mvn archetype:generate
  -DarchetypeArtifactId=basic-webapp
  -DarchetypeVersion=12.2.1-0-0
  -DgroupId=org.mycompany
  -DartifactId=my-real-app-war
  -Dversion=1.0-SNAPSHOT
```

If you use the archetype, you must remove any unnecessary files included in the project.

- To create the project manually, use the following commands to create the necessary directories:

```
mkdir -p my-real-app-war/src/main/webapp/WEB-INF
mkdir -p my-real-app-war/src/main/java/org/mycompany/servlets
```

15.3.3.2 Creating or Modifying the POM File

If you use the archetype, the POM file already exists. Modify that file to match the following example. If you created the project manually, create the POM file (`my-real-app-war/pom.xml`) with the following contents:

```
<project>
  <modelVersion>4.0.0</modelVersion>
  <groupId>org.mycompany</groupId>
  <artifactId>my-real-app-war</artifactId>
  <version>1.0-SNAPSHOT</version>
  <packaging>war</packaging>
  <parent>
    <groupId>org.mycompany</groupId>
    <artifactId>my-real-app</artifactId>
    <version>1.0-SNAPSHOT</version>
  </parent>
  <name>my-real-app-war</name>
  <dependencies>
    <dependency>
      <groupId>org.mycompany</groupId>
      <artifactId>my-real-app-gar</artifactId>
```

```

        <version>1.0-SNAPSHOT</version>
        <scope>provided</scope>
    </dependency>
    <dependency>
        <groupId>javax.servlet</groupId>
        <artifactId>javax.servlet-api</artifactId>
        <version>3.0.1</version>
        <scope>provided</scope>
    </dependency>
</dependencies>
</project>

```

Examine the POM file to understand each part of the file:

- You must set the coordinates for this project. Notice that the packaging for this project is war.

```

<groupId>org.mycompany</groupId>
<artifactId>my-real-app-war</artifactId>
<version>1.0-SNAPSHOT</version>
<packaging>war</packaging>

```

- Define the parent, as you did in the GAR project:

```

<parent>
    <groupId>org.mycompany</groupId>
    <artifactId>my-real-app</artifactId>
    <version>1.0-SNAPSHOT</version>
</parent>

```

- List the dependencies for this project. In this case, there are two dependencies: the GAR project to access the POJO and utility classes you defined there and the Servlet API. This sets the display-name for the web application.

```

<dependencies>
    <dependency>
        <groupId>org.mycompany</groupId>
        <artifactId>my-real-app-gar</artifactId>
        <version>1.0-SNAPSHOT</version>
        <scope>provided</scope>
    </dependency>
    <dependency>
        <groupId>javax.servlet</groupId>
        <artifactId>javax.servlet-api</artifactId>
        <version>3.0.1</version>
        <scope>provided</scope>
    </dependency>
</dependencies>

```

15.3.3.3 Creating the Deployment Descriptor

The web application has a simple Java EE deployment descriptor that sets the display-name for the web application. It is located at the following location:

```
my-real-app-war/src/main/webapp/WEB-INF/web.xml
```

The following are the contents of this file:

```

<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://java.sun.com/xml/ns/javaee"
xmlns:web="http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"

```

```
xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd" id="WebApp_ID" version="2.5">

    <display-name>my-real-app-war</display-name>

</web-app>
```

15.3.3.4 Creating the Servlet

To create the servlet, locate the `MyServlet.java` file:

```
my-real-app-war/src/main/java/org/mycompany/servlets/MyServlet.java
```

The servlet displays a list of people that are currently in the cache and allows you to add a new person to the cache. The aim of the section is to learn how to build these types of applications with Maven, not to learn how to write Java EE web applications, hence the use of a simplistic servlet.

The following is the content for the servlet class:

```
package org.mycompany.servlets;

import org.mycompany.Person;
import org.mycompany.CacheWrapper;

import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import javax.servlet.ServletException;
import javax.servlet.annotation.WebServlet;
import java.io.IOException;
import java.io.PrintWriter;
import java.util.Map;
import java.util.Set;
import java.util.Iterator;

@WebServlet(name = "MyServlet", urlPatterns = "MyServlet")
public class MyServlet extends HttpServlet {
    protected void doPost(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
        String id = request.getParameter("id");
        String name = request.getParameter("name");
        String age = request.getParameter("age");
        if (name == null || name.isEmpty()
            || age == null || age.isEmpty()
            || id == null || id.isEmpty()) {
            // no need to add a new entry
        } else {
            // we have a new entry - so add it
            CacheWrapper.getInstance().addPerson(Integer.parseInt(id), name,
Integer.parseInt(age));
        }
        renderPage(request, response);
    }

    protected void doGet(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
        renderPage(request, response);
    }

    private void renderPage(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
```



```

// get the data
Set people = CacheWrapper.getInstance().getPeople();
PrintWriter out = response.getWriter();
out.write("<html><head><title>MyServlet</title></head><body>");
out.write("<h2>Add a new person</h2>");
out.write("<form name=\"myform\" method=\"POST\">");
out.write("ID:<input type=\"text\" name=\"id\"/><br/>");
out.write("Name:<input type=\"text\" name=\"name\"/><br/>");
out.write("Age:<input type=\"text\" name=\"age\"/><br/>");
out.write("<input type=\"submit\" name=\"submit\" value=\"add\"/>");
out.write("</form>");
out.write("<h2>People in the cache now</h2>");
out.write("<table><tr><th>ID</th><th>Name</th><th>Age</th></tr>");
// for each person in data
if (people != null) {
    Iterator i = people.iterator();
    while (i.hasNext()) {
        Map.Entry entry = (Map.Entry)i.next();
        out.write("<tr><td>"
            + entry.getKey()
            + "</td><td>"
            + ((Person)entry.getValue()).getName()
            + "</td><td>"
            + ((Person)entry.getValue()).getAge()
            + "</td></tr>");
    }
}
out.write("</table></body></html>");
}
}

```

Check if the user has entered any data in the form. If so, add a new person to the cache using that data. Note that this application has fairly minimal error handling. To add the new person to the cache, use the **addPerson()** method in the **CacheWrapper** class that you created in your GAR project.

Print out the contents of the cache in a table. In this example, assume that the cache has a reasonably small number of entries, and read them all using the **getPeople()** method in the **CacheWrapper** class.

15.3.4 Creating the EAR Project

The EAR project manages assembling the WAR and the GAR into an EAR.

This section includes the following topics:

- [Creating the Initial EAR Project](#)
- [About the POM File for the Example Application](#)
- [About the Deployment Descriptor for the Example Application](#)

15.3.4.1 Creating the Initial EAR Project

Create the EAR project manually using the following command:

```
mkdir -p my-real-app-ear/src/main/application/META-INF
```

There are two files in this project: a POM file and a deployment descriptor:

```
my-real-app-ear/pom.xml
my-real-app-ear/src/main/application/META-INF/weblogic-application.xml
```

15.3.4.2 About the POM File for the Example Application

The following are the contents of the POM file:

```
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/
XMLSchema-instance" xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://
maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>org.mycompany</groupId>
  <artifactId>my-real-app-ear</artifactId>
  <version>1.0-SNAPSHOT</version>
  <packaging>ear</packaging>
  <parent>
    <groupId>org.mycompany</groupId>
    <artifactId>my-real-app</artifactId>
    <version>1.0-SNAPSHOT</version>
  </parent>
  <name>ear assembly</name>
  <dependencies>
    <dependency>
      <groupId>org.mycompany</groupId>
      <artifactId>my-real-app-gar</artifactId>
      <version>1.0-SNAPSHOT</version>
      <type>gar</type>
      <scope>optional</scope>
    </dependency>
    <dependency>
      <groupId>org.mycompany</groupId>
      <artifactId>my-real-app-war</artifactId>
      <version>1.0-SNAPSHOT</version>
      <type>war</type>
    </dependency>
  </dependencies>
  <build>
    <plugins>
      <plugin>
        <artifactId>maven-ear-plugin</artifactId>
        <configuration>
          <archive>
            <manifest>
              <addClasspath>>true</addClasspath>
            </manifest>
          </archive>
          <artifactTypeMappings>
            <artifactTypeMapping type="gar" mapping="jar"/>
          </artifactTypeMappings>
        </configuration>
      </plugin>
      <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-dependency-plugin</artifactId>
        <executions>
          <execution>
            <id>copy-gar-locally</id>
            <phase>prepare-package</phase>
            <goals>
              <goal>copy</goal>
            </goals>
            <configuration>
              <artifactItems>
                <artifactItem>
```

```

                <groupId>org.mycompany</groupId>
                <artifactId>my-real-app-gar</artifactId>
                <version>1.0-SNAPSHOT</version>
                <type>gar</type>
            </artifactItem>
        </artifactItems>
    </configuration>
</execution>
</executions>
</plugin>
<plugin>
<groupId>com.oracle.weblogic</groupId>
<artifactId>weblogic-maven-plugin</artifactId>
<version>12.2.1-0-0</version>
<executions>
    <!--Deploy the application to the server-->
    <execution>
        <phase>pre-integration-test</phase>
        <goals>
            <goal>deploy</goal>
        </goals>
        <configuration>
            <adminurl>t3://127.0.0.1:7001</adminurl>
            <user>weblogic</user>
            <password>welcome1</password>
            <middlewareHome>/home/mark/space/maven/wls030213</middlewareHome>
            <!--The location of the file or directory to be deployed-->
            <source>${project.build.directory}/${project.build.finalName}.$
{project.packaging}</source>
            <!--The target servers where the application is deployed-->
            <targets>AdminServer</targets>
            <verbose>true</verbose>
            <name>${project.build.finalName}</name>
        </configuration>
    </execution>
</executions>
</plugin>
</plugins>
</build>
</project>

```

Examine the POM file to understand each part of the file:

- Set the Maven coordinates for this project, and point to the parent:

```

<groupId>org.mycompany</groupId>
<artifactId>my-real-app-ear</artifactId>
<version>1.0-SNAPSHOT</version>
<packaging>ear</packaging>
<parent>
    <groupId>org.mycompany</groupId>
    <artifactId>my-real-app</artifactId>
    <version>1.0-SNAPSHOT</version>
</parent>

```

- The dependencies on the WAR and GAR projects are listed:

```

<dependencies>
    <dependency>
        <groupId>org.mycompany</groupId>
        <artifactId>my-real-app-gar</artifactId>
        <version>1.0-SNAPSHOT</version>
    </dependency>
</dependencies>

```

```

    <type>gar</type>
    <scope>optional</scope>
  </dependency>
</dependencies>
<dependency>
  <groupId>org.mycompany</groupId>
  <artifactId>my-real-app-war</artifactId>
  <version>1.0-SNAPSHOT</version>
  <type>war</type>
</dependency>
</dependencies>

```

- The first of three separate plug-in configurations is for the `maven-ear-plugin`. You need to tell it to treat a `gar` file like a `jar` file by adding an `artifactTypeMapping`, as in the following example:

```

<plugin>
  <artifactId>maven-ear-plugin</artifactId>
  <configuration>
    <archive>
      <manifest>
        <addClasspath>>true</addClasspath>
      </manifest>
    </archive>
    <artifactTypeMappings>
      <artifactTypeMapping type="gar" mapping="jar" />
    </artifactTypeMappings>
  </configuration>
</plugin>

```

- The second plug-in configuration is for the `maven-dependency-plugin`. Configure it to copy the `GAR` file from the `my-real-app-gar` project's output (`target`) directory into the `EAR` project:

```

<plugin>
  <groupId>org.apache.maven.plugins</groupId>
  <artifactId>maven-dependency-plugin</artifactId>
  <executions>
    <execution>
      <id>copy-gar-locally</id>
      <phase>prepare-package</phase>
      <goals>
        <goal>copy</goal>
      </goals>
      <configuration>
        <artifactItems>
          <artifactItem>
            <groupId>org.mycompany</groupId>
            <artifactId>my-real-app-gar</artifactId>
            <version>1.0-SNAPSHOT</version>
            <type>gar</type>
          </artifactItem>
        </artifactItems>
      </configuration>
    </execution>
  </executions>
</plugin>

```

- The third plug-in configuration is for the `weblogic-maven-plugin`. Tell it how to deploy the resulting `EAR` file. In this section, you must update the `adminurl`, `user`, `password`, and `target` parameters to match your environment. For details on these parameters, see [Table 10-1](#).

```

<plugin>
  <groupId>com.oracle.weblogic</groupId>
  <artifactId>weblogic-maven-plugin</artifactId>
  <version>12.2.1-0-0</version>
  <executions>
    <!--Deploy the application to the server-->
    <execution>
      <phase>pre-integration-test</phase>
      <goals>
        <goal>deploy</goal>
      </goals>
      <configuration>
        <adminurl>t3://127.0.0.1:7001</adminurl>
        <user>weblogic</user>
        <password>welcome1</password>
        <!--The location of the file or directory to be deployed-->
        <source>${project.build.directory}/${project.build.finalName}.${
{project.packaging}}</source>
        <!--The target servers where the application is deployed-->
        <targets>AdminServer</targets>
        <verbose>true</verbose>
        <name>${project.build.finalName}</name>
      </configuration>
    </execution>
  </executions>
</plugin>

```

Once you have completed the POM project, add a deployment descriptor.

15.3.4.3 About the Deployment Descriptor for the Example Application

The WebLogic deployment descriptor for the EAR file is located in this file:

```
my-real-app-ear/src/main/application/META-INF/weblogic-application.xml
```

The following are the contents:

```

<weblogic-application>
  <module>
    <name>GAR</name>
    <type>GAR</type>
    <path>my-real-app-gar-1.0-SNAPSHOT.gar</path>
  </module>
</weblogic-application>

```

This deployment descriptor provides the details for where in the EAR file the GAR file should be placed, and what it should be called.

15.3.5 Creating the Top-Level POM

Create the top-level POM. This is located in the pom.xml file in the root directory of your application and contains the following:

```

<project>
  <modelVersion>4.0.0</modelVersion>
  <groupId>org.mycompany</groupId>
  <artifactId>my-real-app</artifactId>
  <version>1.0-SNAPSHOT</version>
  <packaging>pom</packaging>
  <name>my-real-app</name>
  <modules>
    <module>my-real-app-war</module>

```

```
    <module>my-real-app-gar</module>
    <module>my-real-app-ear</module>
</modules>
<properties>
  <coherence.version>12.2.1-0</coherence.version>
</properties>
</project>
```

Set the coordinates for the project. These match the parent coordinates you specified in each of the three projects. Note that the packaging is `pom`. This tells Maven that this project is an assembly of a set of sub-projects, as named in the `modules` section.

There are one **module** entry for each of the three sub-projects.

Since this POM is the parent of the other three, and since POM's inherit from their parents, you can add any common properties to this POM and they will be available in all the three sub-projects. In this case, you are adding the property `coherence.version`.

15.3.6 Building the Application Using Maven

You can now build the application using Maven by using one or more of the following commands (in the top-level directory `my-real-app`):

```
mvn compile
mvn package
mvn verify
```

Maven executes all of the phases up to the one named. These commands have the following effect:

Command	Details
<code>mvn compile</code>	Compiles the Java source into target class files.
<code>mvn package</code>	<ol style="list-style-type: none">1. Compiles the Java source into target class files.2. Creates the archive (WAR, GAR, and so on) containing compiled files and resources (deployment descriptors, configuration files, and so on).
<code>mvn verify</code>	<ol style="list-style-type: none">1. Compiles the Java source into target Class files.2. Creates the archive (WAR, GAR, and so on) containing compiled files and resources (deployment descriptors, configuration files, and so on).3. Deploys the EAR file to the WebLogic Server environment.

From Build Automation to Continuous Integration

There are some important considerations that you need to think about when you move from a simple build automation to a continuous integration environment.

The examples in this book show how to use Maven to manage the build process for projects which are targeted for deployment on Oracle Fusion Middleware environments. The next logical step is to move towards a continuous integration approach, so that the builds of all of your projects can be triggered, managed and monitored in one central place.

The advantage of continuous integration comes from componentization of an application and constant integration of those components as they are independently modified, often by different groups of developers. Maven projects are used to represent these components and their relationships to each other. Since Hudson understands Maven's project relationship model, it can automatically rebuild and retest affected components in the order that they should be built in. When Hudson detects the changes to the code-base, the affected components are built and reintegrated in correct order to ensure proper function of the entire application.

Topics:

- [About Dependency Management](#)
- [Understanding Maven Configuration to Support Continuous Integration Deployment](#)
- [Automating the Build with Hudson](#)
- [Monitoring the Build](#)

16.1 About Dependency Management

Dependency management is a key feature of Maven and something that distinguishes it from other build automation technologies, like ANT, which Fusion Middleware has supported for some time.

This section explores some important dependency management topics:

- [About Snapshot Versioning](#)
- [About Dependency Transitivity](#)
- [About Dependency Scope](#)
- [About Multiple Module Support](#)

16.1.1 About Snapshot Versioning

Snapshot versioning is covered more extensively in [About Maven Version Numbers](#). Using snapshots for components that are under development is required for the automated continuous integration system to work properly. Note that a fixed version, non-snapshot versioned artifact should not be modified and replaced. The best practice is that you should not update artifacts after they are released. This is a core assumption of the Maven approach. However, it is worth noting that often this assumption is not correct in enterprise software development, where vendors and end users do sometimes update "finished" artifacts without changing the version number, for example through patching them in place. Even though it is possible to violate this rule, every attempt should be made to comply to ensure integration stability.

16.1.2 About Dependency Transitivity

Most projects have dependencies on other artifacts. At build time, Maven obtains these artifacts from the configured artifact repositories and use them to resolve compilation, runtime and test dependencies.

Dependencies explicitly listed in the POM may also have dependencies of their own. These are commonly referred to as **transitive dependencies**. Based on dependency attributes such as scope and version, Maven uses rules to determine which dependencies the build should utilize. An important part of this resolution process has to do with version conflicts. It is possible that a project may have transitive dependencies on multiple versions of the same artifact (identical `groupId` and `artifactId`). In such a case, Maven uses the **nearest definition** which means that it uses the version of the closest dependency to your project in the tree of dependencies. You can always guarantee a particular version by declaring it explicitly in your project's POM.

Note:

If two dependency versions are at the same depth in the dependency tree, until Maven 2.0.8 it was not defined which one would win, but since Maven 2.0.9 it is the order in the declaration that counts. Hence, the first declaration wins.

16.1.3 About Dependency Scope

Dependencies may optionally specify a **scope**. In addition to determining whether or not a dependency is made available to the classpath during a particular build phase, scope affects how transitive dependency is propagated to the classpath.

There are six scopes available.

- **Compile:** This is the default scope, used if no scope is specified. Compile dependencies are available in all classpaths of a project. Furthermore, these dependencies are propagated to dependent projects.
- **Provided:** This is much like compile, but indicates you expect the JDK or a container to provide the dependency at runtime. For example, when building a web application for the Java Enterprise Edition, you can set the dependency on the servlet API and related Java EE APIs to scope provided because the web container provides those classes. This scope is only available on the compilation and test classpath, and is not transitive.

- **Runtime:** This scope indicates that the dependency is not required for compilation, but is for execution. It is in the runtime and test classpaths, but not the compile classpath.
- **Test:** This scope indicates that the dependency is not required for normal use of the application, and is only available for the test compilation and execution phases.
- **System:** This scope is similar to Provided except that you have to provide the JAR which contains it explicitly. The artifact is always available and is not looked up in a repository.
- **Import:** (*only available in Maven 2.0.9 or higher*) This scope is only used on a dependency of type POM. It indicates that the specified POM should be replaced with the dependencies in that POMs. Since they are replaced, dependencies with a scope of import do not actually participate in limiting the transitivity of a dependency.

16.1.4 About Multiple Module Support

A series of interdependent projects, such as an application, can be aggregated by a multi-module POM. This should not be confused with a parent POM which provides inherited configuration. A multi-module POM may also be an inheritance parent to sub-module projects. When a Maven build is executed upon a multi module POM, Maven examines the tree of sub-projects and calculates the correct order of dependency to build the modules.

Multiple module POMs can be useful for organizing multiple component builds in Hudson.

16.2 Understanding Maven Configuration to Support Continuous Integration Deployment

There are some aspects of Maven that you should consider while moving to a continuous integration environment.

This section contains the following topics:

- [Understanding Distribution Management](#)
- [Configuring Snapshot Repository Settings](#)

16.2.1 Understanding Distribution Management

Every project that is part of continuous integration must specify a **distributionManagement** section in its POM. This section tells Maven where the artifacts are going to be deployed at the end of the build process, that is, which repository (local or remote). The examples used in this book use the Archiva repository. Deploying artifacts to a repository makes them available for other projects to use as dependencies.

You must define a **distributionManagement** section that describes which repository to deploy snapshots and releases to. It is recommended that the **distributionManagement** configuration be placed at a common inherited POM that is shared among all projects such as the oracle-common POM, as described in [Customizing the Build Process with Maven POM Inheritance](#).

The following shows an example of a **distributionManagement** configuration:

```

<distributionManagement>
  <repository>
    <uniqueVersion>false</uniqueVersion>
    <id>releases</id>
    <name>Releases</name>
    <url>http://server:port/archiva/repository/releases/</url>
    <layout>default</layout>
  </repository>
  <snapshotRepository>
    <uniqueVersion>true</uniqueVersion>
    <id>snapshots</id>
    <name>Snapshots</name>
    <url>http://server:port/archiva/repository/snapshots</url>
    <layout>default</layout>
  </snapshotRepository>
</distributionManagement>

```

16.2.2 Configuring Snapshot Repository Settings

There are some important settings that govern how and when Maven accesses repositories:

- **Update Policy:** This controls how often Maven checks with a remote repository for updates to an artifact that it already has in its local repository. Configure your snapshot repository in your settings.xml in Hudson to use **updatePolicy** as **always**. The effect of **updatePolicy** is on your development systems. The default value is **daily**. If you want to integrate the changes as they occur in Hudson, change their **updatePolicy** accordingly. Dependencies may change suddenly and without warning. While the continuous integration system should have sufficient tests in place to reduce the occurrence of regressions, you can still run into issues depending on up-to-the-minute snapshots while developing. One such example is the API changes.

You should get all project snapshot dependencies up-to-date so that their local build reflects the current state of the deployed code-base prior to check-in.

- **Server credentials:** This tells Maven the credentials that are needed to access a remote repository; typically Maven repositories require you to authenticate before you are allowed to make changes to the repository, for example, publishing a new artifact). Unless you have given the Archiva guest user global upload privileges, which is not recommended, you must specify correct credentials for the snapshot repository in the servers section. You should have a unique Hudson user with snapshot repository upload permissions. See [Installing and Configuring the Archiva Maven Repository Manager](#) for details about user and role configuration.

Use Maven's password encryption for the password value. The Maven guide to password encryption can be found here:

<http://maven.apache.org/guides/mini/guide-encryption.html>.

The following shows a sample settings.xml configuration for the Hudson user:

```

<settings>
...
  <servers>
...
    <server>
      <id>snapshots</id>
      <username>hudson</username>
      <password>{COQLCE6DU6GtcS5P=}</password>
    </server>
  </servers>

```

```
    </server>
  ...
</servers>
...
</settings>
```

16.3 Automating the Build with Hudson

There are various options available to build Maven projects with Hudson. This section describes the approach recommended by Oracle.

Before proceeding, ensure that you have configured Hudson, as described in [Installing and Configuring Hudson for Continuous Integration](#).

This section contains the following topics:

- [Creating a Hudson Job to Build a Maven Project](#)
- [Triggering Hudson Builds](#)
- [Managing a Multi-Module Maven Build with Hudson](#)

16.3.1 Creating a Hudson Job to Build a Maven Project

To create a basic Maven Hudson job:

1. Open the Hudson web interface and log in, if necessary.
2. Create a new job:
 - a. Select **New Job** from the right-hand menu.
 - b. Provide a unique name and select **Build a free-style software project**.
 - c. Click **OK**.
3. Configure the source code management.

Ensure that you complete configuring the Subversion server, including the SSH public and private key configuration.

- a. Under **Source Code Management**, select **Subversion**.
- b. Provide the repository URL for your project directory. For example, `svn+ssh://subversion-server/ciroot/subversion/repository/trunk/projects/my-project`

Note:

This example uses a `svn+ssh` URL, which accesses Subversion using SSH. If you are using a different protocol, the steps that are necessary to configure it may vary slightly.

Hudson attempts to verify the URL and may respond with an error message like the following:

```
Unable to access svn+ssh://hostname/ciroot/subversion/repository/trunk :
svn: E200015: authentication cancelled(show details)
(Maybe you need to enter credential?)
```

If you get this error message, do the following:

- a. From the message, click **enter credentials**.
 - b. Select **SSH public key authentication (svn+ssh)**.
 - c. Enter the user name.
 - d. Enter the SSH private-key passphrase if required.
 - e. Select the private-key file from the Hudson file system. It should be in a `~/ .ssh/id_rsa` format.
-

4. Add a Maven build step:
 - a. Under the Build section, select **Invoke Maven 3** from the **Add Build Step** drop-down menu.
 - b. Select **Maven 3 home**. Add necessary goals and properties in the appropriate text fields.
 - c. If you have a SNAPSHOT continuous integration build environment, then configure the goals to perform a **clean deploy**.
 - d. If necessary, open the **Advanced** settings and ensure that the Settings entry points to the Maven settings that you created in the Hudson web interface, while configuring Hudson.
5. Save the configuration
Click **Save** at the bottom of the page.

16.3.2 Triggering Hudson Builds

Hudson provides number of ways to manage a continuous integration build's triggers in Hudson. These include manual and automated triggers. The option to manually start a build is always available for any job. When choosing an automated trigger, you may consider factors like the structure of the project, the location of the source code, the presence of any branches, and so on.

This section contains the following topics:

- [Triggering a Manual Build](#)
- [Triggering a Subversion Repository Build](#)
- [Triggering a Schedule-Based Build](#)

- [Triggering a Build Based on Hudson Dependency Changes](#)
- [Maven SNAPSHOT Changes](#)

Regardless of how the build is triggered, the job is added to the pending job queue and completed when the resources become available.

16.3.2.1 Triggering a Manual Build

You can start all jobs from the user interface with the **Build Now** link.

16.3.2.2 Triggering a Subversion Repository Build

A Subversion repository build trigger is vital to establishing a healthy continuous integration build. As changes are committed to project source, Hudson triggers builds of the associated Hudson jobs. The trigger does this by periodically checking the associated Subversion URL for changes.

To enable this trigger, select the **Poll SCM** option. You must then provide a cron expression to determine the schedule Hudson uses to poll the repository.

16.3.2.3 Triggering a Schedule-Based Build

For some job types, you can trigger a build on a schedule. Long running system integration tests are an example of a build that you might want to run periodically as opposed to every time the test source is modified.

Schedule based triggers are configured with cron expressions exactly like the Poll SCM trigger.

16.3.2.4 Triggering a Build Based on Hudson Dependency Changes

Trivial projects may contain multiple builds that produce unique artifacts that have dependencies on each other. If Hudson rebuilds an artifact as the result of any trigger type, it must also build and test dependent artifacts to ensure integration is still valid. When dependencies that are also built on this Hudson server are successfully completed, Hudson recognizes these relationships automatically and triggers the build. In order for this trigger to work, the dependencies must also enable the post-build action **Notify that Maven dependencies have been updated by Maven 3 integration**.

16.3.2.5 Maven SNAPSHOT Changes

If there are dependencies that are undergoing concurrent development and being managed as snapshots in your common Maven repository, they should be managed by your Hudson instance. If this is not practical, then you can use the SNAPSHOT dependency trigger to monitor the Maven repository for changes in such dependencies. When an updated SNAPSHOT dependency has been detected, the build triggers and downloads the new dependency for integration.

This trigger also uses a cron expression to configure the polling interval.

16.3.3 Managing a Multi-Module Maven Build with Hudson

To manage your build dependencies correctly, you may add each project as a separate Hudson build and configure the dependency triggers manually, or you can configure a multi-module Maven POM as a parent Hudson job. The multi-module solution reduces the possibility of making mistakes wiring the dependencies manually. It also automatically stays up-to-date as the dependencies are changed in the Maven configuration.

Configuration of a multi-module build is identical to configuration for regular projects. To examine the results of component project builds, Hudson provides a tab in the build results page in the Maven 3 Build Information link. At the top of the page, the Modules tab summarizes the component build results.

To examine the log for any of the sub-project builds, use the Console Log link. All project and sub-project builds are logged in their sequence of execution.

16.4 Monitoring the Build

Hudson should be configured to send notifications to the correct parties when the build breaks. The continuous integration system must ensure that their changes do not break the build and test process. If this does happen, they need to be notified of the breakage and must address the issue as soon as possible.

Hudson should have each user registered as a unique user. The Hudson user name must match the Subversion user name that they ordinarily commit under. Hudson relies on this name to look up the proper contact email to send notification to.

You can configure general email notification under **Manage Hudson -> Configure System -> E-mail Notification**.

You must also make sure some form of user management is enabled. You can do this by selecting **Enable Security** from the **Configure System** panel. There are a number of choices for user management and additional third-party plug-ins to support most other popular solutions, such as LDAP. The best option is to use **Hudson's own user database**. Select this choice from the **Access Control** section. There are additional options for limiting permissions to particular users and groups.

To add a new user, the user simply needs to follow the **sign up** link at the top of the Hudson home page and fill out the necessary information. The user name must match the corresponding Subversion user name.

16.4.1 Following Up on the Triggered Builds

Normally, automated notification is sufficient to ensure the continuous build system is kept healthy and produces effective results. However, there are conditions that can require additional monitoring and coordination to get the system back to an operational state. It is a good policy to designate a build coordinator to track down such problems, coordinate solutions for broad problems and perform troubleshooting when the system itself is suspect.