

Oracle® Complex Event Processing

Getting Started Guide

Release 10gR3 (10.3)

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ORACLE®

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Introduction and Roadmap

This section describes the contents and organization of this guide—*Oracle Complex Event Processing Getting Started Guide*.

- [“Document Scope and Audience”](#) on page 1-1
- [“Oracle CEP Documentation Set”](#) on page 1-2
- [“Guide to This Document”](#) on page 1-2
- [“Samples for the Oracle CEP Application Developer”](#) on page 1-3

Document Scope and Audience

This document is a resource for software developers who develop event driven real-time applications. It also contains information that is useful for business analysts and system architects who are evaluating Oracle Complex Event Processing (or *Oracle CEP* for short) or considering the use of Oracle CEP for a particular application.

The topics in this document are relevant during the design, development, configuration, deployment, and performance tuning phases of event driven applications. The document also includes topics that are useful in solving application problems that are discovered during test and pre-production phases of a project.

It is assumed that the reader is familiar with the Java programming language and Spring.

Oracle CEP Documentation Set

This document is part of a larger Oracle CEP documentation set that covers a comprehensive list of topics. The full documentation set includes the following documents:

- *[Oracle CEP Getting Started](#)*
- *[Oracle CEP Application Development Guide](#)*
- *[Oracle CEP Administration and Configuration Guide](#)*
- *[Oracle CEP EPL Reference Guide](#)*
- *[Oracle CEP Reference Guide](#)*
- *[Oracle CEP Release Notes](#)*
- *[Oracle CEP Visualizer Help](#)*
- *[Oracle CEP Type 4 JDBC Drivers](#)*

See the main [Oracle CEP documentation page](#) for further details.

Guide to This Document

This document is organized as follows:

- This chapter, [Chapter 1, “Introduction and Roadmap,”](#) introduces the organization of this guide and the features of Oracle CEP.
- [Chapter 2, “Overview of Oracle Complex Event Processing,”](#) provides a conceptual overview of Oracle CEP, typical use cases, definition of terms and acronyms, and an overview of the programming model.
- [Chapter 3, “Oracle CEP Examples,”](#) describes in detail two of the examples provided in the distribution kit: HelloWorld and foreign exchange (FX).
- [Chapter 4, “Installing Oracle Complex Event Processing,”](#) describes how to install Oracle CEP.

Samples for the Oracle CEP Application Developer

In addition to this document, Oracle provides a variety of code samples for Oracle CEP application developers. The examples illustrate Oracle CEP in action, and provide practical instructions on how to perform key development tasks.

Oracle recommends that you run some or all of the examples before programming and configuring your own event driven application.

Note: When you initially install Oracle CEP, you must chose the `Custom` option to also install the examples. The `Typical` option does *not* include the examples.

If you previously installed Oracle CEP using the `Typical` option, and you now want to also install the examples, re-run the Oracle CEP installation process and specify the same Oracle CEP home directory; a later step in the installation process allows you to then install just the examples.

The examples are distributed in two ways:

- Pre-packaged and compiled in their own domain so you can immediately run them after you install the product.
- Separately in a Java source directory so you can see a typical development environment setup.

The following four examples are provided in both their own domain and as Java source in this release of Oracle CEP:

- **HelloWorld**—Example that shows the basic elements of an Oracle CEP application. See [Hello World Example](#) for additional information.

The HelloWorld domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\helloworld_domain`, where `ORACLE_CEP_HOME` refers to the Oracle CEP installation directory, such as `c:\oracle_cep`.

The HelloWorld Java source code and configuration files are located in

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\helloworld`.

- **ForeignExchange (FX)**—Example that includes multiple adapters, streams, and complex event processor with a variety of EPL rules, all packaged in the same Oracle CEP application. See [Foreign Exchange \(FX\) Example](#) for additional information.

The ForeignExchange domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\fx_domain`, where

`ORACLE_CEP_HOME` refers to the Oracle CEP installation directory, such as `c:\oracle_cep`.

The ForeignExchange Java source code and configuration files are located in `ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\fx`.

- **Signal Generation**—Example that receives simulated market data and verifies if the price of a security has fluctuated more than two percent, and then detects if there is a *trend* occurring by keeping track of successive stock prices for a particular symbol. See [Signal Generation Example](#) for additional information.

The Signal Generation domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\signalgeneration_domain`, where `ORACLE_CEP_HOME` refers to the Oracle CEP installation directory, such as `c:\oracle_cep`.

The Signal Generation Java source code and configuration files are located in

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\signalgeneration`.

- **Record and Playback**—Example that shows how to configure the recording and playback of events to a persistent event store, as well as how to use the built-in HTTP pub-sub adapter to publish messages to a channel. See [Event Record and Playback Example](#) for additional information.

The Record and Playback domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\recplay_domain`, where `ORACLE_CEP_HOME` refers to the Oracle CEP installation directory, such as `c:\oracle_cep`.

The Record and Playback Java source code and configuration files are located in

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\recplay`.

Overview of Oracle Complex Event Processing

This section contains information on the following subjects:

- [“Introduction to Oracle Complex Event Processing” on page 2-1](#)
- [“Use Cases” on page 2-4](#)
- [“Summary of Oracle CEP Features” on page 2-5](#)
- [“Supported Platforms” on page 2-7](#)
- [“Next Steps” on page 2-8](#)

Introduction to Oracle Complex Event Processing

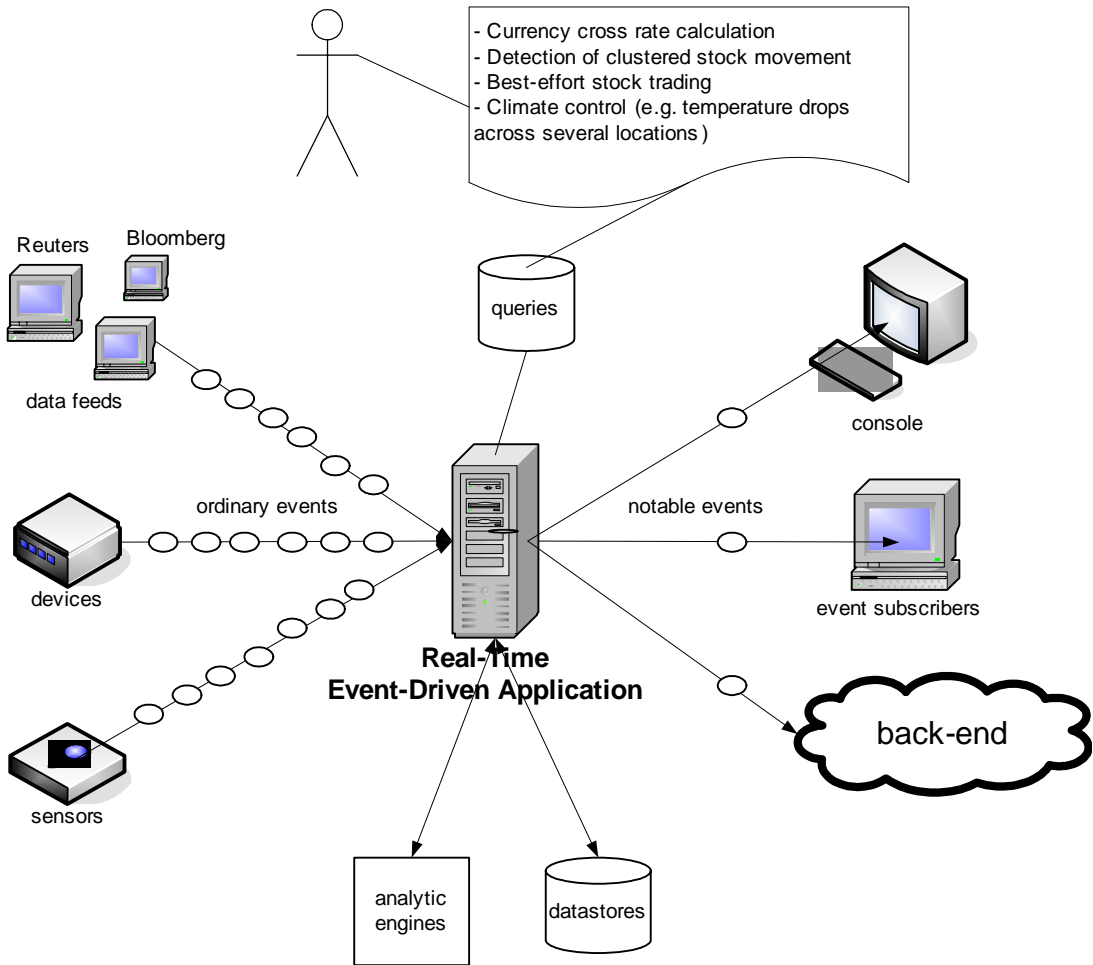
Oracle Complex Event Processing, or *Oracle CEP* for short, is a low latency, Java based middleware framework for event driven applications. It is a light weight application server which connects to high volume data feeds and has a complex event processing engine (CEP) to match events based on user defined rules.

Oracle CEP has the capability of deploying user Java code (POJOs) which contain the business logic. Running the business logic within Oracle CEP provides a highly tuned framework for time and event driven applications.

Conceptual Overview of Oracle CEP

The following graphic provides a high level view of an event-driven system:

Overview of Oracle Complex Event Processing



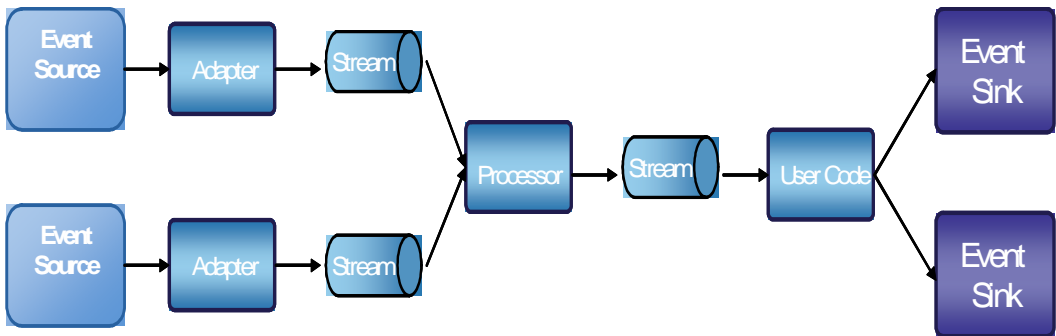
An event-driven system is generally comprised of several event sources, the real-time event-driven (Oracle CEP) applications, and event sinks. The event sources generate streams of ordinary event data. The Oracle CEP applications listen to the event streams, process these events, and generate notable events. Event sinks receive the notable events.

Event sources, event-driven applications, and event sinks are de-coupled from each other; one can add or remove any of these components without causing changes to the other components. This is an attribute of event driven architectures.

Event-driven applications are rule-driven. These rules, or queries, which are persisted using some data store, are used for processing the inbound stream of events, and generating the outbound stream of events. Generally, the number of outbound events is much lower than that of the inbound events.

Oracle CEP is a middleware for the development of event-driven applications. An Oracle CEP application is essentially an event-driven application.

Next, consider the application itself, which is hosted by the Oracle CEP infrastructure, a light-weight container. It can be described by the following diagram:



An Oracle CEP application typically comprises of four main component types. Adapters interface directly to the inbound event sources. Adapters understand the inbound protocol, and are responsible for converting the event data into a normalized data that can be queried by a processor (i.e. event processing agent, or processor). Adapters forward the normalized event data into Streams. Streams are event processing endpoints. Among other things, streams are responsible for queuing event data until the event processing agent can act upon it. The event processing agent removes the event data from the stream, processes it, and may generate new events to an output stream. The user code registers to listen to the output stream, and is triggered by the insertion of a new event in the output stream. The user code is generally just a plain-old-Java-object (POJO). The user application makes use of a set of external services, such as JMS, WS, and file writers, to forward on the generated events to external event sinks.

Event Processing Networks

Adapters, streams, processors, and business logic POJOs can be connected arbitrarily to each other, forming event processing networks (EPN). Examples of topologies of EPNs are:

- Adapter > Stream > Business Logic POJO

Scenario: no processing is needed, aside adaptation from proprietary protocol to some normalized model.

- Adapter > Stream > Processor > Stream > Business Logic POJO

Scenario: straight through processing to user code.

- Adapter > Stream > Processor > Stream > Business Logic POJO > Stream > Processor > Stream-> Business Logic POJO

Scenario: two layers of event processing, the first processor creates causality between events, and the second processor aggregates events into complex events.

EPNs have two important attributes.

First, event processing networks can be used to create hierarchy of processing agents, and thus achieve very complex processing of events. Each layer of the EPN aggregates events of its layer into complex events that become simple events in the layer above it.

A second attribute of event processing networks is that it helps with integrability, that is, the quality of having separately developed components work correctly together. For example, one can add user code and reference to external services at several places in the network.

Use Cases

The use cases for Oracle CEP span a variety of businesses:

- Financial: Algorithmic Trading

Automate stock trading based on market movement. Sample query: if, within any 20 second window, StockB rises by more than 2% and StockA does not, then automatically buy StockA.

- Transportation: Security and Fraud Detection

Discover fraudulent activity by detecting patterns among events. Sample query: if a single ID card is used twice in less than 5 seconds to gain access to a city's subway system, alert security for piggybacking.

- Energy and Telecommunications: Alarm Correlation

Reduce false positive alarms. Sample query: When 15 alarms are received within any 5 second window, but less than 5 similar alarms detected within 30 seconds, then do nothing.

- Health Care: Patient Monitoring

Monitor the vital signs of a patient and perform some task if a particular event happens.
 Sample query: When a change in medication is followed by a rise in blood pressure within 20% of maximum allowable for this patient within any 10 second window, alert nearest nurse.

Summary of Oracle CEP Features

The following list summarizes the main features of Oracle CEP:

- **New in Version 10.3.** Event Caching—Applications can optionally publish or consume events to and from a cache to increase the availability of the events and increase the performance of their applications.
- **New in Version 10.3.** Event Record and Playback—The event repository feature of Oracle CEP allows you to record events flowing through an event processing network (EPN) and store them so you can later play back the events.
- **New in Version 10.3.** Built-in HTTP Publish-Subscribe Adapters—The three built-in HTTP publish-subscribe adapters allow an application to easily to publish (locally and remotely) and and subscribe to an HTTP publish-subscribe server channel.
- **New in Version 10.3.** Built-in JMS Adapters—The two JMS adapters (inbound and outbound) allow you to send and receive messages to and from a JMS queue, respectively, from your application without writing any Java code
- **New in Version 10.3.** Visualizer Administration Console—A Web 2.0 application that consumes data from Oracle Complex Event Processing (or Oracle CEP for short), displays it in a useful and intuitive way to system administrators and operators, and, for specified tasks, accepts data that is then passed back to Oracle CEP so as to change it configuration
- **New in Version 10.3.** Multi-server domains (sometimes referred to as *clustering*)—Oracle CEP now allows multiple servers to be logically connected together for the purposes of management, and physically connected using a shared User Datagram Protocol (UDP) multicast address and port.
- An application server that supports deployment of Plain Old Java applications (POJOs), or Spring applications, for handling large volumes of streaming data with low latency requirements.
- Oracle CEP applications are developed and deployed as event driven applications, that is, a set of custom Spring tags is used to define the event processing network in the EPN assembly file, which extends the standard Spring context file, of your application.

- The application server contains a set of real time services that include a complex event processor (CEP), adapters, and streams. The server is highly tuned for high message throughput and low latency and deterministic behavior.
- The complex event processor is a high performance, continuous query engine for processing high volumes of streaming data. It has full support for filtering, correlation, and aggregation of streaming data from one or more streams.
- The Event Processing Language (EPL), a SQL-like language that allows event data from streams to be declaratively filtered, correlated, aggregated, and merged, with the ability to insert results into other streams for further downstream processing. You define the EPL rules either in an XML file that configures the complex event processor or programmatically using APIs.
- An Adapter SDK that provides all the tools you need to create adapters that listen to incoming data feeds.
- A set of product examples that show both a simple Hello World scenario to get you started and more complex foreign exchange and algorithmic trading scenarios to showcase additional features of Oracle CEP.
- A load generator utility that simulates a data feed, useful for testing your application without needing to connect to a live data feed.
- A monitoring service that includes pre-built instrumentation for measuring throughput and latency at the component level.
- A static and dynamic configuration framework. Static configuration is performed using XML files; dynamic configuration is performed by accessing configuration and runtime MBeans using JMX and with the command-line utility `wlevs.Admin`.
- Oracle CEP is built on the Oracle microServices Architecture (mSA) which uses an OSGi-based framework to manage services provided by modules or feature sets. Oracle mSA provides the following services:
 - Jetty, an HTTP container for running servlets.
 - `javax.sql.DataSource` implementation and thin JDBC drivers for accessing a relational database.
 - Logging and debugging.
 - Authentication and authorization security.

Supported Platforms

The following table displays the supported platforms for Oracle CEP 10gR3.

Table 2-1 Oracle CEP 10gR3 Supported Platforms

Operating System	Hardware	JVM w/ JDK 1.5.x	Release Date
Oracle Enterprise Linux 4 / OVM	x86	JRockit 32	RTM
Oracle Enterprise Linux 4 / OVM	x86-64	JRockit 32	RTM
Redhat Linux 4	x86	JRockit 32	RTM
Redhat Linux 4	x86-64	JRockit 32	RTM
Oracle Enterprise Linux 5.0 / OVM	x86	JRockit 32	RTM
Oracle Enterprise Linux 5.0 / OVM	x86-64	JRockit 32	RTM
Redhat Linux 5.1	x86	JRockit 32	RTM
Redhat Linux 5.1	x86-64	JRockit 32	RTM
SUSE Linux 9	x86	JRockit 32	RTM
SUSE Linux 9	x86-64	JRockit 32	RTM
SUSE Linux 10	x86	JRockit 32	RTM
SUSE Linux 10	x86-64	JRockit 32	RTM
Windows 2003 SP1+	x86	JRockit 32	RTM
Windows 2003 SP1+	x86-64	JRockit 32	RTM
Windows Vista (client only)	x86	JRockit 32	RTM
Windows Vista (client only)	x86-64	JRockit 32	RTM
Windows XP SP2 (client only)	x86	JRockit 32	RTM
Windows XP SP2 (client only)	x86-64	JRockit 32	RTM
Solaris 10	Sparc 64	JRockit 64	Post-RTM

Oracle CEP Development Environment for Eclipse

Oracle provides an IDE targeted specifically to programmers that want to develop Oracle CEP applications. *Oracle CEP Development Environment for Eclipse* is a set of plugins for the Eclipse IDE designed to help develop, deploy, and debug applications for Oracle CEP 10.3.

The key features of this IDE are as follows:

- Project creation wizards and templates to quickly get started building event driven applications.
- Advanced editors for source files including Java and XML files common to Oracle CEP applications.
- Integrated server management to seamlessly start, stop, and deploy to Oracle CEP instances all within the IDE.
- Integrated debugging.
- Event Processing Network (EPN) visual design views for orienting and navigating in event processing applications.

Although it is not required or assumed that you are using this IDE, Oracle recommends that you give it a try. For details, see [Oracle CEP Development Environment for Eclipse](#).

Next Steps

- Install Oracle CEP 10.3. [Chapter 4, “Installing Oracle Complex Event Processing.”](#)
 - Run the examples from their respective domains. See:
 - [“Running the HelloWorld Example from the helloworld Domain” on page 3-8](#)
 - [“Running the Foreign Exchange Example” on page 3-17](#)
 - [“Running the Signal Generation Example” on page 3-28](#)
- See [“Overview of the Samples Provided in the Distribution Kit” on page 3-1](#) for overview information.
- Understand how the sample applications have been programmed by viewing the source and configuration files and then building them from their respective source directories. See:
 - [“Building and Deploying the HelloWorld Example from the Source Directory” on page 3-8](#)

- “Building and Deploying the Foreign Exchange Example from the Source Directory” on page 3-18
- “Building and Deploying the Signal Generation Example from the Source Directory” on page 3-30
- Create your own Oracle CEP domain. See [Creating an Oracle CEP Domain](#).
- Create a new Oracle CEP application and deploy it to your new domain. See [Creating Oracle CEP Applications](#) for a description of the programming model, details about the various components that make up an application, and how they all fit together.

Overview of Oracle Complex Event Processing

Oracle CEP Examples

This section contains information on the following subjects:

- [“Overview of the Samples Provided in the Distribution Kit” on page 3-1](#)
- [“Setting Your Development Environment” on page 3-4](#)
- [“HelloWorld Example” on page 3-7](#)
- [“Foreign Exchange \(FX\) Example” on page 3-15](#)
- [“Signal Generation Example” on page 3-28](#)
- [“Event Record and Playback Example” on page 3-31](#)

Overview of the Samples Provided in the Distribution Kit

Oracle Complex Event Processing, or *Oracle CEP* for short, includes four complete examples: HelloWorld, which is a basic skeleton of a typical Oracle CEP application, a Foreign Exchange (FX) example that includes a multiple components, a Signal Generation example that simulates market trading and trend detection, and a record/playback example that shows how to configure event record and playback using a persistent event store.

These examples are provided in two forms, as follows:

- Out-of-the-box sample domains pre-configured to deploy an assembled application; each sample has its own domain for simplicity. Each domain is a standalone server domain; the server files are located in the `defaultserver` subdirectory of the domain directory. To deploy the application you simply start the default server in the domain.

The sample helloworld domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\helloworld_domain`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`. See [“Running the HelloWorld Example from the helloworld Domain” on page 3-8](#) for details.

The sample foreign exchange domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\fx_domain`. See [“Running the Foreign Exchange Example” on page 3-17](#) for details.

The sample signal generation domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\signalgeneration_domain`. See [“Running the Signal Generation Example” on page 3-28](#) for details.

The sample record and playback domain is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\domains\recplay_domain`. See [“Running the Event Record/Playback Example” on page 3-32](#) for details.

- The Java and configuration XML source for each sample is provided in a separate source directory that describes a sample development environment.

The HelloWorld source directory is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\helloworld`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`. See [“Implementation of the HelloWorld Example” on page 3-10](#) for details.

The Foreign Exchange source directory is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\fx`. See [“Implementation of the FX Example” on page 3-19](#) for details.

The Signal Generation source directory is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\signalgeneration`.

The Record and Playback source directory is located in

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\recplay`. See [“Implementation of the Record and Playback Example” on page 3-36](#) for details.

The samples use Ant as their development tool; for details about Ant and installing it on your computer, see the [Apache Ant Project](#).

Installing the Examples

When initially installing Oracle CEP, you must chose the `Custom` option to also install the examples. The `Typical` option does *not* include the examples.

If you previously installed Oracle CEP using the `Typical` option, and you now want to also install the examples, re-run the Oracle CEP installation process and specify the same Oracle CEP home directory; a later step in the installation process allows you to then install just the examples.

Using Visualizer With the Examples

Oracle CEP Visualizer, or *Visualizer* for short, is a Web 2.0 application that consumes data from Oracle CEP, displays it in a useful and intuitive way to system administrators and operators, and, for specified tasks, accepts data that is then passed back to Oracle CEP so as to change its configuration.

Visualizer is itself an Oracle CEP application and is automatically deployed in each server instance. To use it with the examples, be sure you have started the server (instructions provided for each example below) and then invoke the following URL in your browser:

```
http://host:9002
```

where *host* refers to the name of the computer hosting Oracle CEP; if it is the same as the computer on which the browser is running you can use `localhost`.

Security is disabled for the HelloWorld application, so you can click Logon at the login screen without entering a username and password. For the FX and signal generation examples, however, security is enabled, so use the following to logon:

User Id: `wlevs`

Password: `wlevs`

For more information about Visualizer, see [Overview of Visualizer](#).

Increasing the Performance of the Examples

To increase the throughput and latency when running the examples, and Oracle CEP applications in general, Oracle recommends the following:

- Use the JRockit JDK included in [Oracle JRockit Real Time 3.0](#) and enable the deterministic garbage collector by passing the `-dgc` parameter to the command that starts the Oracle CEP instance for the appropriate domain:

```
prompt> startwlevs.cmd -dgc
```

By default the deterministic garbage collector is disabled for the examples. For documentation on Oracle JRockit Real Time 3.0, see the [Oracle Technology Network](#).

- When running Oracle CEP on a computer with a larger amount of memory, you should set the load generator and server heap sizes appropriately for the size of the computer. On computers with sufficient memory, Oracle recommend a heap size of 1 GB for the server and between 512MB - 1GB for the load generator.

Setting Your Development Environment

You must set your development environment before you can start Oracle CEP instances and run the examples. In particular, you must set the PATH and JAVA_HOME environment variables so that you are using the correct version of the JRockit JDK.

There are two ways in which JRockit might have been installed on your computer:

- As part of the [Oracle JRockit Real Time 3.0](#) installation. This version of the JRockit JDK includes the deterministic garbage collector.
- As part of the Oracle CEP 10.3 installation. This version of the JRockit JDK *does not* include the deterministic garbage collector, and is provided for testing purposes only.

Although not required, Oracle recommends that you run Oracle CEP using the JRockit JDK version included in Oracle JRockit Real Time 3.0 for best results; however, the following procedures describe how to set your environment for either case.

Windows

1. Update your PATH environment variable to include the bin directory of the JRockit JDK. Also, be sure that your PATH environment variable includes the bin directory of your Ant installation.

If using the JRockit JDK installed with Oracle JRockit Real Time 3.0:

If you installed Oracle JRockit Real Time 3.0 in the d:\jrockit directory and Ant is installed in the d:\ant directory, set your PATH environment variable as shown:

```
prompt> set PATH=d:\jrockit\jrvt-3.0.0-1.6.0\bin;d:\ant\bin;%PATH%
```

If using the JRockit JDK installed with Oracle CEP 10.3:

If you installed Oracle CEP 10.3 in the d:\oracle_cep directory and Ant is installed in the d:\ant directory, set your PATH environment variable as shown:

```
prompt> set  
PATH=d:\oracle_cep\jrockit-R27.6.0-50-1.6.0_05\bin;d:\ant\bin;%PATH%
```


2. Ensure that the `JAVA_HOME` variable in the server start script points to the correct JRockit JDK. If it does not, edit the script.

The server start script (called `startwlevs.cmd`) is located in the `defaultserver` subdirectory of the main domain directory; the `defaultserver` subdirectory contains the files for the standalone server of each domain. For example, the `HelloWorld` domain is located in `ORACLE_CEP_HOME\ocep_10.3\samples\domains\helloworld_domain`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`.

If using the JRockit JDK installed with Oracle JRockit Real Time 3.0, the `set` command should be as follows:

```
set JAVA_HOME=d:\jrockit\jrirt-3.0.0-1.6.0
```

If using the JRockit JDK installed with Oracle CEP 10.3, the `set` command should be as follows:

```
set JAVA_HOME=d:\oracle_cep\jrockit-R27.6.0-50-1.6.0_05
```

3. Set the `JAVA_HOME` variable in your own development environment to point to the JRockit JDK.

If using the JRockit JDK installed with Oracle JRockit Real Time 3.0:

```
prompt> set JAVA_HOME=d:\jrockit\jrirt-3.0.0-1.6.0
```

If using the JRockit JDK installed with Oracle CEP 10.3:

```
prompt> set JAVA_HOME=d:\oracle_cep\jrockit-R27.6.0-50-1.6.0_05
```

To make it easier to reset your development environment after logging out of a session, you can create a command file, such as `setEnv.cmd`, that contains these `set` commands.

You can also set these environment variables permanently on your Windows computer by invoking the **Control Panel > System** window, clicking the **Advanced** tab, and then clicking the **Environment Variables** button. You can set the environment variables for the current user or for the entire system.

UNIX

1. Update your `PATH` environment variable to include the `bin` directory of the JRockit JDK. Also, be sure that your `PATH` environment variable includes the `bin` directory of your Ant installation.

If using the JRockit JDK installed with Oracle JRockit Real Time 3.0:

If you installed Oracle JRockit Real Time in the `/jrockit` directory and Ant is installed in the `/ant` directory, set your `PATH` environment variable as shown:

```
prompt> PATH=/jrockit/jrvt-3.0.0-1.6.0/bin:/ant/bin:$PATH
```

If using the JRockit JDK installed with Oracle CEP 10.3:

If you installed Oracle CEP in the `/oracle_cep` directory and Ant is installed in the `/ant` directory, set your `PATH` environment variable as shown:

```
prompt> PATH=/oracle_cep/jrockit-R27.6.0-50-1.6.0_05/bin:/ant/bin:$PATH
```

2. Ensure that the `JAVA_HOME` variable in the server start script points to the correct JRockit JDK. If it does not, edit the script.

The server start script (called `startwlevs.sh`) is located in the `defaultserver` subdirectory of the main domain directory; the `defaultserver` subdirectory contains the files for the standalone server of each domain. For example, the `HelloWorld` domain is located in `ORACLE_CEP_HOME/ocp_10.3/samples/domains/helloworld_domain`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `/oracle_cep`.

If using the JRockit JDK installed with Oracle JRockit Real Time 3.0, the `JAVA_HOME` variable should be set as follows:

```
JAVA_HOME=/jrockit/jrvt-3.0.0-1.6.0
```

If using the JRockit JDK installed with Oracle CEP 10.3, the `JAVA_HOME` variable should be set as follows:

```
JAVA_HOME=/oracle_cep/jrockit-R27.6.0-50-1.6.0_05
```

3. Set the `JAVA_HOME` variable in your development environment to point to the JRockit JDK.

If using the JRockit JDK installed with Oracle JRockit Real Time 3.0:

```
prompt> JAVA_HOME=/jrockit/jrvt-3.0.0-1.6.0
```

If using the JRockit JDK installed with Oracle CEP 10.3:

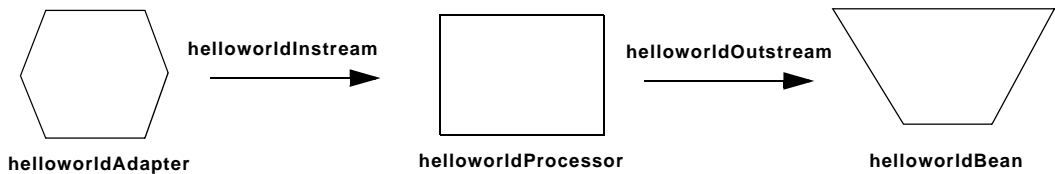
```
prompt> JAVA_HOME=/oracle_cep/jrockit-R27.6.0-50-1.6.0_05
```

To make it easier to reset your environment after logging out of a session, you can create a command file, such as `setEnv.sh`, that contains these commands.

HelloWorld Example

The first example that shows how to create an Oracle CEP application is the ubiquitous HelloWorld. The following diagram shows the components that make up the application and how they fit together, which together make up the HelloWorld *event processing network*:

Figure 3-1 The HelloWorld Event Processing Network



The example includes the following components:

- **helloworldAdapter**—Component that simply generates *Hello World* messages every second. In a real-world scenario, this component would typically read a stream of data from a source, such as a data feed from a financial institution, and convert it into a stream of events that the complex event processor can understand. The HelloWorld application also includes a HelloWorldAdapterFactory that creates instances of HelloWorldAdapter.
- **helloworldInstream**—Component that streams the events generated by the adapter (in this case *Hello World* messages) to the complex event processor.
- **helloworldProcessor**—Component that simply forwards the messages from the helloworldAdapter component to the POJO that contains the business logic. In a real-world scenario, this component would typically execute additional and possibly much more complex processing of the events from the stream, such as selecting a subset of events based on a property value, grouping events, and so on.
- **helloworldOutstream**—Component that streams the events processed by the complex event processor to the POJO that contains the user-defined business logic.
- **helloworldBean**—POJO component that simply prints out a message every time it receives a batch of messages from the processor via the output stream. In a real-world scenario, this component would contain the business logic of the application, such as running reports on the set of events from the processor, sending appropriate emails or alerts, and so on.

Running the HelloWorld Example from the helloworld Domain

To run the HelloWorld application that is pre-deployed to the `helloworld` domain, you simply start an instance of Oracle CEP, as described in the following steps:

1. Open a command window and change to the default server directory of the helloworld domain directory, located in `ORACLE_CEP_HOME\ocep_10.3\samples\domains\helloworld_domain\defaultserver`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`.

```
prompt> cd  
d:\oracle_cep\ocep_10.3\samples\domains\helloworld_domain\defaultserver
```
2. Ensure the environment is set correctly in the server startup script; see [“Setting Your Development Environment” on page 3-4](#).
3. Start Oracle CEP by running the `startwlevs.cmd` (Windows) or `startwlevs.sh` (UNIX) command:

```
prompt> startwlevs.cmd
```

If you are using the JRockit JDK included in Oracle JRockit Real Time 3.0, enable the deterministic garbage collector by passing the `-dgc` parameter to the command:

```
prompt> startwlevs.cmd -dgc
```

After server status messages scroll by, you should see the following message printed to the output about every second:

```
Message: HelloWorld - the current time is: 3:56:57 PM
```

This message indicates that the HelloWorld example is running correctly.

Building and Deploying the HelloWorld Example from the Source Directory

The HelloWorld sample source directory contains the Java source, along with other required resources such as configuration XML files, that make up the HelloWorld application. The `build.xml` Ant file contains targets to build and deploy the application to the helloworld domain; see [“Description of the Ant Targets to Build Hello World” on page 3-9](#) for details.

To build and deploy the HelloWorld application, follow these steps:

1. If the helloworld Oracle CEP instance is not already running, follow the procedure in [“Running the HelloWorld Example from the helloworld Domain” on page 3-8](#) to start the server. You must have a running server to successfully deploy the rebuilt application.
2. Open a new command window and change to the HelloWorld source directory, located in `ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\helloworld`.

```
prompt> cd
d:\oracle_cep\ocep_10.3\samples\source\applications\helloworld
```

3. Set your development environment; see [“Setting Your Development Environment” on page 3-4](#).
4. Execute the `all` Ant target to compile and create the application JAR file:

```
prompt> ant all
```

5. Execute the `deploy` Ant target to deploy the application JAR file to Oracle CEP:

```
prompt> ant -Daction=update deploy
```

WARNING: This target overwrites the existing helloworld application JAR file in the domain directory.

You should see the following message printed to the output about every second:

```
Message: HelloWorld - the current time is: 3:56:57 PM
```

This message indicates that the HelloWorld example has been redeployed and is running correctly.

Description of the Ant Targets to Build Hello World

The `build.xml` file, located in the top level of the HelloWorld source directory, contains the following targets to build and deploy the application:

- `clean`—This target removes the `dist` and `output` working directories under the current directory.
- `all`—This target cleans, compiles, and jars up the application into a file called `com.bea.wlevs.example.helloworld_3.0.0.0.jar`, and places the generated JAR file into a `dist` directory below the current directory.
- `deploy`—This target deploys the JAR file to Oracle CEP using the Deployer utility. See [Deployer Command-Line Reference](#) for complete reference information about the Deployer utility.

Implementation of the HelloWorld Example

The implementation of the HelloWorld example generally follows the [main steps for creating an Oracle CEP application](#); refer to that section for a task-oriented procedure that describes the typical development process.

The HelloWorld example, because it is relatively simple, does not use all the components and configuration files described in the general procedure for creating an Oracle CEP application. All the files of the example are located relative to the

`ORACLE_CEP_HOME\ocp_10.3\samples\source\applications\helloworld` directory, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory such as `c:\oracle_cep`. Oracle recommends that you use this example directory setup in your own environment, although it is obviously not required.

The files used by the HelloWorld example include:

- An EPN assembly file that describes each component in the application and how all the components are connected together. The EPN assembly file extends the standard Spring context file. The file also registers the event types used in the application. You are required to include this XML file in your Oracle CEP application.

In the example, the file is called `com.bea.wlevs.example.helloworld-context.xml` and is located in the `META-INF/spring` directory.

For details, see [“The HelloWorld EPN Assembly File” on page 3-11](#).

- Java source file for the `helloworldAdapter` component.

In the example, the file is called `HelloWorldAdapter.java` and is located in the `src/com/bea/wlevs/adapter/example/helloworld` directory.

For a detailed description of this file and how to program the adapter Java files in general, see [Programming the Adapter Class: Guidelines](#).

- Java source file that describes the `HelloWorldEvent` event type.

In the example, the file is called `HelloWorldEvent.java` and is located in the `src/com/bea/wlevs/event/example/helloworld` directory.

For a detailed description of this file, as well as general information about programming event types, see [Creating Event Types](#).

- An XML file that configures the `helloworldProcessor` and `helloworldOutstream` components. An important part of this file is the set of EPL rules that select the set of events that the HelloWorld application processes. You are required to include a processor

configuration file in your Oracle CEP application, although the adapter and stream configuration is optional.

In the example, the file is called `config.xml` and is located in the `META-INF/wlevs` directory.

For details, see [“The HelloWorld Component Configuration File” on page 3-14.](#)

- A Java file that implements the `helloworldBean` component of the application, a POJO that contains the business logic.

In the example, the file is called `HelloWorldBean.java` and is located in the `src/com/bean/wlevs/example/helloworld` directory.

For details about this file, and programming the business logic POJO in general, see [Programming Business Logic: Guidelines.](#)

- A `MANIFEST.MF` file that describes the contents of the OSGi bundle that will be deployed to Oracle CEP.

In the example, the `MANIFEST.MF` file is located in the `META-INF` directory

See [Assembling an Oracle CEP Application: Main Steps](#) for information about creating this file, as well as a description of creating the OSGi bundle that you deploy to Oracle CEP.

The HelloWorld example uses a `build.xml` Ant file to compile, assemble, and deploy the OSGi bundle; see [“Building and Deploying the HelloWorld Example from the Source Directory” on page 3-8](#) for a description of this `build.xml` file if you also use Ant in your development environment.

The HelloWorld EPN Assembly File

One of the main purposes of the EPN assembly file is to define the event processing network by declaring the components of the application and how they are all connected, or in other word, which components listen to which other components. Oracle CEP provides a set of custom Spring tags used to declare the network. You also use the EPN assembly file to register the event types used by your application and its EPL rules.

You use the EPN assembly file in the typical way to define the application component beans in the Spring application context; the application components beans are those implemented with Java classes, such as adapters and the POJO that contains the business logic.

For full reference information about the custom Spring tags, see [Oracle CEP Custom Spring Tags Reference](#) or the [XSD Schema file](#) that defines the tags.

The following example shows the EPN assembly file used in the HelloWorld sample application; see the explanation after the example for details about the entries in bold.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:osgi="http://www.springframework.org/schema/osgi"
  xmlns:wlevs="http://www.bea.com/ns/wlevs/spring"
  xsi:schemaLocation="
    http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/osgi
    http://www.springframework.org/schema/osgi/spring-osgi.xsd
    http://www.bea.com/ns/wlevs/spring
    http://www.bea.com/ns/wlevs/spring/spring-wlevs.xsd">

  <wlevs:event-type-repository>
    <wlevs:event-type type-name="HelloWorldEvent">

<wlevs:class>com.bea.wlevs.event.example.helloworld.HelloWorldEvent</wlevs:cla
ss>
    </wlevs:event-type>
  </wlevs:event-type-repository>

  <wlevs:adapter id="helloworldAdapter"
class="com.bea.wlevs.adapter.example.helloworld.HelloWorldAdapter" >
    <wlevs:instance-property name="message" value="HelloWorld - the
currenttime is:"/>
  </wlevs:adapter>

  <wlevs:processor id="helloworldProcessor" />

  <wlevs:stream id="helloworldInstream" >
    <wlevs:listener ref="helloworldProcessor"/>
    <wlevs:source ref="helloworldAdapter"/>
  </wlevs:stream>

  <wlevs:stream id="helloworldOutstream" manageable="true">
    <wlevs:listener>
      <bean class="com.bea.wlevs.example.helloworld.HelloWorldBean"/>
    </wlevs:listener>
    <wlevs:source ref="helloworldProcessor"/>
  </wlevs:stream>

</beans>
```

In the preceding example:

- The `<wlevs:event-type-repository>` entry registers the event types that are used throughout the application; in the HelloWorld application, there is just a single event type:

HelloWorldEvent, implemented with the `com.bea.wlevs.event.example.helloworld>HelloWorldEvent` class. Oracle CEP automatically creates instances of this data type when needed. You can also reference this data type in the EPL rules of the application.

- The `<wlevs:adapter>`, `<wlevs:processor>`, and `<wlevs:stream>` entries together define the event processor network by declaring each component in the network; the following bullets describe the configuration of each component.
- The `<wlevs:adapter>` tag defines the adapter component of the HelloWorld application:

```
<wlevs:adapter id="helloworldAdapter"
  class="com.bea.wlevs.adapter.example.helloworld>HelloWorldAdapter"
  >
  <wlevs:instance-property name="message" value="HelloWorld - the
currenttime is:"/>
</wlevs:adapter>
```

The `id` attribute specifies a unique identifier for this component; the `id` will be referenced later by other components. The `class` attribute specifies the class that implements the adapter; in this case it is

`com.bea.wlevs.adapter.example.helloworld>HelloWorldAdapter`.

The `<wlevs:instance-property>` child tag passes an instance variable to adapter instance; the name of the variable is `message` and the value is `HelloWorld - the current time is: .`

- The `<wlevs:processor>` tag defines the processor component of the application:

```
<wlevs:processor id="helloworldProcessor" />
```

The `id` attribute functions the same as that of `<wlevs:adapter>`.

- The `<wlevs:stream>` tags defines the two stream components of the application:

```
<wlevs:stream id="helloworldInstream" >
  <wlevs:listener ref="helloworldProcessor"/>
  <wlevs:source ref="helloworldAdapter"/>
</wlevs:stream>

<wlevs:stream id="helloworldOutstream" manageable="true">
  <wlevs:listener>
    <bean class="com.bea.wlevs.example.helloworld>HelloWorldBean"/>
  </wlevs:listener>
  <wlevs:source ref="helloworldProcessor"/>
</wlevs:stream>
```

The `id` attribute for streams functions the same as that of `<wlevs:adapter>`. The `manageable` attribute enables monitoring of the stream; by default the manageability of components is disabled.

The `<wlevs:stream id="helloworldInstream">` tag uses the `<wlevs:listener>` child tag to specify that the `helloworldProcessor` listens to the stream, and the `<wlevs:source>` child tag to specify that the stream gets its events from the `helloworldAdapter` component.

The `<wlevs:stream id="helloworldOutstream">` tag also uses these listener and source tags. One difference, however, is that it directly nests the definition of the business logic POJO in the `<wlevs:listener>` tag rather than reference a unique identifier. In this case, the nested tag is a standard Spring `<bean>` that specifies that the POJO is implemented with the `com.bea.wlevs.example.helloworld.HelloWorldBean` class.

The HelloWorld Component Configuration File

The HelloWorld application configures the processor and one of the streams in a component configuration file as follows:

```
<?xml version="1.0" encoding="UTF-8"?>
<n1:config xmlns:n1="http://www.bea.com/ns/wlevs/config/application"
          xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <processor>
    <name>helloworldProcessor</name>
    <rules>
      <rule id="helloworldRule"><![CDATA[ select * from HelloWorldEvent
retain 1 event ]]></rule>
    </rules>
  </processor>
  <stream>
    <name>helloworldOutstream</name>
    <max-size>10000</max-size>
    <max-threads>2</max-threads>
  </stream>
</n1:config>
```

If your application contains multiple processors, adapters or streams, you can either declare them all in a single configuration file, or create separate configuration files for each component; the method you chose depends on which you find easier to manage.

For each component you configure, you must add the `<name>` child element to explicitly declare the specific component to which you are referring. The value of the `<name>` element must correspond to the component's unique identifier of its declaration in the EPN assembly file.

For example, assume a processor is declared in the EPN assembly file as follows:

```
<wlevs:processor id="helloworldProcessor" ...>
```

Then its corresponding XML configuration would be as follows:

```
<processor>
  <name>helloworldProcessor</name>
  ...
</processor>
```

The HelloWorld example uses a single configuration file for one processor with the name `helloworldProcessor` and one stream with the name `helloworldOutstream`. These names correspond with the declaration of the components in the EPN assembly file.

The `<processor>` element configures the processor component. The most important part of the processor configuration is the declaration of the set of Event Processing Language (EPL) rules that this processor executes; these rules select the set of events that are eventually passed to the application business object. Each rule is declared with a `<rule>` element using an XML `![CDATA[...]]` section; all rules are grouped together with a single `<rules>` element. You can define as many rules as you want for a particular processor.

The HelloWorld application has just a single very simple rule:

```
select * from HelloWorldEvent retain 1 event
```

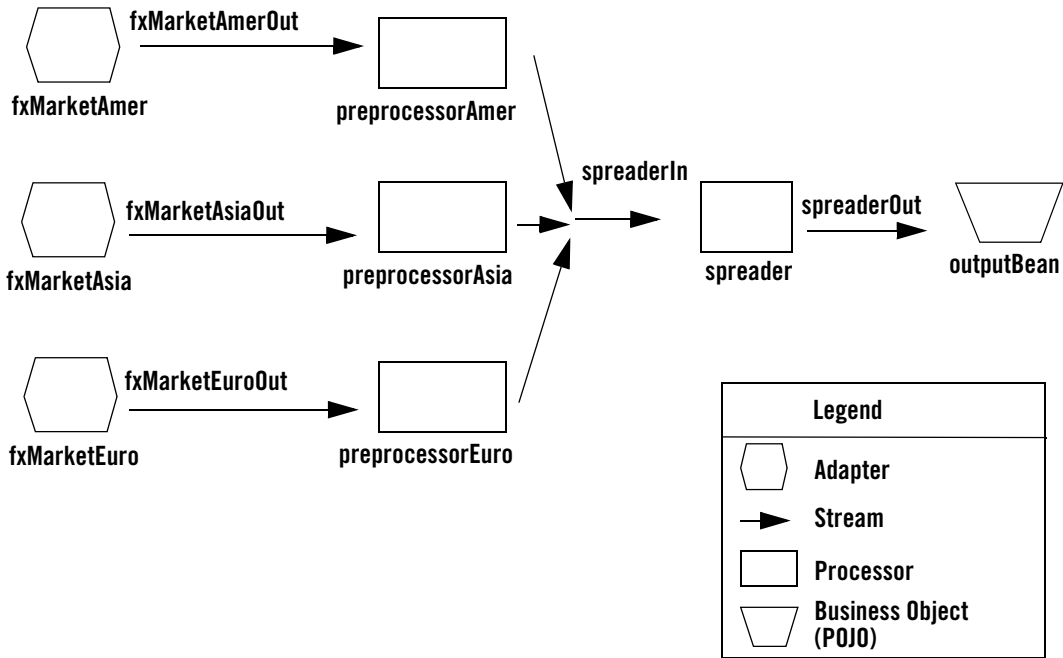
This rule selects all events of type `HelloWorldEvent`, but retains only one event at a time in its window. For additional information and examples about using EPL, see the [EPL Reference Guide](#).

The `<stream>` element configures the `helloworldOutstream` component. The `<max-size>` and `<max-threads>` elements specify the maximum size of the stream and the maximum number of threads assigned to the stream, respectively.

Foreign Exchange (FX) Example

The foreign exchange example, called FX for simplicity, is a more complex example than the HelloWorld one because it includes multiple processors that handle information from multiple data feeds. In the example, the data feeds are simulated using the Oracle CEP load generator utility. The following diagram describes the FX event processing network:

Figure 3-2 FX Event Processing Network



In the scenario, three data feeds, simulated using the load generator, send a constant pair of values from different parts of the world; the value pairs consist of a currency pair, such as USDEUR for US dollar - European euro, and an exchange rate between the two currencies. The `fxMarketXXX` adapters receive the data from the feeds, convert them into events, and pass them to the `preprocessorXXX` processors. Each processor performs an initial stale check to ensure that no event is more than ten seconds old and then a boundary check to ensure that the exchange rate between the two currencies is within a current boundary. The server also only selects a specific currency pair from a particular stream; for example, the server selects USDEUR from the simulated American data feed, but rejects all other pairs, such as USDAUD (Australian dollar).

After the data from each data feed provider passes this initial preparation phase, a different processor, called `spreader`, joins all events across all providers, calculates the mid-point between the maximum and minimum rate, and then applies a trader-specified spread. Finally, the processor forwards the rate to the POJO that contains the business code; in this example, the POJO simply publishes the rate to clients.

The Oracle CEP monitor is configured to watch if the event latency in the last step exceeds some threshold, such as no updated rates in a 30 second time-span, and if there is too much variance between two consecutive rates for the same currency pair. Finally, the last rate of each currency pair is forwarded to the dashboard.

Running the Foreign Exchange Example

For optimal demonstration purposes, Oracle recommends that you run this example on a powerful computer, such as one with multiple CPUs or a 3 GHz dual-core Intel, with a minimum of 2 GB of RAM.

To run the Foreign Exchange (FX) application that is pre-deployed to the `fx_domain` domain, you simply start an instance of Oracle CEP, as described in the following steps:

1. Open a command window and change to the default server directory of the `fx_domain` directory, located in

```
ORACLE_CEP_HOME\ocep_10.3\samples\domains\fx_domain\defaultserver, where
ORACLE_CEP_HOME refers to the main Oracle CEP installation directory, such as
d:\oracle_cep.
```

```
prompt> cd
d:\oracle_cep\ocep_10.3\samples\domains\fx_domain\defaultserver
```

2. Set your development environment, as described in [“Setting Your Development Environment” on page 3-4](#).
3. Start Oracle CEP by running the `startwlevs.cmd` (Windows) or `startwlevs.sh` (UNIX) command:

```
prompt> startwlevs.cmd
```

If you are using the JRockit JDK included in Oracle JRockit Real Time 3.0, enable the deterministic garbage collector by passing the `-dgc` parameter to the command:

```
prompt> startwlevs.cmd -dgc
```

The FX application is now ready to receive data from the data feeds.

4. To simulate an American data feed, open a new command window and set your environment as described in [“Setting Your Development Environment” on page 3-4](#).
5. Change to the `ORACLE_CEP_HOME\ocep_10.3\utils\load-generator` directory, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`.
6. Run the load generator using the `fxAmer.prop` properties file:

```
prompt> runloadgen.cmd fxAmer.prop
```

7. Repeat steps 4 - 6 to simulate an Asian data feed, using the `fxAsia.prop` properties file:

```
prompt> runloadgen.cmd fxAsia.prop
```

8. Repeat steps 4 - 6 to simulate an European data feed, using the `fxEuro.prop` properties file:

```
prompt> runloadgen.cmd fxEuro.prop
```

After the server status messages scroll by in the command window from which you started the server, and the three load generators start, you should see messages similar to the following being printed to the server command window:

```
{crossRate=USDJPY, internalPrice=119.09934499999781}, {crossRate=USDGBP,  
internalPrice=0.5031949999999915}, {crossRate=USDJPY,  
internalPrice=117.73945624999783}
```

These messages indicate that the Foreign Exchange example is running correctly. The output shows the cross rates of US dollars to Japanese yen and US dollars to UK pounds sterling.

Building and Deploying the Foreign Exchange Example from the Source Directory

The Foreign Exchange (FX) sample source directory contains the Java source, along with other required resources such as configuration XML files, that make up the FX application. The `build.xml` Ant file contains targets to build and deploy the application to the `fx_domain` domain, as described in [“Description of the Ant Targets to Build FX” on page 3-19](#).

To build and deploy the FX application, follow these steps:

1. If the fx Oracle CEP instance is not already running, follow the procedure in [“Running the Foreign Exchange Example” on page 3-17](#) to start the server. You must have a running server to successfully deploy the rebuilt application.
2. Open a new command window and change to the FX source directory, located in `ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\fx`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`.

```
prompt> cd d:\oracle_cep\ocep_10.3\samples\source\applications\fx
```
3. Set your development environment, as described in [“Setting Your Development Environment” on page 3-4](#).
4. Execute the `all` Ant target to compile and create the application JAR file:

```
prompt> ant all
```

5. Execute the `deploy` Ant target to deploy the application JAR file to Oracle CEP:

```
prompt> ant -Dusername=wlevs -Dpassword=wlevs -Daction=update deploy
```

WARNING: This target overwrites the existing helloworld application JAR file in the domain directory.

6. If the load generators required by the FX application are not running, start them as described in [“Running the Foreign Exchange Example” on page 3-17](#).

After server status messages scroll by, you should see the following message printed to the output:

```
{crossRate=USDJPY, internalPrice=119.09934499999781}, {crossRate=USDGBP,
internalPrice=0.5031949999999915}, {crossRate=USDJPY,
internalPrice=117.73945624999783}
```

This message indicates that the FX example has been redeployed and is running correctly.

Description of the Ant Targets to Build FX

The `build.xml` file, located in the top-level directory of the FX source, contains the following targets to build and deploy the application:

- `clean`—This target removes the `dist` and `output` working directories under the current directory.
- `all`—This target cleans, compiles, and jars up the application into a file called `com.bea.wlevs.example.fx_3.0.0.0.jar`, and places the generated JAR file into a `dist` directory below the current directory.
- `deploy`—This target deploys the JAR file to Oracle CEP using the Deployer utility. See [Deployer Command-Line Reference](#) for complete reference information about the Deployer utility.

Implementation of the FX Example

The implementation of the foreign exchange (FX) example generally follows the [main steps for creating an Oracle CEP application](#); refer to that section for a procedure that describes the typical development process.

All the files of the FX example are located relative to the

`ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\fx` directory, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory such as `c:\oracle_cep`.

Oracle recommends that you use this example directory setup in your own environment, although it is obviously not required.

The files used by the FX example include:

- A EPN assembly file that describes each component in the application and how all the components are connected together. You are required to include this XML file in your Oracle CEP application.

In the example, the file is called `com.bea.wlevs.example.fx-context.xml` and is located in the `META-INF/spring` directory.

For details, see [“The FX EPN Assembly File” on page 3-21](#).

- Two XML files that configure the processor components of the application.

The first XML file configures the `preprocessorAmer`, `preprocessorAsia`, and `preprocessorEuro` components, all in a single file. This XML file includes the EPL rules that select particular currency pairs from particular simulated market feeds and executes the boundary conditions described in the example overview. In the example, this file is called `preprocessors.xml` and is located in the `META-INF/wlevs` directory.

The second XML file configures the `spreader` processor. This component joins together all the events that were selected by the pre-processors, calculates an internal price for the particular currency pair, and then calculates the cross rate. This file is called `spreader.xml` and is located in the `META-INF/wlevs` directory.

For details, see [“The FX Processor Configuration Files” on page 3-25](#).

- A Java file that implements the `OutputBean` component of the application, a POJO that contains the business logic. This POJO prints out to the screen the events that it receives, programmed in the `onEvent` method. The POJO also registers into the event type repository the `ForeignExchangeEvent` event type.

In the example, the file is called `OutputBean.java` and is located in the `src/com/bea/wlevs/example/fx` directory.

For additional information about the Oracle CEP APIs referenced in the POJO, see the [Oracle CEP Javadocs](#).

- A Java file that implements the `ForeignExchangeBuilderFactory`, which is the factory that generates `ForeignExchangeEvents`.

In the example, the file is called `ForeignExchangeBuilderFactory.java` and is located in the `src/com/bea/wlevs/example/fx` directory.

For additional information about the Oracle CEP APIs referenced in `ForeignExchangeBuilderFactory`, see the [Oracle CEP Javadocs](#).

- A `MANIFEST.MF` file that describes the contents of the OSGi bundle that will be deployed to Oracle CEP.

In the example, the `MANIFEST.MF` file is located in the `META-INF` directory

See [Assembling an Oracle CEP Application: Main Steps](#) for information about creating this file, as well as a description of creating the OSGi bundle that you deploy to Oracle CEP.

The FX example uses a `build.xml` Ant file to compile, assemble, and deploy the OSGi bundle; see [“Building and Deploying the Foreign Exchange Example from the Source Directory” on page 3-18](#) for a description of this `build.xml` file if you also use Ant in your development environment.

The FX EPN Assembly File

The following example shows the EPN assembly file used in the FX sample application; see the explanation after the example for details about the entries in bold.

Note: See the first few paragraphs of [“The HelloWorld EPN Assembly File” on page 3-11](#) for a brief overview of the EPN assembly file. For full reference information about the custom Spring tags, see [Oracle CEP Custom Spring Tags Reference](#) or the [XSD Schema file](#) that defines the tags.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:osgi="http://www.springframework.org/schema/osgi"
       xmlns:wlevs="http://www.bea.com/ns/wlevs/spring"
       xsi:schemaLocation="
http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd
http://www.springframework.org/schema/osgi
http://www.springframework.org/schema/osgi/spring-osgi.xsd
http://www.bea.com/ns/wlevs/spring
http://www.bea.com/ns/wlevs/spring/spring-wlevs.xsd">

  <wlevs:event-type-repository>
    <wlevs:event-type type-name="ForeignExchangeEvent">
```

```

<wlevs:class>com.bea.wlevs.example.fx.OutputBean$ForeignExchangeEvent</wle
vs:class>
    <wlevs:property name="builderFactory">
        <bean id="builderFactory"
class="com.bea.wlevs.example.fx.ForeignExchangeBuilderFactory"/>
    </wlevs:property>
</wlevs:event-type>
</wlevs:event-type-repository>
<!-- Assemble EPN (event processing network) -->
<wlevs:adapter id="fxMarketAmer" provider="loadgen">
    <wlevs:instance-property name="port" value="9011"/>
</wlevs:adapter>
<wlevs:adapter id="fxMarketAsia" provider="loadgen">
    <wlevs:instance-property name="port" value="9012"/>
</wlevs:adapter>
<wlevs:adapter id="fxMarketEuro" provider="loadgen">
    <wlevs:instance-property name="port" value="9013"/>
</wlevs:adapter>
<wlevs:processor id="preprocessorAmer" listeners="spreaderIn"/>
<wlevs:processor id="preprocessorAsia" listeners="spreaderIn"/>
<wlevs:processor id="preprocessorEuro" listeners="spreaderIn"/>
<wlevs:stream id="fxMarketAmerOut">
    <wlevs:listener ref="preprocessorAmer"/>
    <wlevs:source ref="fxMarketAmer"/>
</wlevs:stream>
<wlevs:stream id="fxMarketAsiaOut">
    <wlevs:listener ref="preprocessorAsia"/>
    <wlevs:source ref="fxMarketAsia"/>
</wlevs:stream>
<wlevs:stream id="fxMarketEuroOut">
    <wlevs:listener ref="preprocessorEuro"/>
    <wlevs:source ref="fxMarketEuro"/>
</wlevs:stream>

```

```

<wlevs:stream id="spreaderOut" manageable="true">
  <wlevs:listener>
    <!-- Create business object -->
    <bean id="outputBean"
      class="com.bea.wlevs.example.fx.OutputBean"
      autowire="byName"/>
  </wlevs:listener>
</wlevs:stream>

<!-- The processor id needs to be well known so that it can import the
rules config -->

<wlevs:processor id="spreader">
  <wlevs:listener ref="spreaderOut"/>
</wlevs:processor>

<wlevs:stream id="spreaderIn">
  <wlevs:listener ref="spreader"/>
</wlevs:stream>
</beans>

```

In the preceding example:

- The `<wlevs:event-type-repository>` entry registers the event types that are used throughout the application; in the FX application, there is just a single event type: `ForeignExchangeEvent`, implemented with the `ForeignExchangeEvent` inner class of the `com.bea.wlevs.example.fx.OutputBean` POJO class. The `<wlevs:property name="builderFactory">` child tag specifies that the event builder factory class in the FX application is implemented by the `com.bea.wlevs.example.fx.ForeignExchangeBuilderFactory`.

Oracle CEP automatically creates instances of the `ForeignExchangeEvent` type when needed. You can then reference this data type in the EPL rules of the application, the adapter Java class, and the POJO.

- The set of `<wlevs:adapter>`, `<wlevs:processor>`, and `<wlevs:stream>` entries set up the event processor network by declaring each component in the network. The network consists of three adapters, four processors, and five streams, as described in [“FX Event Processing Network”](#) on page 3-16.

Each component is given a unique ID which can be referenced by other components when they declare their listeners and sources.

- The `<wlevs:adapter>` entries specify the three adapters, for example:

```
<wlevs:adapter id="fxMarketAmer" provider="loadgen">
  <wlevs:instance-property name="port" value="9011"/>
</wlevs:adapter>
```

The `provider="loadgen"` attribute of each `<wlevs:adapter>` specifies that the adapters get their data from the Oracle CEP load generator utility. The

`<wlevs:instance-property>` child tag specifies the port number to which the adapter should listen.

- The `<wlevs:processor>` entries specify the four complex event processors, for example:

```
<wlevs:processor id="preprocessorAmer" listeners="spreaderIn"/>
```

The `listeners` attribute, common to all component tags, specifies the component that listens to the processor; in this case, it is a stream called `spreaderIn`.

You can also use a `<wlevs:listeners>` child tag to specify the listeners of a component:

```
<wlevs:processor id="spreader">
  <wlevs:listener ref="spreaderOut"/>
</wlevs:processor>
```

In the example, the `spreaderOut` stream listens to the `spreader` processor.

- The `<wlevs:stream>` entries specify the four streams, for example:

```
<wlevs:stream id="fxMarketAmerOut">
  <wlevs:listener ref="preprocessorAmer"/>
  <wlevs:source ref="fxMarketAmer"/>
</wlevs:stream>
```

As with all components, you can use the `<wlevs:listener>` and `<wlevs:source>` child tags to specify the other components that act as listeners and sources for this component.

In the example, the `preprocessorAmer` processor listens to the `fxMarketAmerOut` stream, which in turn listens to the `fxMarketAmer` adapter.

The following example shows how you can nest the definition of a component inside a `<wlevs:listener>` tag:

```
<wlevs:stream id="spreaderOut" manageable="true">
  <wlevs:listener>
    <!-- Create business object -->
    <bean id="outputBean"
      class="com.bea.wlevs.example.fx.OutputBean"
      autowire="byName"/>
  </wlevs:listener>
</wlevs:stream>
```

In the example, the `outBean` POJO, declared as a standard Spring bean using the `<bean>` tag, listens to the `spreaderOut` stream. The `manageable="true"` attribute of the `spreaderOut` stream enables monitoring of the stream; by default the manageability of components is disabled

The FX Processor Configuration Files

The FX application uses four processors: three to handle the three data feeds and one that joins the resulting events. The first three processors are configured in a single XML file, called `preprocessor.xml`, as shown:

```
<?xml version="1.0" encoding="UTF-8"?>
<nl:config xmlns:nl="http://www.bea.com/ns/wlevs/config/application"
           xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

  <processor>
    <name>preprocessorAmer</name>
    <rules>
      <rule id="UsdToEurRule"><![CDATA[

        insert into ForeignExchangeEvent
        select avg(lastPrice) as price, 'USD' as fromRate, 'EUR' as toRate
        from (select * from StockTick where symbol='USDEUR') retain 1 sec
        where lastPrice < 3.0 and lastPrice > 0.25

      ]]></rule>
    </rules>
  </processor>

  <processor>
    <name>preprocessorAsia</name>
    <rules>
      <rule id="EurToJpyRule"><![CDATA[

        insert into ForeignExchangeEvent
        select avg(lastPrice) as price, 'EUR' as fromRate, 'JPY' as toRate
        from (select * from StockTick where symbol='EURJPY') retain 1 sec
        where lastPrice < 200.0 and lastPrice > 100.0

      ]]></rule>
    </rules>
  </processor>
```

```

<processor>
  <name>preprocessorEuro</name>
  <rules>
    <rule id="EurToGbpRule"><![CDATA[
      insert into ForeignExchangeEvent
      select avg(lastPrice) as price, 'EUR' as fromRate, 'GBP' as toRate
      from (select * from StockTick where symbol='EURGBP') retain 1 sec
      where lastPrice < 1.5 and lastPrice > 0.5
    ]]></rule>
  </rules>
</processor>
</nl:config>

```

The three processors in this file are all essentially the same; the differences lie only in the values used in the EPL queries for querying different items from the data feeds and applying different boundary conditions. For this reason, this section will discuss just a single one of the processors: `preprocessorAmer`.

The EPL rule fired for the american data feed is:

```

insert into ForeignExchangeEvent
select avg(lastPrice) as price, 'USD' as fromRate, 'EUR' as toRate
from (select * from StockTick where symbol='USDEUR') retain 1 sec
where lastPrice < 3.0 and lastPrice > 0.25

```

To understand the query, one must look at the various clauses, as follows:

- The `insert` clause specifies that any event selected by this EPL rule should be inserted into `ForeignExchangeEvent`; this is the object that the next processor in the network, `spreader`, performs its own EPL query against.
- The `from` clause specifies that the processor should accept only those items from the `StockTick` data feed in which the `symbol` value is `USDEUR` (US dollar - European euro exchange) and should reject all other items. The `from` clause specifies also specifies that the window of time for which this EPL query executes is 1 second.
- The `where` clause specifies the boundary condition to ensure that the rates for a particular item from the feed fall within an accepted range; in this case, the `LastPrice` for a particular item from the feed must be between \$3.00 and \$0.25.

- The `select` clause specifies which values from the selected item should be inserted into the `ForeignExchangeEvent` object; in this case, the average of all prices in the window (1 second), and then the `USD` and `EUR` symbols to specify the `to` and `from` currency rates.

The spreader processor is configured with the `spreader.xml` file, as shown:

```
<?xml version="1.0" encoding="UTF-8"?>
<n1:config xmlns:n1="http://www.bea.com/ns/wlevs/config/application"
           xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <processor>
    <name>spreader</name>
    <rules>
      <rule id="spreaderRule"><![CDATA[
        select ((a.price * b.price) + 0.05) as internalPrice, a.fromRate ||
b.toRate as crossRate
        from ForeignExchangeEvent a, ForeignExchangeEvent b
        retain 10 sec with unique a.toRate partition by a.fromRate
        where a.toRate = b.fromRate and a.fromRate != b.toRate
      ]]></rule>
    </rules>
  </processor>
</n1:config>
```

In the spreader EPL rule:

- The `from` and `where` clauses join two events from the `ForeignExchangeEvent` object (which contains events selected by the three `preprocessorXXX` components) where the value of the `toRate` and `fromRate` are the same. The `from` clause also sets the processing window, again of 1 second.
- The `select` clause calculates an internal price of a particular currency, which averages the `to` and `from` rate of a the currency plus a fee of \$.05, and also calculates a cross rate, which is defined as the price of one currency in terms of another currency in the market of a third country.

The result of this query is then sent to the business object `POJO`.

For additional information and examples about using EPL, see the [EPL Reference Guide](#).

Signal Generation Example

The signal generation sample application receives simulated market data and verifies if the price of a security has fluctuated more than two percent. The application also detects if there is a *trend* occurring by keeping track of successive stock prices for a particular symbol; if more than three successive prices fluctuate more than two percent, this is considered a trend.

The application simulates a market data feed using the Oracle CEP load generator utility; in this example, the load generator generates up to 10,000 messages per second. The example includes an HTML dashboard which displays the matched events along with the latencies; events consist of a stock symbol, a timestamp, and the price.

The example demonstrates very low latencies, with minimum latency *jitter* under high throughputs. Once the application starts running, the processor matches an average of 800 messages per second. If the application is run on the minimum configured system, the example shows very low average latencies (30-300 microsecond, on average) with minimal latency spikes (low milliseconds).

The example computes and displays latency values based on the difference between a timestamp generated on the load generator and timestamp on Oracle CEP. Computing valid latencies requires very tight clock synchronization, such as 1 millisecond, between the computer running the load generator and the computer running Oracle CEP. For this reason, Oracle recommends running both the load generator and Oracle CEP on a single multi-CPU computer where they will share a common clock.

The example also shows how to use the Oracle CEP event caching feature. In particular the single processor in the EPN sends events to both an event bean and a cache.

The example also demonstrates how to use parameterized EPL queries in which the rules configured in the processor configuration file use the ? character as a placeholder, and then the queries are passed specific parameter values at runtime.

Running the Signal Generation Example

For optimal demonstration purposes, Oracle recommends that you run this example on a powerful computer, such as one with multiple CPUs or a 3 GHz dual-core Intel, with a minimum of 2 GB of RAM.

The `signalgeneration_domain` domain contains a single application: the signal generation sample application. To run the signal generation application, you simply start an instance of Oracle CEP in the domain, as described in the following steps:

1. Open a command window and change to the default server directory of the `signalgeneration_domain` domain directory, located in `ORACLE_CEP_HOME\ocep_10.3\samples\domains\signalgeneration_domain\defaultserver`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`.

```
prompt> cd
d:\oracle_cep\ocep_10.3\samples\domains\signalgeneration_domain\default
server
```

2. Set your development environment, as described in [“Setting Your Development Environment”](#) on page 3-4.
3. Start Oracle CEP by running the `startwlevs.cmd` (Windows) or `startwlevs.sh` (UNIX) command:

```
prompt> startwlevs.cmd
```

If you are using the JRockit JDK included in Oracle JRockit Real Time 3.0, enable the deterministic garbage collector by passing the `-dgc` parameter to the command:

```
prompt> startwlevs.cmd -dgc
```

The signal generation application is now ready to receive data from the data feeds.

On Windows you can also start the server using the Start menu:

```
Start > All Programs > Oracle Complex Event Processing 10gR3 > Examples
> Start Signal Generation Example Server
```

4. To simulate a data feed, use a load generator programmed specifically for the example, as described in the following steps:
 - a. Open a new command window .
 - b. Change to the `ORACLE_CEP_HOME\ocep_10.3\samples\domains\signalgeneration_domain\defaultserver\utils` directory, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`.
 - c. Run the `startDataFeed` command:

```
prompt> startDataFeed.cmd
```

On Windows you can also start the load generator using the Start menu:

```
Start > All Programs > Oracle Complex Event Processing 10gR3 > Examples
> Start Load Generator
```

5. Invoke the example dashboard by starting a browser and opening the following HTML page:

```
http://host:9002/algo/dashboard.html
```

Replace *host* with the name of the computer on which Oracle CEP is running; if it's the same computer as your browser, you can use `localhost`.

On Windows you can also start the dashboard using the Start menu:

```
Start > All Programs > Oracle Complex Event Processing 10gR3 > Examples  
> Start Signal Generation Console
```

6. In the browser, click the Start Button on the HTML page. You should start seeing the events that match the EPL rules configured for this example.

Building and Deploying the Signal Generation Example from the Source Directory

The signal generation sample source directory contains the Java source, along with other required resources, such as configuration XML files, EPN assembly file, and DOJO client Javascript libraries, that make up the signal generation application. The `build.xml` Ant file contains targets to build and deploy the application to the `signalgeneration_domain` domain, as described in [“Description of the Ant Targets to Build Signal Generation” on page 3-31](#).

To build and deploy the signal generation application, follow these steps:

1. If the signal generation Oracle CEP instance is not already running, follow the procedure in [“Running the Signal Generation Example” on page 3-28](#) to start the server. You must have a running server to successfully deploy the rebuilt application.

2. Open a new command window and change to the signal generation source directory, located in

```
ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\signalgeneration,  
where ORACLE_CEP_HOME refers to the main Oracle CEP installation directory, such as  
d:\oracle_cep.
```

```
prompt> cd  
d:\oracle_cep\ocep_10.3\samples\source\applications\signalgeneration
```

3. Set your development environment, as described in [“Setting Your Development Environment” on page 3-4](#).
4. Execute the `all` Ant target to compile and create the application JAR file:

```
prompt> ant all
```

- Execute the `deploy` Ant target to deploy the application JAR file to the `ORACLE_CEP_HOME\ocep_10.3\samples\domains\signalgeneration_domain\defaultserver\applications\signalgeneration` directory:

```
prompt> ant deploy
```

WARNING: This target overwrites the existing signal generation application JAR file in the domain directory.

- If the load generator required by the signal generation application is not running, start it as described in [“Running the Signal Generation Example” on page 3-28](#).
- Invoke the example dashboard as described in [“Running the Signal Generation Example” on page 3-28](#).

Description of the Ant Targets to Build Signal Generation

The `build.xml` file, located in the top-level directory of the FX source, contains the following targets to build and deploy the application:

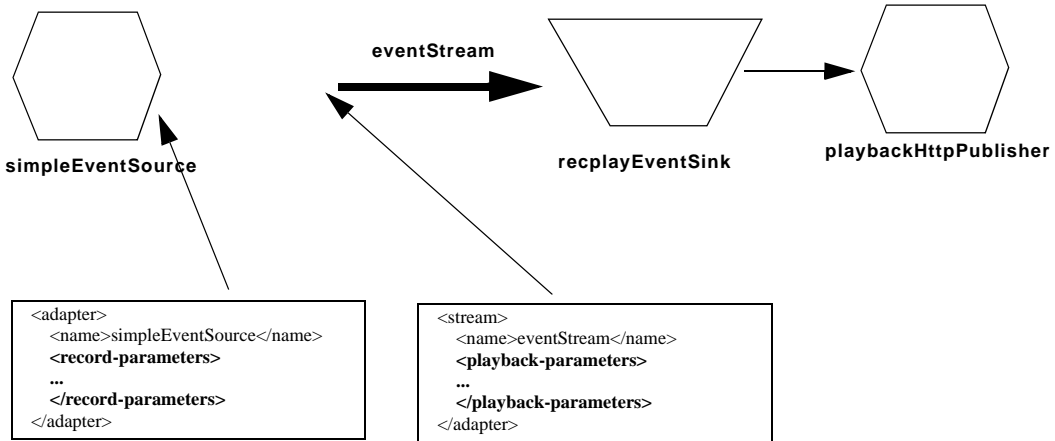
- `clean`—This target removes the `dist` and `output` working directories under the current directory.
- `all`—This target cleans, compiles, and jars up the application into a file called `com.bea.wlevs.example.signalgen_3.0.0.0.jar`, and places the generated JAR file into a `dist` directory below the current directory.
- `deploy`—This target deploys the JAR file to Oracle CEP using the Deployer utility. See [Deployer Command-Line Reference](#) for complete reference information about the Deployer utility.

Event Record and Playback Example

The record and playback example shows how to configure a component to record events to an event store and then configure another component in the network to playback events from the store. The example uses the Oracle CEP-provided database server, Apache Derby, to store the events. The example also shows how to configure a publishing HTTP pub-sub adapter as a node in the event processing network.

The following graphic describes the event processing network of the example.

Figure 3-3 Configuring Record and Playback in an EPN



The application contains four components in its event processing network:

- An adapter called `simpleEventSource` that generates simple events for purposes of the example. This component has been configured to record events, as shown in the graphic.
- An event bean called `replayEventSink` that acts as a sink for the events generated by the adapter.
- A stream called `eventStream` that connects the `simpleEventSource` adapter and `replayEventSink` event bean. This component has been configured to playback events.
- A publishing HTTP pub-sub adapter called `playbackHttpPublisher` that listens to the `replayEventSink` event bean and publishes to a channel called `/playbackchannel` of the Oracle CEP HTTP Pub-Sub server.

Running the Event Record/Playback Example

The `replay_domain` domain contains a single application: the record and playback sample application. To run this application, you first start an instance of Oracle CEP in the domain, as described in the following procedure.

The procedure then shows how you use Visualizer to start the recording and playback of events at the `simpleEventSource` and `eventStream` components, respectively. Finally, the procedure

shows how you can use Visualizer to view the stream of events being published to a channel by the `playbackHttpPublisher` adapter.

1. Open a command window and change to the default server directory of the `recplay_domain` domain directory, located in

```
ORACLE_CEP_HOME\ocep_10.3\samples\domains\recplay_domain\defaultserver,
where ORACLE_CEP_HOME refers to the main Oracle CEP installation directory, such as
d:\oracle_cep.
```

```
prompt> cd
d:\oracle_cep\ocep_10.3\samples\domains\recplay_domain\defaultserver
```

2. Set your development environment, as described in [“Setting Your Development Environment” on page 3-4](#).
3. Start Oracle CEP by running the `startwlevs.cmd` (Windows) or `startwlevs.sh` (UNIX) command:

```
prompt> startwlevs.cmd
```

If you are using the JRockit JDK included in Oracle JRockit Real Time 3.0, enable the deterministic garbage collector by passing the `-dgc` parameter to the command:

```
prompt> startwlevs.cmd -dgc
```

After server status messages scroll by, you should see the following message printed to the output:

```
SimpleEvent created at: 14:33:40.441
```

This message indicates that the Oracle CEP server started correctly and that the `simpleEventSource` component is creating events.

4. Invoke Visualizer in your browser using the following URL:

```
http://host:9002/wlevs
```

where `host` refers to the computer hosting the Oracle CEP server; if it is the same computer from which you are running your browser, you can use `localhost`.

Log in to Visualizer using username `wlevs` and password `wlevs`.

5. In the left pane, click `WLEventServerDomain > NonClusteredServer > Applications > recplay > Stages > simpleEventSource`.
6. In the right pane, click the Record tab.
7. At the bottom of the tab, click the Start Recording button. You should see a blinking Recording... status in the Current Status field.

As soon as you click the button, events start to flow out of the `simpleEventSource` component and are stored in the configured database. You can further configure when events are recorded using the Start Recording and Stop Recording fields.

8. In the left pane, click the `eventStream` component (`WLEventServerDomain > NonClusteredServer > Applications > replay > Stages > eventStream.`)
9. In the right pane, click the Playback tab.
10. At the bottom of the tab, click the Start Playback button. You should see a blinking Playing... status in the Current Status field.

As soon as you click the button, events that had been recorded by the `simpleEventSource` component are now played back to the `simpleStream` component. You should see the following messages being printed to the command window from which you started Oracle CEP server to indicate that both original events and playback events are streaming through the EPN:

```
SimpleEvent created at: 14:33:11.501  
Played back: Original time=14:15:23.141 Playback time=14:33:11.657
```

You can further configure the playback parameters, such as the recorded time period for which you want playback events and the speed that they are played back, by updating the appropriate field and clicking the Change Parameters button. You must restart the playback after changing the playback parameters.

11. To view the events that the `playbackHttpPublisher` adapter is publishing to a channel, follow these steps:
 - a. In the top pane, click the Viewstream button.
 - b. In the right pane, click Initialize Client.
 - c. In the Subscribe Channel text box, enter `/playbackchannel`.
 - d. Click Subscribe.

The Received Messages text box displays the played back event details. The played back events show the time at which the event was created and the time at which it was played back.

Building and Deploying the Event Record/Playback Example from the Source Directory

The record and playback sample source directory contains the Java source, along with other required resources, such as configuration XML file and EPN assembly file that make up the application. The `build.xml` Ant file contains targets to build and deploy the application to the `signalgeneration_domain` domain, as described in [“Description of the Ant Targets to Build Record and Playback” on page 3-36](#).

To build and deploy the record and playback application, follow these steps:

1. If the record/playback Oracle CEP instance is not already running, follow the procedure in [“Running the Event Record/Playback Example” on page 3-32](#) to start the server. You must have a running server to successfully deploy the rebuilt application.
2. Open a new command window and change to the record/playback source directory, located in `ORACLE_CEP_HOME\ocep_10.3\samples\source\applications\recplay`, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory, such as `d:\oracle_cep`.

```
prompt> cd d:\oracle_cep\ocep_10.3\samples\source\applications\recplay
```

3. Set your development environment, as described in [“Setting Your Development Environment” on page 3-4](#).
4. Execute the `all` Ant target to compile and create the application JAR file:

```
prompt> ant all
```

5. Execute the `deploy` Ant target to deploy the application JAR file to the `ORACLE_CEP_HOME\ocep_10.3\samples\domains\recplay_domain\defaultserver\applications\recplay` directory:

```
prompt> ant -Dusername=wlevs -Dpassword=wlevs -Daction=update deploy
```

WARNING: This target overwrites the existing record playback application JAR file in the domain directory.

After an application redeploy message, you should see the following message printed to the output about every second:

```
SimpleEvent created at: 14:33:40.441
```

This message indicates that the record and playback example has been redeployed and is running correctly.

6. Follow the instructions in “[Running the Event Record/Playback Example](#)” on page 3-32, starting at [step 4](#), to invoke Visualizer and start recording and playing back events.

Description of the Ant Targets to Build Record and Playback

The `build.xml` file, located in the top-level directory of the record/playback source, contains the following targets to build and deploy the application:

- `clean`—This target removes the `dist` and `output` working directories under the current directory.
- `all`—This target cleans, compiles, and jars up the application into a file called `com.bea.wlevs.example.recplay_3.0.0.0.jar`, and places the generated JAR file into a `dist` directory below the current directory.
- `deploy`—This target deploys the JAR file to Oracle CEP using the Deployer utility. See [Deployer Command-Line Reference](#) for complete reference information about the Deployer utility.

Implementation of the Record and Playback Example

The implementation of the record and playback example generally follows the [main steps for creating an Oracle CEP application](#); refer to that section for a task-oriented procedure that describes the typical development process.

All the files of the example are located relative to the `ORACLE_CEP_HOME\occep_10.3\samples\source\applications\recplay` directory, where `ORACLE_CEP_HOME` refers to the main Oracle CEP installation directory such as `c:\oracle_cep`. Oracle recommends that you use this example directory setup in your own environment, although it is obviously not required.

The files used by the record and playback example include:

- An EPN assembly file that describes each component in the application and how all the components are connected together.

In the example, the file is called `com.bea.wlevs.example.recplay-context.xml` and is located in the `META-INF/spring` directory.

- Java source file for the `simpleEventSource` adapter.

In the example, the the file is called `SimpleEventSource.java` and is located in the `src/com/bean/wlevs/adapter/example/recplay` directory.

For a detailed description of this file and how to program the adapter Java files in general, see [Creating Custom Adapters and Event Beans](#).

- Java source file that describes the `PlayedBackEvent` and `SimpleEvent` event types. The `SimpleEvent` event type is the one originally generated by the adapter, but the `PlayedBackEvent` event type is used for the events that are played back after having been recorded. The `PlayedBackEvents` look almost exactly the same as `SimpleEvent` except they have an extra field, the time the event was recorded.

In the example, the two events are called `SimpleEvent.java` and `PlayedBackEvent.java` and are located in the `src/com/bean/wlevs/event/example/recplay` directory.

For a detailed description of this file, as well as general information about programming event types, see [Creating Event Types](#).

- A Java file that implements the `recplayEventSink` event bean of the application, which is an event sink that receives both realtime events from the `simpleEventSource` adapter as well as playback events.

In the example, the file is called `RecplayEventSink.java` and is located in the `src/com/bean/wlevs/example/recplay` directory.

For details about this file, and programming the business logic in an event bean in general, see [Creating Custom Adapters and Event Beans](#).

- An XML file that configures the `simpleEventSource` adapter and `eventStream` stream components. The adapter includes a `<record-parameters>` element that specifies that the component will record events to the event store; similarly, the stream includes a `<playback-parameters>` element that specifies that it receives playback events.

In the example, the file is called `config.xml` and is located in the `META-INF/wlevs` directory.

- A `MANIFEST.MF` file that describes the contents of the OSGi bundle that will be deployed to Oracle CEP.

In the example, the `MANIFEST.MF` file is located in the `META-INF` directory

See [Assembling an Oracle CEP Application: Main Steps](#) for information about creating this file, as well as a description of creating the OSGi bundle that you deploy to Oracle CEP.

The record/playback example uses a `build.xml` Ant file to compile, assemble, and deploy the OSGi bundle; see [“Building and Deploying the Event Record/Playback Example from the Source](#)

[Directory](#)” on page 3-35 for a description of this `build.xml` file if you also use Ant in your development environment.

Installing Oracle Complex Event Processing

This section contains information on the following subjects:

- “Before You Begin” on page 4-1
- “Installation Overview” on page 4-2
- “Installing Oracle CEP in Graphical Mode: Main Steps” on page 4-2
- “Installing Oracle CEP in Console Mode: Main Steps” on page 4-5
- “Installing Oracle CEP in Silent Mode: Main Steps” on page 4-8
- “Post-Installation Steps” on page 4-13

Before You Begin

Before you install Oracle Complex Event Processing 10.3 (or *Oracle CEP* for short):

- Optionally install Oracle JRockit Real Time 3.0. Oracle recommends this step if your applications require low latency. Oracle CEP 10.3 performs optionally when it can access certain features from Oracle JRockit Real Time, in particular the JRockit deterministic garbage collector. Oracle CEP includes its own version of JRockit, but it does not include the deterministic garbage collector.

WARNING: Be sure you install the version of Oracle JRockit Real Time that includes JRockit 5.0 or 6.0. The version that includes JRockit 1.4.2 is *not* compatible with Oracle CEP 10.3.

See the [Oracle JRockit Real Time](#) site on the Oracle Technology Network for more information.

- Install Apache Ant, a Java-based build tool. For details, see the [Apache Ant Project](#).

Installation Overview

You install Oracle CEP using a standard Oracle installation program. The program can be used in the following modes:

- **Graphical mode**

Graphical-mode installation is an interactive, GUI-based method for installing your software. It can be run on both Windows and UNIX systems. See “[Installing Oracle CEP in Graphical Mode: Main Steps](#)” on page 4-2.

WARNING: If you want to run graphical-mode installation, the console attached to the machine on which you are installing the software must support a Java-based GUI. All consoles for Windows systems support Java-based GUIs, but not all consoles for UNIX systems do. If you attempt to start the installation program in graphical mode on a system that cannot support a graphical display, the installation program automatically starts console-mode installation.

- **Console mode**

Console-mode installation is an interactive, text-based method for installing your software from the command line, on either a UNIX system or a Windows system. See “[Installing Oracle CEP in Console Mode: Main Steps](#)” on page 4-5.

- **Silent mode**

Silent-mode installation is a non-interactive method of installing your software that requires the use of an XML properties file for selecting installation options. You can run silent-mode installation in either of two ways: as part of a script or from the command line. Silent-mode installation is a way of setting installation configurations only once and then using those configurations to duplicate the installation on many machines. See “[Installing Oracle CEP in Silent Mode: Main Steps](#)” on page 4-8.

Installing Oracle CEP in Graphical Mode: Main Steps

The Oracle CEP graphical installation program is self-explanatory, however, you can follow these steps for more information.

1. Log in to the Windows or UNIX computer on which you want to install Oracle CEP.

Be sure you log in to the computer as the user that will be the main administrator of the Oracle CEP installation.

2. Download the product distribution file for the platform on which you want to install Oracle CEP.
3. Launch the installation program in graphical mode using the commands listed in the following table appropriate for your platform.

Platform	Instructions
Windows	Using Windows Explorer, double-click the <code>ocep30_win32.exe</code> file from its download directory.
UNIX	<p>Open a command window, change to the download directory, and enter these commands:</p> <pre>prompt> chmod a+x filename.bin prompt> ./filename.bin</pre> <p>In these commands, <code>filename.bin</code> is the name of the installation program specific to your platform, for example, <code>ocep30_linux32.bin</code> and <code>ocep30_solaris64.bin</code>.</p> <p>If you want to create an installation log, use the <code>-log=full_path_to_log_file</code> option; for example:</p> <pre>prompt> ./filename.bin -log=C:\logs\server_install.log</pre>

4. After the installation program has finished loading, you will see the standard Welcome window.

Click Next.

5. In the Choose Home Directory window, you can specify either an existing `ORACLE_CEP_HOME` directory or create a new one.

The `ORACLE_CEP_HOME` directory is the main installation directory for Oracle CEP, such as `c:\oracle_cep`. You can have one or many `ORACLE_CEP_HOME` directories on your computer, whichever suits your development and production environments best.

If you decide to install into an existing `ORACLE_CEP_HOME` directory, the installer program checks if the directory includes the version of JRockit required by this release of Oracle CEP. If it finds the required JRockit installation, it does not install a new one. If, however,

the installer program does not find an appropriate JRockit installation, then the program installs its own version in the `ORACLE_CEP_HOME` directory.

Use the Browse button to browse your computer for an existing or new `ORACLE_CEP_HOME` directory.

Click Next.

6. In the Choose Install Type window, you can choose whether to install the complete version of Oracle CEP or whether you want to pick the individual components of the product that you want to install.

Caution: By default, the complete installation does *not* include the product samples. If you want to install the samples (recommended), chose the Custom option.

Click Next.

7. If you chose Custom in the preceding step:

- a. You will see the Choose Products and Components window. Check the components you want to install, such as the product samples.

Click Next.

- b. In the JDK Selection window, select the JDKs you want to install for use with Oracle CEP. Use the Browse button to find other JDKs installed in different directories.

Click Next.

8. In the Choose Product Installation Directories, you can change the default name of the home directory of Oracle CEP, `ocep_10.3`.

Although you can name this directory anything you want, Oracle recommends that you use the default name for clarity and standardization. For example, the documentation assumes that you install into the `ocep_10.3` directory.

Click Next.

9. If you are installing on Windows, and you logged in as a user with Administrator privileges, then you will see the Choose Shortcut Location window where you can choose where you want the Start Menu folder to appear. The following table describes the options available:

If you select . . .	The following occurs . . .
All Users	Recommended. All users registered on the machine are provided with access to the installed software. Subsequently, if users without Administrator privileges use the Configuration Wizard from this installation to create domains, Start menu shortcuts to the domains are not created. In this case, users can manually create shortcuts in their local Start menu folders, if desired.
Local user	Other users registered on this machine will not have access to the Start menu entries for this installation.

If you logged in as a user without Administrator privileges, the Start menu entries are created in your user's local Start menu folder.

Click Next.

- The Installation Summary window shows the products and components you are about to install, along with the approximate size in MB. This window is for your information only; to change the components to be installed, use the Previous button to return to the appropriate window.

Click Next.

The installer program installs Oracle CEP. The Installation Complete window indicates that the product was installed successfully.

- Click Done to exit the program.

Installing Oracle CEP in Console Mode: Main Steps

Console-mode installation is an interactive, text-based method for installing your software from the command line, on either a UNIX or Windows system.

When installing in console-mode, respond to the prompts in each section by entering the number associated with your choice or by pressing Enter to accept the default. To exit the installation process, enter `exit` (or `x`, for short) in response to any prompt. To review or change your selection, enter `previous` (or `p`, for short) at the prompt. To proceed to the following window, enter `next` (or `n`, for short).

Note: In the following procedure, Windows conventions (such as back-slashes in pathnames) are used, for example, `C:\oracle_cep\ocep_10.3`. When entering pathnames on a UNIX system, be sure to use UNIX conventions, instead. For example, use forward slashes in pathnames, such as `/oracle_cep/ocep_10.3`.

The following procedure steps you through the installation program.

1. Log in to the Windows or UNIX computer on which you want to install Oracle CEP.
Be sure you log in to the computer as the user that will be the main administrator of the Oracle CEP installation.
2. Download the product distribution file for the platform on which you want to install Oracle CEP.
3. Launch the installation program in console mode using the commands listed in the following table appropriate for your platform.

Platform	Instructions
Windows	<p>Open a command window, change to the download directory, and enter the following command:</p> <pre>prompt> ocep30_win32.exe -mode=console</pre> <p>If you want to create an installation log, use the <code>-log=full_path_to_log_file</code> option; for example:</p> <pre>prompt> ocep30_win32.exe -mode=console -log=C:\logs\server_install.log</pre>
UNIX	<p>Open a command window, change to the download directory, and enter these commands:</p> <pre>prompt> chmod a+x filename.bin prompt> ./filename.bin -mode=console</pre> <p>In these commands, <code>filename.bin</code> is the name of the installation program specific to your platform, for example, <code>ocep30_linux32.bin</code> and <code>ocep30_solaris64.bin</code>.</p> <p>If you want to create an installation log, use the <code>-log=full_path_to_log_file</code> option; for example:</p> <pre>prompt> ./filename.bin -mode=console -log=C:\logs\server_install.log</pre>

4. At the Welcome prompt, type `next` (or `n` for short) or press Enter to continue with the installation process.
5. In the Choose Home Directory window, the list of known home directories (if any) appear, as well as an option to create a new one.

The `ORACLE_CEP_HOME` directory is the main Oracle CEP installation directory, such as `c:\oracle_cep`. You can have one or many `ORACLE_CEP_HOME` directories on your computer, whichever suits your development and production environments best.

If you decide to install into an existing `ORACLE_CEP_HOME` directory, the installer program checks if the directory includes the version of JRockit required by this release of Oracle CEP. If it finds the required JRockit installation, it does not install a new one. If, however, the installer program does not find an appropriate JRockit installation, then the program installs its own version in the `ORACLE_CEP_HOME` directory.

Type 1 to create a new `ORACLE_CEP_HOME` directory, or type the number of the existing `ORACLE_CEP_HOME` directory.

6. If you chose 1 to create a new `ORACLE_CEP_HOME` directory, the installation program guides you through the required steps to create the new `ORACLE_CEP_HOME`. Be sure to enter the *full* path of the `ORACLE_CEP_HOME` directory, for example `C:\oracle_cep2`. If you specify a directory that does not exist, the installation program creates it for you.
7. In the Choose Install Type window, you can choose whether to install the complete version of Oracle CEP or whether you want to pick the individual components of the product that you want to install.

Enter 1 for a complete install or 2 for a custom install.

Caution: By default, the complete installation does *not* include the product samples. If you want to install the samples (recommended), chose the Custom option.

8. If you chose Custom in the preceding step, you will see the Choose Components to Install window. Enter the numbers in brackets to toggle the components you want to install, such as the samples.

Enter `next` (or `n`) when you have chosen the components.

9. In the Choose Product Installation Directories, you can change the default name of the home directory of Oracle CEP, `ocep_10.3`, by entering a new value.

Although you can name this directory anything you want, Oracle recommends that you use the default name for clarity and standardization. For example, the documentation assumes that you install into the `ocep_10.3` directory.

Enter `next` (or `n`) when you are done.

10. If you are installing on Windows, and you logged in as a user with Administrator privileges, then you will see the Choose Shortcut Location window where you can choose where you want the Start Menu folder to appear. The following table describes the options available:

If you select . . .	The following occurs . . .
1 "All Users"	Recommended. All users registered on the machine are provided with access to the installed software. Subsequently, if users without Administrator privileges use the Configuration Wizard from this installation to create domains, Start menu shortcuts to the domains are not created. In this case, users can manually create shortcuts in their local Start menu folders, if desired.
2 "Local user"	Other users registered on this machine will not have access to the Start menu entries for this installation.

If you logged in as a user without Administrator privileges, the Start menu entries are created in your user's local Start menu folder.

Enter the appropriate number.

The installer program installs Oracle CEP. The Installation Complete window indicates that the product was installed successfully.

11. Type `exit` to exit the program.

Installing Oracle CEP in Silent Mode: Main Steps

Silent-mode installation is a non-interactive method of installing your software that requires the use of an XML properties file for selecting installation options. To install using silent mode:

1. Log in to the Windows or UNIX computer on which you want to install Oracle CEP.
Be sure you log in to the computer as the user that will be the main administrator of the Oracle CEP installation.
2. Download the product distribution file for the platform on which you want to install Oracle CEP.

3. Create a `silent.xml` file that defines the configuration settings normally entered by a user during an interactive installation process. See [“Creating a silent.xml File for Silent-Mode Installation”](#) on page 4-10.

Note: Incorrect entries in the `silent.xml` file can cause installation failures. To help you determine the cause of a failure, we recommend that you create a log file when you launch the installation program.

4. Launch the installation program in silent mode using the commands in the following table appropriate for your platform.

Platform	Instructions
Windows	<p>Open a command window, change to the download directory, and enter the following command:</p> <pre>prompt> ocep30_win32.exe -mode=silent -silent_xml=path_to_xml_file</pre> <p>In the preceding command, <code>path_to_xml_file</code> is the full pathname of the <code>silent.xml</code> template file you created in the preceding step.</p> <p>If you want to create an installation log, use the <code>-log=full_path_to_log_file</code> option; for example:</p> <pre>prompt> ocep30_win32.exe -mode=silent -silent_xml=path_to_xml_file -log=C:\logs\server_install.log</pre>
UNIX	<p>Open a command window, change to the download directory, and enter these commands:</p> <pre>prompt> chmod a+x filename.bin prompt> ./filename.bin -mode=silent -silent_xml=path_to_xml_file</pre> <p>In these commands, <code>filename.bin</code> is the name of the installation program specific to your platform, for example, <code>ocep30_linux32.bin</code> and <code>ocep30_solaris64.bin</code>, and <code>path_to_xml_file</code> is the full pathname of the <code>silent.xml</code> template file you created in the preceding step.</p> <p>If you want to create an installation log, use the <code>-log=full_path_to_log_file</code> option; for example:</p> <pre>prompt> ./filename.bin -mode=silent -silent_xml=path_to_xml_file -log=C:\logs\server_install.log</pre>

An Oracle Installer window is displayed, indicating that the files are being extracted. No other prompt or text is displayed.

The installation is complete when the Oracle Installer window disappears.

See [“Returning Exit Codes to the Command Window” on page 4-12](#) for getting information about the success or failure of the silent installation.

Creating a silent.xml File for Silent-Mode Installation

When you install Oracle CEP in silent mode, the installation program uses an XML file (`silent.xml`) to determine which installation options should be implemented.

To create a `silent.xml` file, follow these steps:

1. Using your favorite text edit, create an empty file called `silent.xml` on the computer on which you want to install Oracle CEP in silent mode.
2. Copy the contents of the sample XML file, shown in [“Sample silent.xml File for Silent-Mode Installation” on page 4-12](#), into your own `silent.xml` file.
3. In the `silent.xml` file you just created, edit the values for the keywords shown in [Table 4-1](#) to reflect your configuration.

For example, if you want to install into the `ORACLE_CEP_HOME` directory `e:\oracle_cep`, update the corresponding `<data-value>` element as follows

```
<data-value name="BEAHOME" value="e:\oracle_cep" />
```

4. Save the file in the directory of your choice.

Table 4-1 Values for the silent.xml File

For this data-value name...	Enter the following value...
BEAHOME	The full pathname for the <code>ORACLE_CEP_HOME</code> directory of your choice.
USER_INSTALL_DIR	The full pathname for the directory where you want to install your Oracle CEP software.

Table 4-1 Values for the silent.xml File

For this data-value name...	Enter the following value...
INSTALL_SHORTCUT_IN_ALL_USERS_FOLDER	<p>Windows only. Specify:</p> <ul style="list-style-type: none"> • true, or yes, to create the shortcuts in the All Users folder. • false, or no, to create the shortcuts in the local users folder. <p>The user performing the installation must have Administrator privileges to install the Start menu shortcuts in the All Users folder.</p> <p>The default value for this parameter, if you do not specify it, is true.</p>
COMPONENT_PATHS	<p>Specify the components and subcomponents of Oracle CEP you want to install on your system. Use the following values:</p> <pre>WebLogic Event Server WebLogic Event Server/Event Server WebLogic Event Server/Event Server Samples</pre> <p>For additional information about entering these values, see “Guidelines for Component Selection” on page 4-11.</p> <p>If you do not include the COMPONENT_PATHS data-value name in the silent.xml file, the complete Oracle CEP product is installed.</p>

Guidelines for Component Selection

Use the following guidelines when you specify values for the COMPONENT_PATHS data-value name:

- When you specify a product component to be installed, all subcomponents that are installed by default in a complete installation are also installed. For example, the following entry installs both Oracle CEP and the samples:

```
<data-value name="COMPONENT_PATHS" value="WebLogic Event Server" />
```

- To install multiple components or subcomponents, separate the components with a bar (|). Do not leave a space before or after the bar.
- To specify subcomponents, you must specify a component/subcomponent combination for each entry. For example, to explicitly install Oracle CEP and the samples, enter the following line in the file:

```
<data-value name="COMPONENT_PATHS" value="WebLogic Event Server/Event
Server|WebLogic Event Server/Event Server Samples" />
```

Note: Because this release of Oracle CEP includes only the server itself and samples, the preceding example is equivalent to the example in the first bullet.

Sample silent.xml File for Silent-Mode Installation

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Silent installer option: -mode=silent -silent_xml=C:\oracle\silent.xml -->

<bea-installer>
  <input-fields>
    <data-value name="BEAHOME" value="C:\oracle_cep" />
    <data-value name="USER_INSTALL_DIR" value="C:\oracle_cep\ocep_10.3" />
    <data-value name="INSTALL_SHORTCUT_IN_ALL_USERS_FOLDER" value="yes"/>
    <data-value name="COMPONENT_PATHS" value="WebLogic Event Server" />
  </input-fields>
</bea-installer>
```

Returning Exit Codes to the Command Window

When run in silent mode, the installation program generates exit codes that indicate the success or failure of the installation. These exit codes are shown in the following table.

Table 4-2 Exit Codes

Code	Description
0	Installation completed successfully
-1	Installation failed due to a fatal error
-2	Installation failed due to an internal XML parsing error

[Listing 4-1](#) provides a sample Windows command file that invokes the installation program in silent mode and echoes the exit codes to the command window from which the script is executed.

Listing 4-1 Sample Windows Command File Displaying Silent-Mode Exit Codes

```
rem Execute the installer in silent mode
@echo off
ocp30_win32.exe -mode=silent -silent_xml=C:\downloads\silent.xml
-log=C:\logs\products_silent.log

@rem Return an exit code to indicate success or failure of installation
set exit_code=%ERRORLEVEL%

@echo.
@echo Exitcode=%exit_code%
@echo.
@echo Exit Code Key
@echo -----
@echo 0=Installation completed successfully
@echo -1=Installation failed due to a fatal error
@echo -2=Installation failed due to an internal XML parsing error
@echo.
```

Post-Installation Steps

After installing Oracle CEP:

- Try out the product examples. For information about the examples and how to run them, see [Chapter 3, “Oracle CEP Examples.”](#)
- Create your own Oracle CEP domain. See [Creating an Oracle CEP Domain](#).
- Create an Oracle CEP application and deploy it to your new domain. See [Creating Oracle CEP Applications](#) for a description of the programming model, details about the various components that make up an application, and how they all fit together.

Installing Oracle Complex Event Processing