Oracle® Fusion Middleware

Configuring and Using the Diagnostics Framework for Oracle WebLogic Server

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Oracle Fusion Middleware Configuring and Using the Diagnostics Framework for Oracle WebLogic Server, 14c (14.1.2.0.0)

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Preface

This document describes and tells how to configure and use the monitoring and diagnostic services provided by WebLogic Diagnostics Framework (WLDF).

Audience

WLDF provides features for monitoring and diagnosing problems in running WebLogic Server instances and clusters and in applications deployed to them. Therefore, the information in this document is directed both to system administrators and to application developers. It also contains information for third-party tool developers who want to build tools to support and extend WLDF.

It is assumed that readers are familiar with Web technologies and the operating system and platform where WebLogic Server is installed.

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Related Documentation

- *Configuring Log Files and Filtering Log Messages for Oracle WebLogic Server* describes how to use WLDF logging services to monitor server, subsystem, and application events.
- The WLDF system resource descriptor conforms to the `weblogic-diagnostics.xsd` schema, available at http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/weblogic-diagnostics.xsd.
- Samples and Tutorials
- New and Changed WebLogic Server Features

Samples and Tutorials

Oracle provides a variety of code examples and tutorials that show WebLogic Server configuration and API use, and provide practical instructions on how to perform key development tasks. For more information, see Sample Applications and Code Examples in Understanding Oracle WebLogic Server.

WLDF Samples Available for Download

Additional WLDF samples for download can be found at `http://www.oracle.com/technetwork/indexes/samplecode/index.html`. These examples are distributed as `.zip` files that you can unzip into an existing WebLogic Server samples directory structure. These samples include Oracle-certified ones, as well as samples submitted by fellow developers.

New and Changed WebLogic Server Features

For a comprehensive listing of the new WebLogic Server features introduced in this release, see *What's New in Oracle WebLogic Server*.

Conventions

The following text conventions are used in this document:

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

1

Introduction

The WebLogic Diagnostics Framework (WLDF) is a monitoring and diagnostic framework that defines and implements a set of services that run within WebLogic Server processes and participate in the standard server life cycle.

Using WLDF, you can create, collect, analyze, archive, and access diagnostic data generated by a running server and the applications deployed within its containers. This data provides insight into the run-time performance of servers and applications and enables you to isolate and diagnose faults when they occur.

What Is the WebLogic Diagnostics Framework?

The WebLogic Diagnostics Framework (WLDF) is a suite of services and APIs that provide the ability to collect and surface metrics that provide visibility into server and application performance.Independent Software Vendors (ISVs) can use these APIs, using standard interfaces such as WLST, REST, and JMX, to develop custom monitoring and diagnostic tools for integration with WLDF.
The suite of services, components, and APIs provided by WLDF for collecting and analyzing data includes the following:

- Integration with Oracle HotSpot—If WebLogic Server is configured with Oracle HotSpot, WLDF can generate diagnostic information about WebLogic Server that is captured in the Java Flight Recorder file.
- Built-in diagnostic system modules—A set of diagnostic modules available out-of-the-box that you can enable dynamically to capture basic performance data about the JVM, the WebLogic Server run time, and primary WebLogic Server subsystems, including JDBC data sources, messaging, and Jakarta EE containers, such as servlets, EJBs, and resource adapters. The built-in diagnostic modules can also be cloned and modified, providing a simple way to create custom diagnostic system modules.
- Monitoring Dashboard—Graphically presents the current and historical operating state of WebLogic Server and hosted applications, including information gathered by the built-in diagnostic system modules. The Monitoring Dashboard, which is accessed from the WebLogic Remote Console, provides a set of tools for organizing and displaying diagnostic data into views, which surface some of the more critical run-time WebLogic Server performance metrics and the change in those metrics over time.
- Diagnostic Image Capture—Creates a diagnostic snapshot from the server that can be used for post-failure analysis. The diagnostic image capture includes Java Flight Recorder data, if it is available, that can be viewed in Java Mission Control.
- Archive—Captures and persists data events, log records, and metrics from server instances and applications.
- Instrumentation—Adds diagnostic code to WebLogic Server instances and the applications running on them to execute diagnostic actions at specified locations in the code. The Instrumentation component provides the means for associating a diagnostic *context* with requests so they can be tracked as they flow through the system. The WebLogic Remote Console includes a Performance page, which shows real-time and historical views of

method performance information that has been captured through the WLDF instrumentation capabilities, serving as a tool that can help identify performance problems in applications.

- Harvester—Captures metrics from run-time MBeans, including WebLogic Server MBeans and custom MBeans, which can be archived and later accessed for viewing historical data.
- Policies and Actions—Provides the means for monitoring server and application states and sending notifications based on criteria set in the policies.
- Logging services—Manage logs for monitoring server, subsystem, and application events. The WebLogic Server logging services are documented separately from the rest of the WebLogic Diagnostics Framework. See Related Documentation.

WLDF provides a set of standardized application programming interfaces (APIs) that enable dynamic access and control of diagnostic data, as well as improved monitoring that provides visibility into the server. These APIs can be accessed using the JMX and the WebLogic Scripting Tool (WLST), as described in Configuring and Using WLDF Programmatically.

WLDF enables dynamic access to server data through standard interfaces, and the volume of data accessed at any given time can be modified without shutting down and restarting the server.

2

Overview of the WLDF Architecture

WebLogic Diagnostics Framework (WLDF) consists of various components that work together to collect, archive, and access diagnostic information about a WebLogic Server instance and the application it hosts.This chapter provides an overview of the WLDF architecture, describes its components, and illustrates how all components work together to collect and access diagnostic information about a WebLogic Server and the application it hosts.

> **Note:**
>
> Concepts are presented in this section in a way to help you understand how WLDF works. Some of this differs from the way WLDF is surfaced in its configuration and run-time APIs and in the WebLogic Server Console. If you want to start configuring and using WLDF right away, you can safely skip this discussion and start with Using the Built-in Diagnostic System Modules.

The following topics summarize WLDF and its architectural components:

- Overview of the WebLogic Diagnostics Framework
- Data Creation, Collection, and Instrumentation
- Archive
  The Archive component of WLDF captures the state of the system and archives it for future access in diagnosing critical faults in the system. It creates a historical archive using several persistent components.
- Policies and Actions
  The Policies and Actions component of WLDF is used to create automated monitors that observe specific diagnostic states and send notifications based on configured rules.
- Data Accessor
  The Data Accessor component of WLDF provides access to all the data collected by WLDF, including log, event, and metric data. It interacts with the Archive component to get historical data including logged event data and persisted metrics.
- Monitoring Dashboard and Request Performance Pages
  The WebLogic Remote Console displays the Monitoring Dashboard and Diagnostics Request Performance pages. The diagnostics data collected is visually represented in these pages. The Monitoring Dashboard displays the current and historical operating state of WebLogic Server and hosted applications. The Diagnostics Request Performance page shows real-time and historical views of method performance information.
- Diagnostic Image Capture
  The Diagnostic Image Capture component captures the key server state as a diagnostic image. The diagnostic image is a diagnostic snapshot of the server state used in diagnosing problems.
- How It All Fits Together
  The components of the WLDF work together to collect data and diagnose faults in running server.

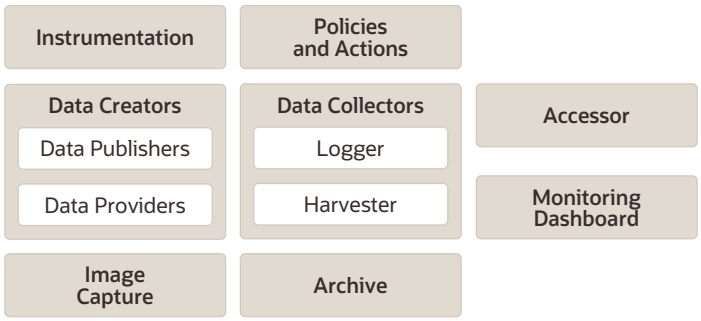
Overview of the WebLogic Diagnostics Framework

The WLDF components interact with each other to process data at the server level.WLDF consists of the following components:

- Data creators (data publishers and data providers that are distributed across WLDF components)
- Data collectors (the Logger and the Harvester components)
- Archive component
- Accessor component
- Instrumentation component
- Policies and Actions component
- Image Capture component
- Monitoring Dashboard

Data creators generate diagnostic data that is consumed by the Logger and the Harvester. Those components coordinate with the Archive to persist the data, and they coordinate with the Policies and Actions subsystem to provide automated monitoring. The Accessor interacts with the Logger and the Harvester to expose current diagnostic data and with the Archive to present historical data. The Image Capture facility provides the means for capturing a diagnostic snapshot of a key server state. The Major WLDF components are shown in Figure 2-1.

Figure 2-1 Major WLDF Components



All of the framework components operate at the server level and are only aware of server scope. All the components exist entirely within the server process and participate in the standard server lifecycle. All artifacts of the framework are configured and stored on a per server basis.

Data Creation, Collection, and Instrumentation

Diagnostic data is collected from a number of logically classified sources.The sources are logically classified as either *data providers*, data creators that are sampled at regular intervals to harvest current values, or *data publishers*, data creators that synchronously generate events.
Data providers and data publishers are distributed across components, and the generated data can be collected by the Logger or the Harvester, as shown in Figure 2-2.

Figure 2-2 Relationship of Data Creation Components to Data Collection Components

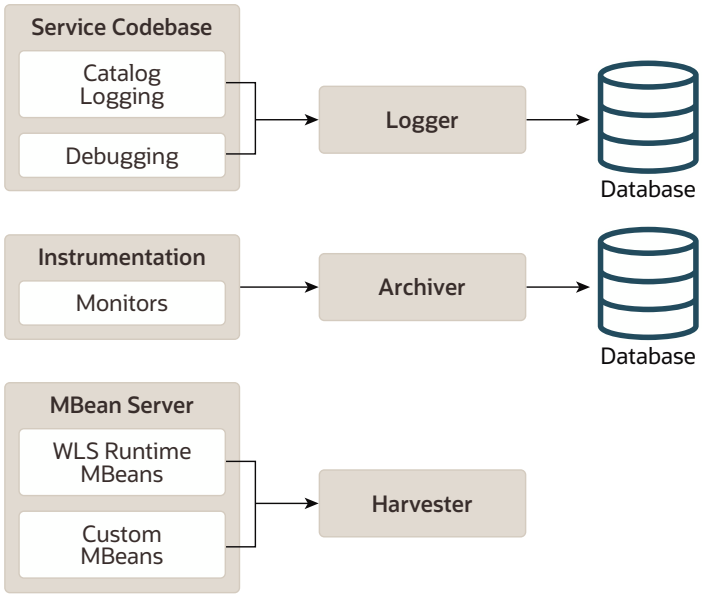


Figure 2-2 shows that invocations of the server logging infrastructure serve as inline data publishers, and that the generated data is collected as events. (The logging infrastructure can be invoked through the catalog infrastructure, the debugging model, or directly through the Logger.)

The Instrumentation component creates monitors and inserts them at well-defined points in the flow of execution. These monitors publish data directly to the Archive.

Components registered with the MBean Server may also make themselves known as data providers by registering with the Harvester. Collected data is then exposed to both the Policies and Actions system for automated monitoring and to the Archive for persistence.

Archive

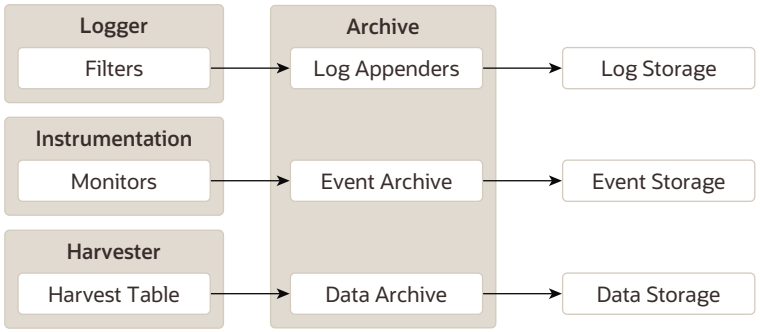
The Archive component of WLDF captures the state of the system and archives it for future access in diagnosing critical faults in the system. It creates a historical archive using several persistent components.

The past state is often critical in diagnosing faults in a system. This requires that the state be captured and archived for future access, creating a historical archive. In WLDF, the Archive meets this need with several persistence components. Both events and harvested metrics can be persisted and made available for historical review.

Traditional logging information, which is human readable and intended for inclusion in the server log, is persisted through the standard logging appenders. New event data that is intended for system consumption is persisted into an event store using an event archiver. Metric data is persisted into a data store using a data archiver. The relationship of the Archive to the Logger and the Harvester is shown in Figure 2-3.

The Archive provides access interfaces so that the Accessor may expose any of the persisted historical data.

Figure 2-3 Relationship of the Archive to the Logger and the Harvester

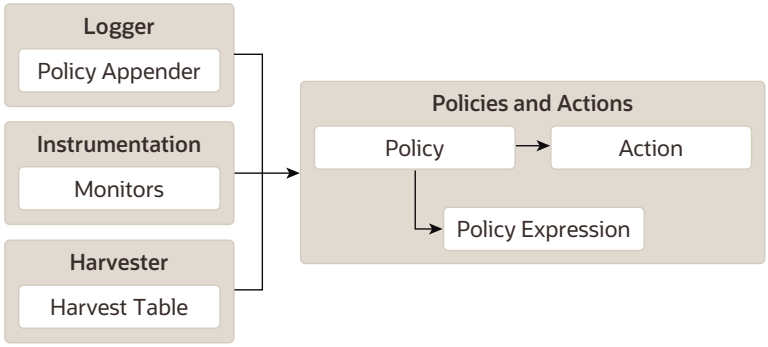


Policies and Actions

The Policies and Actions component of WLDF is used to create automated monitors that observe specific diagnostic states and send notifications based on configured rules.

A policy can monitor log data, event data from the Instrumentation component, or metric data from a data provider that is harvested by the Harvester. The Policy Manager is capable of managing policies that are composed of a number of policy expressions. These relationships are shown in Figure 2-4.

Figure 2-4 Relationship of the Logger and the Harvester to the Policies and Actions System



One or more actions can be configured for use by a policy. By default, every policy logs an event in the server log. SMTP, SNMP, JMX, elastic, REST, script, log, and JMS actions are also supported.

Data Accessor

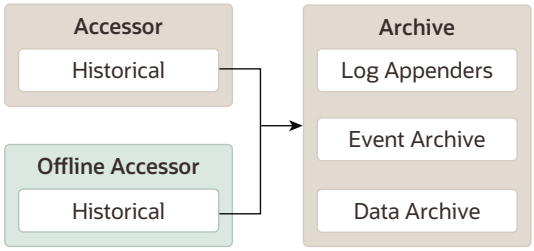
The Data Accessor component of WLDF provides access to all the data collected by WLDF, including log, event, and metric data. It interacts with the Archive component to get historical data including logged event data and persisted metrics.

When accessing data in a running server, a JMX-based access service is used. The Accessor provides for data lookup by type, by component, and by attribute. It permits time-based filtering and, in the case of events, filtering by severity, source and content.

Tools may need to access data that was persisted by a currently inactive server. In this case, an offline Accessor is also provided. You can use it to export archived data to an XML file for later access. To use the Accessor in this way, you must use the WebLogic Scripting Tool (WLST) and must have physical access to the machine.

The relationship of the Accessor to the Harvester and the Archive is shown in Figure 2-5.

Figure 2-5 Relationship of the Online and Offline Accessors to the Archive



Monitoring Dashboard and Request Performance Pages

The WebLogic Remote Console displays the Monitoring Dashboard and Diagnostics Request Performance pages. The diagnostics data collected is visually represented in these pages. The Monitoring Dashboard displays the current and historical operating state of WebLogic Server and hosted applications. The Diagnostics Request Performance page shows real-time and historical views of method performance information.

The following sections provide more information about the web pages that visually display the diagnostic data:

- Monitoring Dashboard
- Diagnostics Request Performance Page

Monitoring Dashboard

The Monitoring Dashboard displays the current and historical operating state of WebLogic Server and hosted applications by providing visualizations of metric runtime MBean attributes, which surface some of the more critical runtime performance metrics and the change in those metrics over time. Historical operating state is represented by collected metrics that have been persisted into the Archive. To view collected metrics from the Archive, you must configure the Harvester to capture the data you want to monitor.

The Monitoring Dashboard displays metric information in a series of views. A view is a collection of one or more charts that display metrics. The Monitoring Dashboard includes a predefined set of built-in views of available runtime metrics for all running WebLogic Server instances in the domain. Built-in views surface some of the more critical runtime WebLogic Server performance metrics and serve as examples of the Monitoring Dashboard's graphic capabilities.

Custom views are available only to the user who creates them. Custom views are automatically persisted and can be accessed again when you restart the Monitoring Dashboard sessions.

Diagnostics Request Performance Page

The Diagnostics Request Performance page of the WebLogic Remote Console shows real-time and historical views of method performance information that is captured using the Instrumentation component. To view request performance information, you must first configure the Instrumentation component to make that data available.

Diagnostic Image Capture

The Diagnostic Image Capture component captures the key server state as a diagnostic image. The diagnostic image is a diagnostic snapshot of the server state used in diagnosing problems.

Diagnostic Image Capture support gathers the most common sources of the key server state used in diagnosing problems. It packages that state into a single artifact which can be made available to support technicians, as shown in Figure 2-6. The diagnostic image is in essence a diagnostic snapshot or dump from the server, analogous to a UNIX core dump.

If WebLogic Server is configured with Oracle HotSpot, and Java Flight Recorder is enabled, the diagnostic image capture includes all available Java Flight Recorder data from all producers. Furthermore, if WLDF is configured to generate WebLogic Server diagnostic information captured by Java Flight Recorder, the JFR file includes that information as well. The JFR file can be extracted from the diagnostic image capture and viewed in Java Mission Control. See Using WLDF with Java Flight Recorder.

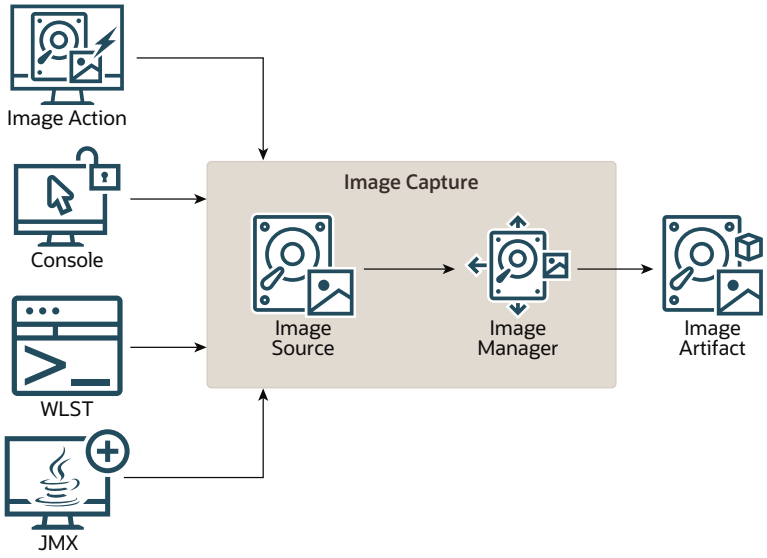
Image Capture support includes:

- On-demand capture, which is the creation of a diagnostic image capture by means of an operation or command issued from the WebLogic Remote Console, WLST script, or JMX application.
- Image action, which is automatically creating a diagnostic image capture in response to the triggering of an associated Harvester policy, Log policy, or Instrumentation policy expression. For example, a Harvester policy that monitors runtime MBean attributes in a running server can execute an image action if the metrics harvested from specific runtime MBean instances indicate a performance issue. Data in the diagnostic image capture can be analyzed to determine the likely causes of the issue.

For more information about diagnostic image capture, see:

- Configuring and Capturing Diagnostic Images
- Configuring Image Actions

Figure 2-6 Diagnostic Image Capture

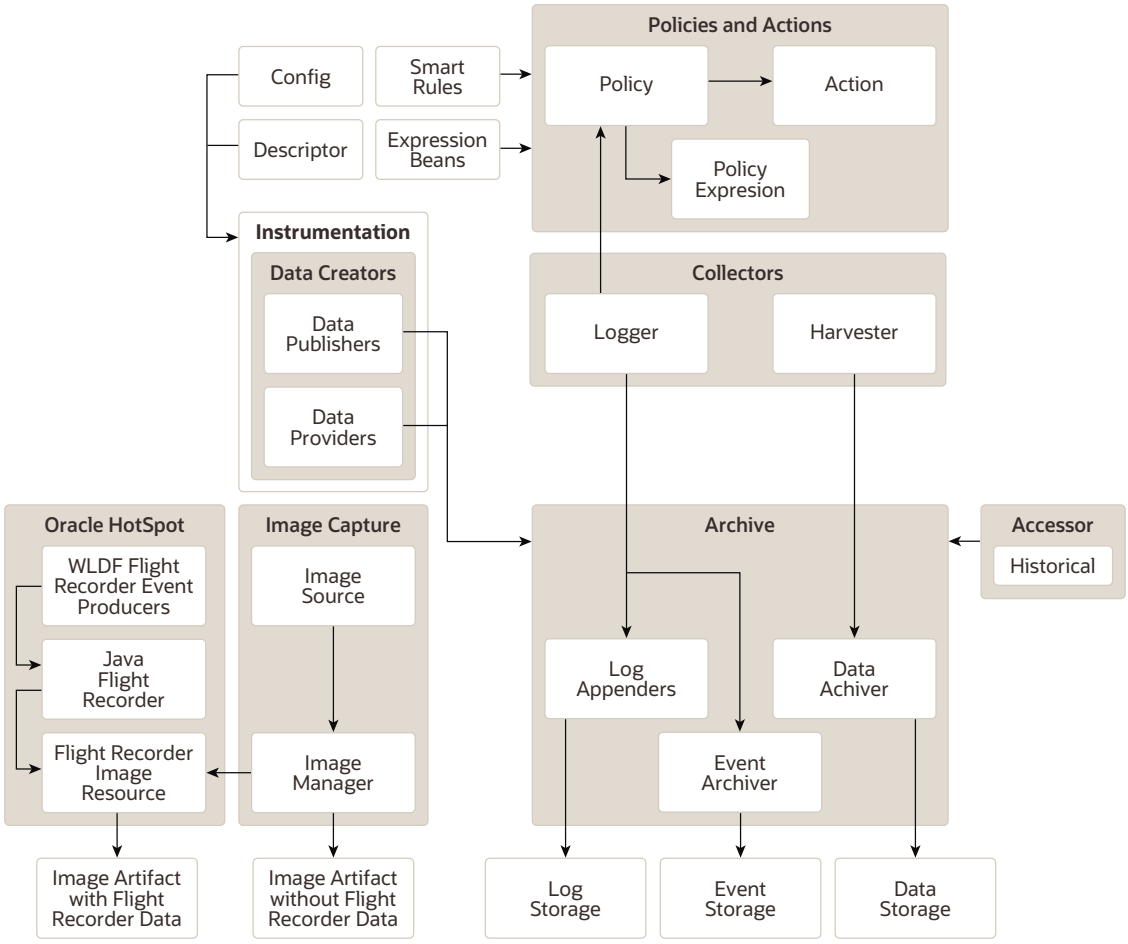


How It All Fits Together

The components of the WLDF work together to collect data and diagnose faults in running server.

Figure 2-7 shows how all the parts of WLDF fit together.

Figure 2-7 Overall View of the WebLogic Diagnostics Framework



3

Using the Built-in Diagnostic System Modules

The built-in diagnostic system modules are provided by the WebLogic Diagnostics Framework (WLDF) as a simple and easy-to-use mechanism for performing basic health and performance monitoring of a WebLogic Server instance.

Overview

The WLDF built-in diagnostic modules collect data from key WebLogic Server run-time MBeans that monitor the main components of a server instance.Those main components are:

- JVM
- WebLogic Server run time
- JDBC, JMS, transaction, and logging services
- Jakarta EE containers hosting servlets, EJBs, and Connector Architecture resource adapters

When configured in a WebLogic Server instance, the built-in diagnostic modules are particularly useful for providing a low-overhead, historical record of server performance. As server workload changes over time, or the performance characteristics change as a result of updates made to the server's configuration, you can examine the data collected by the built-ins to obtain details about performance changes. For example, if you notice a slowdown in the response time of one or more deployed applications, you can use the Monitoring Dashboard or the Metrics Log table in the WebLogic Remote Console to examine the data collected by the built-ins for performance bottlenecks associated with one or more WebLogic Server subsystems. Then using other diagnostic tools, such as custom diagnostic modules, policies and actions, or Java Flight Recorder, you can drill down further into details about those bottlenecks to pinpoint specific causes and test the effectiveness of solutions.

In WebLogic domains configured to run in production mode, a built-in diagnostic module is enabled by default in each server instance. (In domains configured to run in development mode, built-ins are disabled by default.) However, a built-in diagnostic module can be enabled or disabled for a server instance easily and dynamically, using either the WebLogic Remote Console or WLST.

Data collected by the built-in diagnostic modules can be accessed easily, using tools such as the Metrics Log table in the WebLogic Remote Console or the Monitoring Dashboard. The data can also be accessed programmatically using JMX, WLST, or REST.

Types of Built-in Diagnostic System Modules

WLDF provides three built-in diagnostic system module types:

- `Low` — Captures the most important data from key WebLogic Server runtime MBeans (enabled by default in production mode).

- `Medium` — Captures additional attributes from the WebLogic Server runtime MBeans captured by `Low`, and also includes data from additional runtime MBeans.
- `High` — Captures the most verbose data from attributes on the WebLogic Server runtime MBeans captured by `Medium`, and also includes data from a larger number of runtime MBeans.

The built-in diagnostic system module type configured for a server instance is specified in the `WLDFServerDiagnosticMBean.WLDFBuiltinSystemResourceType=`*`string`* MBean attribute, where *`string`* can be set to one of `Low`, `Medium`, `High`, or `None`.

Data Collected by Built-in Diagnostic System Modules

When you enable a built-in diagnostic module in a WebLogic Server instance, WLDF begins collecting data from key WebLogic Server run-time MBeans to obtain information, such as the following:

Data Category	Example of Information Collected
JVM statistics	Amount of available free memory and JVM processor load on host machine.
Thread statistics	Threads being held by a request and the number of pending user requests.
JDBC subsystem statistics	Examples of information collected may include: • Number of connections currently in use by applications. • Average amount of time taken to create a physical connection to the database. • Number of leaked connections (that is, connections reserved from the data source but not returned to the data source). • Number of available and idle database connections. • Cumulative, running count of requests for a connection from a data source.
JMS subsystem statistics	Examples of information collected may include statistics about: • WebLogic JMS consumers and producers, such as number of messages pending by a consumer or producer. • JMS destinations, such as current number of messages in the destination, and number of pending messages in the destination. • The current number of connections to WebLogic Server.
Logging subsystem statistics	The number of log messages that the WebLogic Server instance has generated.
JTA subsystem	Examples of information collected may include: • Number of active transactions on the server. • Total number of seconds that transactions were active for all committed transactions.
Jakarta EE container statistics	Examples of information collected may include statistics about: • EJBs, such as the EJB cache, EJB pool, and EJB transaction statistics. • Servlets, such as the average amount of time all invocations of a servlet have executed since the servlet was created.

> **Note:**
>
> The specific configuration of each built-in diagnostic module is internal to WebLogic Server and subject to change in a future release.

4

Using WLDF with Java Flight Recorder

The integration of the WebLogic Diagnostics Framework (WLDF) with Java Flight Recorder enables WebLogic Server events to be propagated to the Java Flight Recorder for inclusion in a common data set for runtime or post-incident analysis.The Flight Recording data is also included in WLDF diagnostic image captures, which enables you to capture flight recording snapshots based on WLDF policies. You can use this capability to capture and analyze, in a single view, the runtime system information for both the JVM and the Fusion Middleware components running on it.
This chapter also explains common usage scenarios that show how this integration can provide for a comprehensive performance analysis and diagnostic foundation for production systems based on WebLogic Server.

- About Java Flight Recorder
  Java Flight Recorder is a performance monitoring and profiling tool that records diagnostic information on a continuous basis. The Java Flight Recorder is available even when there is a catastrophic failure such as a system crash.
- Using Java Flight Recorder with Oracle HotSpot
  Java Flight Recorder is available with Oracle Hotspot. If WebLogic Server is configured with Oracle HotSpot, Java Flight Recorder is disabled by default. Enable the Java Flight Recorder to capture the WLDF diagnostic data.
- Key Features of WLDF Integration with Java Flight Recorder
  WLDF integration with Java Flight Recorder provides several useful features, including having WebLogic Server events captured in the flight recording, the ability to throttle the volume of data captured, tools for downloading diagnostic image captures, and more.
- Java Flight Recorder Use Cases
  Java Flight Recorder helps to resolve important diagnostic issues such as diagnosing critical failure, and examining and reporting runtime data. When a critical failure occurs, the data captured by Java Flight Recorder is useful for failure analysis. Likewise, capturing data at specific time and at runtime help to diagnose data after and before a particular event.
- Obtaining the Flight Recording File
  The diagnostic image capture is a single Java Flight Recorder (JFR) file that contains individual images produced by different server subsystems. The JFR file is included in the diagnostic image as `FlightRecording.jfr`.

About Java Flight Recorder

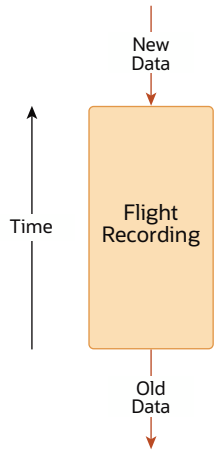
Java Flight Recorder is a performance monitoring and profiling tool that records diagnostic information on a continuous basis. The Java Flight Recorder is available even when there is a catastrophic failure such as a system crash.

Java Flight Recorder is available in Oracle HotSpot. When WebLogic Server is configured with HotSpot, Java Flight Recorder is not enabled by default. See Using Java Flight Recorder with Oracle HotSpot for information about how to enable Java Flight Recorder with WebLogic Server.

> **Note:**
>
> For the most current information about configurations supported in this release of WebLogic Server, see Oracle Fusion Middleware Supported System Configurations on the Oracle Technology Network.

Java Flight Recorder maintains a buffer of diagnostics and profiling data, called a flight recording or a JFR file, that you can access whenever you need it. The flight recording functions in a manner similar to an aircraft "black box" in which new data is continuously added and older data is stripped out, as shown in Figure 4-1.

Figure 4-1 Circular Flight Recording Buffer



The data contained in the JFR file includes events from the JVM and from any other event producer, such as WebLogic Server and Oracle Dynamic Monitoring System (DMS). The JFR file can be analyzed at any time, using Java Mission Control, to examine the details of system execution flow that occurred leading up to an event.

The amount of additional processing overhead that results when Java Flight Recorder is enabled, and also configure WLDF to generate WebLogic Server diagnostics to be captured by Java Flight Recorder, is minimal. This makes it ideal to be used on a full time basis, especially in production environments where it adds the greatest value.

Java Flight Recorder provides the following key benefits:

- Designed to run continuously — When Java Flight Recorder is configured to run full-time, with both JVM and WLDF events captured in the flight recording, diagnostic data is always available at the time an event occurs, including a system crash. This ensures that a record of diagnostic data leading up to the event is available, allowing you to diagnose the event without having to recreate it.
- Comprehensive data — Java Flight Recorder combines data generated by tools such as the Runtime Analyzer and the Latency Analysis Tool and presents it in one place.
- Integration with event providers — HotSpot includes a set of APIs that allow Java Flight Recorder to monitor additional system components, including WebLogic Server, Oracle Dynamic Monitoring System (DMS), and other Oracle products.

For more information about Java Flight Recorder, see Java Flight Recorder Runtime Guide at the following location:

http://docs.oracle.com/javacomponents/index.html

Using Java Flight Recorder with Oracle HotSpot

Java Flight Recorder is available with Oracle Hotspot. If WebLogic Server is configured with Oracle HotSpot, Java Flight Recorder is disabled by default. Enable the Java Flight Recorder to capture the WLDF diagnostic data.

To enable Java Flight Recorder, you must specify the following JVM options in the WebLogic Server instance in which the JVM runs:

```
-XX:+UnlockCommercialFeatures -XX:+FlightRecorder
```

> **Note:**
>
> The sequence in which you specify JVM options to Hotspot is very important. The options are processed from left to right, and option values are overwritten if there are duplicates. Therefore, note the following:
>
> - HotSpot does not recognize the `FlightRecorder` option unless it is preceded by the `UnlockCommercialFeatures` option.
> - If you specify only the `FlightRecorder` option, or you specify `FlightRecorder` before specifying `UnlockCommercialFeatures`, the HotSpot JVM does not start.

Key Features of WLDF Integration with Java Flight Recorder

WLDF integration with Java Flight Recorder provides several useful features, including having WebLogic Server events captured in the flight recording, the ability to throttle the volume of data captured, tools for downloading diagnostic image captures, and more.

The key features provided by WLDF to leverage integration with Java Flight Recorder include the following:

- WLDF diagnostic data captured in a flight recording

  WLDF can be configured to generate diagnostic data about WebLogic Server events that is captured in the flight recording. Captured events include those from components such as: web applications; EJBs; JDBC, JTA, and JMS resources; resource adapters; and WebLogic web services.

- WLDF diagnostic volume control

  The ability to generate WebLogic Server event data for the Flight Recording is controlled by the WLDF diagnostic volume configuration. This control also determines the amount of WebLogic Server event data that is captured by Java Flight Recorder, and can be adjusted to include more, or less, data for each WebLogic Server event that is generated.

> **Note:**
>
> – By default, the WLDF diagnostic volume is set to `Low`.
>
> – The WLDF diagnostic volume setting does not affect explicitly configured diagnostic modules or the built-in diagnostic modules.

- Automatic throttling of generated events under load

  As processing load rises on a given WebLogic Server instance, WLDF automatically begins throttling the number of incoming WebLogic Server requests that are selected for event generation and recording into the JFR file. The degree of throttling is adjusted continuously as system load rises and falls.

  Throttling provides three key benefits:

  – The overhead of capturing events generated by WLDF for Java Flight Recorder remains minimized, which is especially important when systems are under load.

  – The time interval encompassed in the flight recording buffer is maximized, giving you a better historical record of data.

  – Throttling has the effect of sampling incoming WebLogic Server requests, maintaining high performance while still providing an accurate overall view of system activity under load.

> **Note:**
>
> Throttling affects only the Flight Recording data that is captured by WLDF. It does not affect data captured by other event producers, such as the JVM.

- WLDF diagnostic image capture support for JFR files

  WLDF diagnostic image capture automatically includes the JFR file, if one has been generated by Java Flight Recorder. The JFR file includes data generated by all active event producers, including WebLogic Server. An image captured using the Policies and Actions component may contain the JFR file, if available.

- WLST commands for downloading the contents of diagnostic image captures

  WLST includes a set of commands for downloading the contents of diagnostic image captures, described in WLST Online Commands for Downloading Diagnostics Image Captures. Although these commands are generally useful for listing, copying, and downloading all entries contained in the diagnostic image capture, they can also be used for obtaining the JFR file, if available. Once obtained from the diagnostic image capture, the JFR file can be viewed in Java Mission Control.

Java Flight Recorder Use Cases

Java Flight Recorder helps to resolve important diagnostic issues such as diagnosing critical failure, and examining and reporting runtime data. When a critical failure occurs, the data captured by Java Flight Recorder is useful for failure analysis. Likewise, capturing data at specific time and at runtime help to diagnose data after and before a particular event.

This section summarizes the three common business cases of using the Java Flight Recorder to resolve diagnostic issues:

For more information about scenarios using Java Flight Recorder, see also About Java Flight Recorder in *Java Flight Recorder Runtime Guide*, available at the following URL:

http://docs.oracle.com/javacomponents/index.html

- Diagnosing a Critical Failure — The "Black Box"
- Profiling During Performance Testing or in Production
- Real-Time Application Diagnostics and Reporting

Diagnosing a Critical Failure — The "Black Box"

When a "catastrophic" failure occurs, the content of the Java Flight Recorder buffer can be made available for post-failure analysis in a manner analogous to the use of an aircraft's black box. Examples of such failures include a JVM crash or an out-of-memory error (OOME) resulting in an application terminating.

When these situations arise, the flight recording contains the following information, which can be helpful in determining the cause of the failure:

- JVM core dump, including metadata about the Java Flight Recorder configuration at the time of the crash. Furthermore, depending on the disk storage parameters that are set, the Java Flight Recorder data buffer might contain a certain amount of data.
- WebLogic Server events, captured by WLDF, that preceded the failure.

Java Flight Recorder uses a combination of memory and disk to store its buffer. The most recent data is stored in memory and is flushed out to disk as it "ages". In this way, the on-disk data can be available even after a power failure or similar catastrophic event; only the most recent data will be unavailable (for example, the data that had not yet been flushed to disk). The text dump file will contain metadata about the Java Flight Recorder configuration at the time of the crash, including the path to the data buffer file when applicable.

Profiling During Performance Testing or in Production

Profiling involves capturing data beginning at a specific point in time so that, later, you can analyze the events that were generated after that point. In contrast to real-time diagnostics reporting, described in the following section, profiling involves analyzing the diagnostic data generated after a particular event occurs, as opposed to the data that precedes it.

Profiling with Java Flight Recorder optimizes the ability to perform deep analysis of lock contention and causes of latency.

Real-Time Application Diagnostics and Reporting

It is particularly useful to examine diagnostic data generated during run time when a particular event occurs for the purposes of understanding the system activity that preceded the event; for example, system activity occurring moments before a serious error message is generated. By using the diagnostic capabilities available in WLDF in conjunction with Java Flight Recorder, you can capture a large amount of system-wide diagnostic data the moment a problem occurs. You can then leverage the capabilities of Java Mission Control to quickly correlate that event with other system activity and process execution data within the "snapshot in time" that the JFR file provides, enabling you to quickly isolate likely causes of the problem.

One WLDF feature that is particularly useful in conjunction with Java Flight Recorder is the image action. An image action generates a diagnostic image capture in response to the triggering of a policy that is configured in a diagnostic system module. The policy monitors the server environment for one or more specific conditions, and when those conditions occur, the

policy can automatically executes an image action. When Flight Recorder is enabled, the diagnostic image capture automatically includes the JFR file. The JFR file can then be extracted from the diagnostic image capture and examined immediately in Java Mission Control or stored for later analysis. An image action, used when WLDF data is captured by Java Flight Recorder, is particularly well suited for real-time diagnosis of intermittent problems.

Image action is part of the Policies and Actions system in WLDF. To set up an image action, you create one or more individual policies. A policy includes a Java EL expression to specify the event for the policy to detect. For example, the following log policy expression detects the server log message with severity level `Critical` and ID `BEA-149618`:

```
log.severityString == 'Critical'  &&  log.messageId == 'BEA-149618'
```

Policies can monitor any of the following:

- Runtime MBean instances in the local runtime MBean server

  A scheduled policy can execute an image action if runtime MBean attributes detect a performance issue, such as high memory utilization rates or problems with open socket connections to the server.

- Messages published to the server log

  A log policy can execute an image action if a specific message, severity level, or string is issued.

- Event generated by the WLDF Instrumentation component

  An event policy can execute an image action if an instrumentation service generates a particular event.

See the following topics:

- Configuring Policies and Actions
- Configuring Image Actions

The following section explains how to obtain the JFR file from the diagnostic image capture:

- Obtaining the Flight Recording File

Obtaining the Flight Recording File

The diagnostic image capture is a single Java Flight Recorder (JFR) file that contains individual images produced by different server subsystems. The JFR file is included in the diagnostic image as `FlightRecording.jfr`.

A diagnostic image capture can be generated on-demand — for example, from the WebLogic Remote Console, Fusion Middleware Control, WLST, or a JMX application — or it can be generated as the result of an image action.

To view the contents of the JFR file, you first need to extract it from the diagnostic image capture as described in Configuring and Capturing Diagnostic Images. Once you have extracted the JFR file, you can view its contents in Java Mission Control.

For an example WLST script that retrieves the JFR file from a diagnostic image file and saves it to a local directory, see Example: Retrieving a JFR File from a Diagnostic Image Capture.

5

Understanding WLDF Configuration

The WebLogic Diagnostics Framework (WLDF) provides several features for generating, gathering, analyzing, and persisting diagnostic data from WebLogic Server instances and from applications deployed to them.For server-scoped diagnostics, some WLDF features are configured as part of the configuration for a server in a domain. Other features are configured as system resource descriptors that can be targeted to servers (or clusters). For application-scoped diagnostics, diagnostic features are configured as resource descriptors for the application.
For general information about WebLogic Server domain configuration, see Understanding Oracle WebLogic Server Domains in *Understanding Domain Configuration for Oracle WebLogic Server*.

- Configuration MBeans and XML
  WLDF is configured using configuration MBeans (Managed Beans), and the configuration is persisted in the XML configuration files. The configuration MBeans are instantiated at startup, based on the configuration settings in `config.xml`. When you modify a configuration by changing the values of MBean attributes, those changes are persisted in the XML files.
- Tools for Configuring WLDF
  You can configure the WLDF in several ways such as using the built-in diagnostic modules, WebLogic Remote Console, WebLogic Scripting Tool (WLST), JMX and WLDF configuration beans, and editing the XML configuration files.
- How WLDF Configuration Is Partitioned
  You can use WLDF to perform diagnostics tasks for server instances, clusters, and for applications.
- Configuring Diagnostic Image Capture and Diagnostic Archives
  Configure the Diagnostic Image Capture and Diagnostic Archive components in the `config.xml` file for a domain. The server configuration details are defined in the `<server-diagnostic-config >` element of the XML configuration file.
- Configuring Diagnostic Image Capture for Java Flight Recorder
  The JFR file contains data for all events procedures that are enabled. When WebLogic Server is configured with a supported version of Oracle HotSpot and Java Flight Recorder is enabled, the JFR file is automatically included in the diagnostic image capture.
- Configuring Diagnostic System Modules
  To configure and use the Instrumentation, Harvester, and Policies and Actions components at the server level, you must first create a system resource called a diagnostic system module, which will contain the configurations for all those components. The configuration of diagnostic system module is defined in a resource descriptor.
- Configuring Diagnostic Modules for Applications
- WLDF Configuration MBeans and Their Mappings to XML Elements
  The set of WLDF configuration MBeans, along with the diagnostic system module beans for WLDF objects, are organized into a specific hierarchy in a WebLogic domain.

Configuration MBeans and XML

WLDF is configured using configuration MBeans (Managed Beans), and the configuration is persisted in the XML configuration files. The configuration MBeans are instantiated at startup, based on the configuration settings in `config.xml`. When you modify a configuration by changing the values of MBean attributes, those changes are persisted in the XML files.

Configuration MBean attributes map directly to configuration XML elements. For example, the Enable attribute of the WLDFInstrumentationBean maps directly to the <enabled> sub-element of the <instrumentation> element in the resource descriptor file (configuration file) for a diagnostic module. If you change the value of the MBean attribute, the content of the XML element is changed when the configuration is saved. Conversely, if you were to edit an XML element in the configuration file directly (which is not recommended), the change to an MBean value would take effect after the next session is started.

For more information about WLDF Configuration MBeans, see WLDF Configuration MBeans and Their Mappings to XML Elements. For general information about how MBeans are implemented and used in WebLogic Server, see Understanding WebLogic Server MBeans in *Developing Custom Management Utilities Using JMX for Oracle WebLogic Server*.

Tools for Configuring WLDF

You can configure the WLDF in several ways such as using the built-in diagnostic modules, WebLogic Remote Console, WebLogic Scripting Tool (WLST), JMX and WLDF configuration beans, and editing the XML configuration files.

Refer to the following sections for more information about the tools:

- Use the built-in diagnostic system modules, which provide a simple and easy-to-use mechanism for performing basic health and performance monitoring of a WebLogic Server instance. See Using the Built-in Diagnostic System Modules.
- Write scripts to be run in the WebLogic Scripting Tool (WLST). For specific information about using WLST with WLDF, see WebLogic Scripting Tool Examples. Also see Using the WebLogic Scripting Tool in *Understanding the WebLogic Scripting Tool* for general information about using WLST.
- Configure WLDF programmatically using JMX and the WLDF configuration MBeans. See Configuring and Using WLDF Programmatically for specific information about programming WLDF. See *MBean Reference for Oracle WebLogic Server* and browse or search for specific MBeans for programming reference.
- Edit the XML configuration files directly. This documentation explains many configuration tasks by showing and explaining the XML elements in the configuration files. The XML is easy to understand, and you can edit the configuration files directly, although it is recommended that you do not. (If you have a good reason to edit the files directly, you should first generate the XML files by configuring WLDF in the WebLogic Remote Console. Doing so provides a blueprint for valid XML.)

> **Note:**
>
> If you make changes to a configuration by editing configuration files, you must restart the server for the changes to take effect.

How WLDF Configuration Is Partitioned

You can use WLDF to perform diagnostics tasks for server instances, clusters, and for applications.

- Server-Level Configuration
- Application-Level Configuration

Server-Level Configuration

You configure the following WLDF components as part of a server instance in a domain. The configuration settings are controlled using MBeans and are persisted in the domain's `config.xml` file.

- Diagnostic Image Capture
- Diagnostic Archives

See Configuring Diagnostic Image Capture and Diagnostic Archives.

You configure the following WLDF components as the parts of one or more diagnostic system modules that can be deployed to one or more server instances or clusters. These configuration settings are controlled using beans and are persisted in one or more diagnostic resource descriptor files (configuration files) that can be targeted to one or more server instances or clusters.

- Harvester (for collecting metrics)
- Policies and Actions
- Instrumentation

See Configuring Diagnostic System Modules.

Application-Level Configuration

You can use the WLDF Instrumentation component with applications, as well as at the server level. The Instrumentation component is configured in a resource descriptor file deployed with the application in the application's archive file. See Configuring Diagnostic Modules for Applications.

Configuring Diagnostic Image Capture and Diagnostic Archives

Configure the Diagnostic Image Capture and Diagnostic Archive components in the `config.xml` file for a domain. The server configuration details are defined in the `<server-diagnostic-config >` element of the XML configuration file.

The `<server-diagnostic-config>` element is a child of the `<server>` element in a domain, as shown in Example 5-1.

Example 5-1 Sample WLDF Configuration Information in the config.xml File for a Domain

```
<domain>
  <server>
    <name>myserver</name>
    <server-diagnostic-config>
```

```
      <image-dir>logs/diagnostic_images</image-dir>
      <image-timeout>3</image-timeout>
      <diagnostic-store-dir>data/store/diagnostics</diagnostic-store-dir>
      <diagnostic-data-archive-type>FileStoreArchive
      </diagnostic-data-archive-type>
    </server-diagnostic-config>
  </server>
  <!-- Other server elements to configure other servers in this domain -->
  <!-- Other domain-based configuration elements, including references to
       WLDF system resources, or diagnostic system modules.  -->
</domain>
```

> **Note:**
>
> If WebLogic Server is configured with Oracle HotSpot, and Java Flight Recorder is enabled, the diagnostic image capture can optionally include a Java Flight Recorder file, also called a JFR file, that includes WebLogic Server events. The JFR file can then be viewed in Java Mission Control. See Using WLDF with Java Flight Recorder.

See the following topics:

- Configuring and Capturing Diagnostic Images
- Configuring Diagnostic Archives

Configuring Diagnostic Image Capture for Java Flight Recorder

The JFR file contains data for all events procedures that are enabled. When WebLogic Server is configured with a supported version of Oracle HotSpot and Java Flight Recorder is enabled, the JFR file is automatically included in the diagnostic image capture.

The amount of WebLogic Server event data that is included in the JFR file is determined by the configuration of the WLDF diagnostic volume.

> **Note:**
>
> Note the following:
>
> - If WebLogic Server is configured with Oracle HotSpot, Java Flight Recorder is disabled by default unless HotSpot is started using the JVM parameters described in Using Java Flight Recorder with Oracle HotSpot.
> - By default, the WLDF diagnostic volume is set to `Low`.
> - For the most current information about configurations supported in this release of WebLogic Server, including HotSpot support, see Oracle Fusion Middleware Supported System Configurations on the Oracle Technology Network.

To include WebLogic Server event data in the JFR file:

1. Ensure that WebLogic Server is configured with Oracle HotSpot, which installed separately from WebLogic Server.

   See Planning the Oracle WebLogic Server Installation in *Installing and Configuring Oracle WebLogic Server and Coherence*.

2. Ensure that Java Flight Recorder is enabled.

   In a default installation of Oracle HotSpot with WebLogic Server, Java Flight Recorder is disabled. For information about enabling Java Flight Recorder with HotSpot and WebLogic Server, see Using Java Flight Recorder with Oracle HotSpot.

3. Set the WLDF diagnostic volume as appropriate. For general use, Oracle recommends the default setting of `Low`. However, you can increase the volume of WebLogic Server event data that is generated, as appropriate, by setting the volume to `Medium` or `High`.

   Note that the WLDF diagnostic volume setting has no impact on data recorded for other event producers, such as the JVM.

> **Note:**
>
> If the WLDF diagnostic volume is set to `Off`, and Java Flight Recorder has not been explicitly disabled, the JFR file continues to include JVM event data and is always included in the diagnostic image capture.

Configuring Diagnostic System Modules

To configure and use the Instrumentation, Harvester, and Policies and Actions components at the server level, you must first create a system resource called a diagnostic system module, which will contain the configurations for all those components. The configuration of diagnostic system module is defined in a resource descriptor.

The diagnostic system module created at the server level contains the configurations for the components. When creating a diagnostic system module, note the following:

- Diagnostic system modules are globally available for targeting to servers and clusters configured in a domain.
- In a given domain, you can create multiple diagnostic system modules with distinct configurations.
- You can target multiple diagnostic system modules to any given server or cluster.
- WLDF Runtime Control allows you to dynamically enable or disable a diagnostic system module without changing the domain configuration.
- Runtime control also allows you to deploy, activate, deactivate, and undeploy a diagnostic system module on-the-fly that is not defined in the domain configuration.

The following sections described the configuration of diagnostic system modules:

- About the Resource Descriptor
- WLDF Runtime Control
- Creating a Diagnostic System Module Based on a Configured Resource Descriptor
- Creating a Diagnostic System Module Based on an External Resource Descriptor
- Targeting a Diagnostic System Module to a Server or Cluster
- Dynamically Activating or Deactivating Diagnostic System Modules
- Using WLST to Activate and Deactivate Diagnostic System Modules
- More Information About Configuring Diagnostic System Modules

About the Resource Descriptor

A diagnostic system module has a corresponding resource descriptor that defines the diagnostic module's configuration. A resource descriptor can be either *configured* or *external*:

- A *configured* resource descriptor is one that is defined as part of the domain configuration, and exists as a file in the *DOMAIN_HOME*/config/diagnostics directory. A configured resource descriptor is referenced by the domain config.xml file, and the corresponding diagnostic system module:
  - Is persisted in the domain configuration.
  - Is available to all servers and clusters in the domain.
  - Can be targeted to a server or cluster through the domain configuration.
  - Can be activated or deactivated dynamically using Runtime Control, regardless of whether it is explicitly targeted to a server or cluster.

  Any dynamic changes made to the activation state of the diagnostic system module are not persisted across server restarts.
- An *external* resource descriptor is one that is *not* referenced by the domain config.xml file; that is, it is defined outside the domain configuration. The diagnostic system module that is configured by an external resource descriptor may be deployed and activated on a server using Runtime Control. However, this diagnostic system module:
  - Is not persisted in the domain configuration (that is, it is not referenced by the domain config.xml file.
  - Can be deployed, activated, and deactivated only dynamically.
  - Cannot have its deployment and activation state persisted in the domain configuration.
  - Remains in memory only until the server or cluster on which it is activated is shut down.
  - Cannot be automatically available on server restart.

  An external resource descriptor may exist in a file located outside the *DOMAIN_HOME*/config/diagnostics directory, or may be passed as a String object using the WLDF Runtime Control API (see Creating a Diagnostic System Module Based on an External Resource Descriptor).

> **Note:**
>
> The configuration of a diagnostic module conforms to the diagnostics.xsd schema, available at http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/weblogic-diagnostics.xsd.

Except for the name and list of targets for the diagnostic system module, all configuration information for a diagnostic system module is contained in its resource descriptor file. Example 5-2 shows portions of the descriptor file for a diagnostic system module named myDiagnosticModule.

Example 5-2 Sample Structure of a Diagnostic System Module Descriptor File, MyDiagnosticModule.xml

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>MyDiagnosticModule</name>
  <instrumentation>
    <!-- Configuration elements for zero or more diagnostic monitors -->
  </instrumentation>
  <harvester>
    <!-- Configuration elements for harvesting metrics from zero or more
         MBean types, instances, and attributes -->
  </harvester>
  <watch-notification>
    <!-- Configuration elements for one or more policies and one or more
         actions-->
  </watch-notification>
</wldf-resource>
```

WLDF Runtime Control

WLDF Runtime Control allows you to control the activation or deactivation of diagnostics system modules dynamically at run time without making a change to the domain configuration. This allows you to perform specific, targeted diagnostic analysis tasks, and optionally of limited duration, without interfering with the operation of the server instances themselves.

You can use Runtime Control to do the following:

- Dynamically activate and deactivate diagnostic system modules that are persisted in the domain configuration without restarting the servers or clusters to which they are targeted.
- Dynamically deploy, activate, deactivate, and undeploy diagnostic system modules that are configured by an external resource descriptor.

> **Note:**
>
> Note the following:
>
> - Changes applied to diagnostic system modules using Runtime Control, whether defined by configured or external resource descriptors, are not persisted. When a server instance is restarted, that server returns to its configured state, and any changes prior to that restart that were made using Runtime Control are lost.
> - If you use the Runtime Control to activate a diagnostic system module that is based on an external resource descriptor (see Creating a Diagnostic System Module Based on an External Resource Descriptor), the diagnostic resource name that you specify in the `createSystemResourceControl()` command to create that diagnostic system module is used as the WLDF Module name in Harvester records in the archive.

Creating a Diagnostic System Module Based on a Configured Resource Descriptor

You create a diagnostic system module based on a configured resource descriptor using either the WebLogicRemote Console or the WebLogic Scripting Tool (WLST). It is created as a WLDFResourceBean, and the configuration is persisted in a resource descriptor file named *DIAG_MODULE*.xml, where *DIAG_MODULE* is the name of the diagnostic system module. You can specify a name for the descriptor file, but it is not required. If you do not provide a file name, a file name is generated based on the value in the descriptor file's <name> element. The file is created by default in the *DOMAIN_HOME*\config\diagnostics directory, and a reference to the module is added to the domain's config.xml file.

The config.xml file can contain references to multiple diagnostic system modules, in one or more <wldf-system-resource> elements. The <wldf-system-resource> element includes the name of the diagnostic system module file and the list of servers and clusters to which the module is targeted.

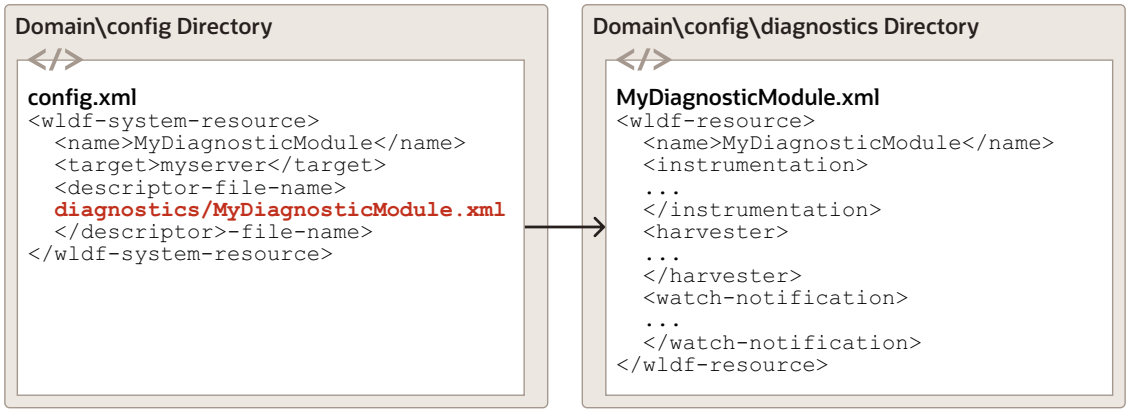
For example, Example 5-3 shows a config.xml file with a module named myDiagnosticModule targeted to the server myserver and another module named newDiagnosticMod targeted to servers myserver and ManagedServer2. Note that myDiagnosticModule and newDiagnosticMod are both targeted to myserver.

Example 5-3 Sample WLDF Configuration Information in the config.xml File for a Domain

```
<domain>
  <!-- Other domain-level configuration elements -->
  <wldf-system-resource
        xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics">
    <name>myDiagnosticModule</name>
    <target>myserver</target>
    <descriptor-file-name>diagnostics/MyDiagnosticModule.xml
    </descriptor-file-name>
    <description>My diagnostic module</description>
  </wldf-system-resource>
  <wldf-system-resource>
    <name>newDiagnosticMod</name>
    <target>myserver,ManagedServer2</target>
    <descriptor-file-name>diagnostics/newDiagnosticMod.xml
    </descriptor-file-name>
    <description>A diagnostic module for my managed servers</description>
  </wldf-system-resource>
<!-- Other WLDF system resource configurations -->
</domain>
```

The relationship of the config.xml file and the MyDiagnosticModule.xml file is shown in Figure 5-1.

Figure 5-1 Relationship of config.xml to System Descriptor File



Creating a Diagnostic System Module Based on an External Resource Descriptor

WLDF provides the following API that you can use to pass an external resource descriptor and create a diagnostic system module on-the-fly. You can use this API to dynamically create and activate a diagnostic system module for a server, but neither its deployment nor activation state is persisted when the servers or clusters on which it was activated are rebooted. This API is provided by the following MBeans:

- `weblogic.management.runtime.WLDFControlRuntimeMBean`
- `weblogic.management.runtime.WLDFSystemResourceControlRuntimeMBean`

Using this API, you can pass the resource descriptor as a String object on-the-fly. For ease-of-use, WLDF also provides the following WLST commands, which you can use with a resource descriptor file that exists externally to the domain configuration:

- `createSystemResourceControl()` — Creates (deploys) a diagnostics system module on-the-fly using a specified descriptor file.
- `destroySystemResourceControl()` — Destroys (undeploys) a diagnostics system module previously created on-the-fly.

Externally configured diagnostic system modules that are deployed and activated in a server or cluster are automatically destroyed when that server or cluster is shut down.

If you activate a diagnostic system module that is based on an external resource descriptor, the diagnostic resource name that you specify in the `createSystemResourceControl` command is used as the module name. For example, this is the name that appears in the **WLDF Module** column when displaying the contents of the Harvester archive in the WebLogic Remote Console. For more information about the `createSystemResourceControl` command, see Diagnostics Commands in *WLST Command Reference for Oracle WebLogic Server*.

For an example of using WLST to create, activate, and destroy a diagnostic system module that is based on an external resource descriptor, see Using WLST to Activate and Deactivate Diagnostic System Modules.

Targeting a Diagnostic System Module to a Server or Cluster

A diagnostic system module can be targeted by the domain `config.xml` file to zero, one, or more servers or clusters. In addition, a given server can have multiple modules targeted to it simultaneously. Typically you create multiple modules that monitor different aspects of your system. You can then choose which modules to target to a server or cluster, based on what you want to monitor at that time.

Because you can target the same module to multiple servers or clusters, you can write general purpose modules that you want to use across a domain.

You can change the target of a diagnostic module without restarting the server instances to which it is targeted or untargeted. This gives you considerable flexibility in writing and using diagnostic monitors that address a specific diagnostic goal, without interfering with the operation of the server instances themselves.

Dynamically Activating or Deactivating Diagnostic System Modules

After you configure a diagnostic system module, you can activate or deactivate it without making a configuration change or rebooting the server instance to which it is targeted. This capability gives you control over the operative state of diagnostic system modules without restarting the targeted server or cluster instance or making a change to the domain configuration.

Because the domain configuration and all resource files are replicated to all servers in the domain, all configured WLDF resources are available for dynamic activation and deactivation on all servers in the domain. Note that if you dynamically activate or deactivate a diagnostics system module, and restart the targeted server, the module's activation state is reverted to whatever is configured in the domain.

You can also use WLST to dynamically activate or deactivate diagnostic system modules, including those configured by an external descriptor, as described in Using WLST to Activate and Deactivate Diagnostic System Modules.

Using WLST to Activate and Deactivate Diagnostic System Modules

You can also use WLST to dynamically activate or deactivate a diagnostic system module. This capability is provided by the WLST commands listed and described in Table 5-1:

Table 5-1 WLST Commands to Dynamically Activate and Deactivate Diagnostic Modules

Command	Summary
`enableSystemResource`	Enables a diagnostic system module on a WebLogic Server instance.
`disableSystemResource`	Disables a diagnostic system module on a WebLogic Server instance.
`createSystemResourceControl`	Creates a diagnostics system module from an external diagnostic descriptor file. Note that the diagnostics system module remains in memory only until the server is shut down and is not deployed the next time the server is restarted.

Table 5-1 (Cont.) WLST Commands to Dynamically Activate and Deactivate Diagnostic Modules

Command	Summary
`destroySystemResourceControl`	Destroys, or undeploys, a diagnostics system module configured in an external diagnostic descriptor without changing the domain configuration.
`listSystemResourceControls`	Lists the diagnostic system modules currently configured on a WebLogic Server instance.

For complete details about these WLST commands, see Diagnostics Commands in *WLST Command Reference for Oracle WebLogic Server*.

Example

This example describes the steps for using WLST to dynamically activate and deactivate the following diagnostic system modules:

- `Module-0`, configured in the domain and defined by the resource descriptor file `Module-0-3905.xml` located in the *`DOMAIN_HOME`*`/config/diagnostics` directory
- `Module-1`, configured in the domain and defined by the resource descriptor file `Module-0-3905.xml` located in the *`DOMAIN_HOME`*`/config/diagnostics` directory
- `External-1`, not a part of the domain configuration, but defined by the external resource descriptor `external-wldf`. This external resource descriptor is configured in the file `external-wldf.xml`, which is external to the domain configuration.

This example assumes the following has been set up:

- The domain `config.xml` file references two diagnostic system modules that are part of the domain configuration, as follows:

```
<wldf-system-resource>
  <name>Module-0</name>
  <descriptor-file-name>diagnostics/Module-0-3905.xml</descriptor-file-name>
  <description></description>
</wldf-system-resource>
<wldf-system-resource>
  <name>Module-1</name>
  <descriptor-file-name>diagnostics/Module-1-3904.xml</descriptor-file-name>
  <description></description>
</wldf-system-resource>
```

- The server name shown in these examples is `myserver`.
- The external descriptor file `external-wldf.xml` is located in the domain's root directory, `wl_domain`. It contains the following lines for configuring the diagnostic system module named `External-1`:

```
<?xml version='1.0' encoding='UTF-8'?>
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
xmlns:sec="http://xmlns.oracle.com/weblogic/security"
xmlns:wls="http://xmlns.oracle.com/weblogic/security/wls"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics
http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/weblogic-diagnostics.xsd">
  <name>External-1</name>
  <harvester>
```

```
    <enabled>true</enabled>
    <sample-period>10000</sample-period>
    <harvested-type>
      <name>weblogic.management.runtime.ServerRuntimeMBean</name>
      <harvested-attribute>OverallHealthState.ReasonCodeSummary</harvested-attribute>
      <harvested-attribute>OverallHealthState.State</harvested-attribute>
      <namespace>ServerRuntime</namespace>
    </harvested-type>
  </harvester>
</wldf-resource>
```

Step 1: List Diagnostic System Modules

The following WLST command, shown in **bold**, lists the diagnostic system modules that are currently configured:

```
wls:/wl_domain/Server1> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           false               Module-0
false           false               Module-1
```

The preceding command shows that `Module-0` and `Module-1` are configured in the domain (that is, they are referenced from `config.xml` and are not configured by external resource descriptors), but that they have not been activated.

Step 2: Activate Module-0

The following WLST command activates `Module-0`:

```
wls:/mydomain/serverConfig> enableSystemResource('Module-0')
```

You can also supply a server name to all of the WLDF system resource runtime control functions. If you do not specify a server name, the `enableSystemResource()` command defaults to the server instance to which WLST is currently connected. (However, by default, all configured WLDF system resources are available for runtime control operations on all servers in the domain.)

```
wls:/mydomain/serverConfig> enableSystemResource('Module-0', Server='myserver')
```

Step 3: Verify that Module-0 is Activated

The following WLST command shows that `Module-0` is now activated:

```
wls:/mydomain/serverConfig> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           true                Module-0
false           false               Module-1
```

Step 4: Activate Module-1

The following WLST commands activate `Module-1` and verify the activation state of all diagnostic system modules:

```
wls:/mydomain/serverConfig> enableSystemResource('Module-1', Server='myserver')
wls:/mydomain/serverConfig> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           true                Module-0
false           true                Module-1
```

Step 5: Deactivate Configured Diagnostic Modules

The following WLST commands deactivate all diagnostic system modules that are configured in the domain and verify their state:

```
wls:/mydomain/serverConfig> disableSystemResource('Module-0')
wls:/mydomain/serverConfig> disableSystemResource("Module-1")
wls:/mydomain/serverConfig> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           false               Module-0
false           false               Module-1
```

Step 6: Create a Diagnostic System Module from an External Resource Descriptor File

The external resource descriptor needs to be accessible by the WLST client. The following WLST command creates and deploys the diagnostic system module `External-1` from the external resource descriptor in the file `external-wldf.xml`, and verifies its activation state. ()

```
wls:/mydomain/serverConfig> createSystemResourceControl('external-wldf', 'external-
wldf.xml')
wls:/mydomain/serverConfig> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           false               Module-0
true            false               external-wldf
false           false               Module-1
```

Note that the External column identifies `External-1` as being configured by an external resource descriptor.

Step 7: Activate External-1

Because the `createSystemResourceControl()` command only deploys the diagnostic system module, the following WLST command activates it. The subsequent command verifies the diagnostic system module's activation state.

```
wls:/mydomain/serverConfig> enableSystemResource("external-wldf")
wls:/mydomain/serverConfig> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           false               Module-0
true            true                external-wldf
false           false               Module-1
```

Step 8: Deactivate External-1

The following WLST commands deactivate `External-1` and verify its deactivation status:

```
wls:/mydomain/serverConfig> disableSystemResource("external-wldf")
wls:/mydomain/serverConfig> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           false               Module-0
true            false               external-wldf
false           false               Module-1
```

Step 9: Destroy External-1

The following WLST command destroys the diagnostic system module that is configured by an external resource descriptor:

```
wls:/mydomain/serverConfig> destroySystemResourceControl("external-wldf")
```

Step 10: Verify Original State of Configured Diagnostic Modules

The following WLST command verifies that the domain's configuration is reverted to its original state, showing only the two diagnostic system modules whose configuration is persisted in the `config.xml` file:

```
wls:/mydomain/serverConfig> listSystemResourceControls()
External        Enabled             Name
--------        -------             ------------------------------
false           false               Module-0
false           false               Module-1
```

More Information About Configuring Diagnostic System Modules

See the following sections for detailed instructions about configuring WLDF system modules:

- Configuring the Harvester for Metric Collection
- Configuring Policies and Actions
- Configuring Instrumentation
- Configuring the DyeInjection Monitor to Manage Diagnostic Contexts

Configuring Diagnostic Modules for Applications

WLDF supports the ability to configure instrumentation of an application by means of a diagnostic application module. A diagnostic application module is similar to a diagnostic system module, with the exception that you configure it in an XML descriptor file that you package with the application archive file. A diagnostic application module deployed this way is available only to the application in which that module is enclosed. This ensures that the application can be reliably deployed into new environments with access to all required resources in the diagnostic module.
You configure and deploy application-scoped instrumentation as a diagnostic module, which is similar to a diagnostic system module. However, an application module is configured in an XML descriptor (configuration) file named `weblogic-diagnostics.xml`, which is packaged with the application archive in the *`ARCHIVE_PATH`*`/META-INF` directory for the deployed application. For example, `C:\Oracle\Middleware\Oracle_Home\user_projects\applications\medrec\dist\standalone\exploded\medrec\META-INF\weblogic-diagnostics.xml`.

> **Note:**
>
> The DyeInjection monitor, which is used to configure diagnostic context (a way of tracking requests as they flow through the system), can be configured only at the server level. But once a diagnostic context is created, the context attached to incoming requests remains with the requests as they flow through the application. For information about the diagnostic context, see Configuring the DyeInjection Monitor to Manage Diagnostic Contexts.

For more information about configuring and deploying diagnostic modules for applications, see:

- Configuring Application-Scoped Instrumentation

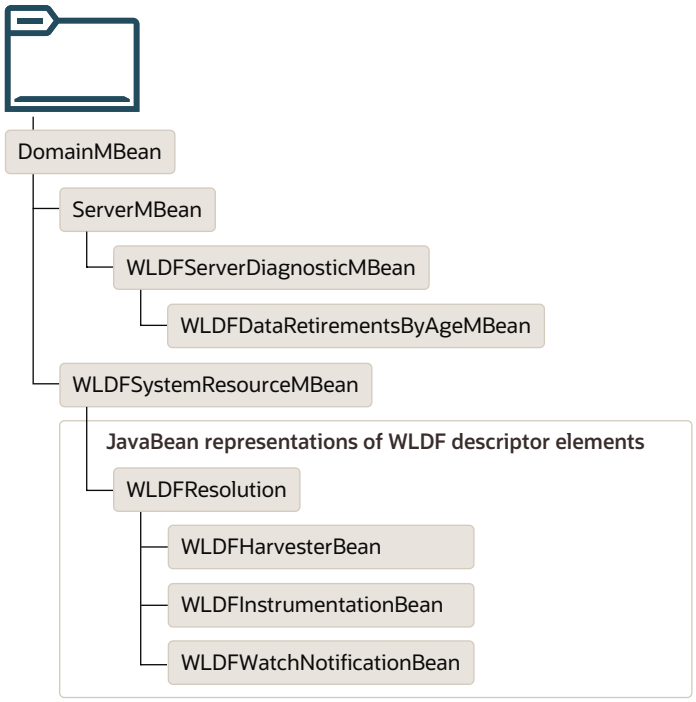
- Deploying WLDF Application Modules

WLDF Configuration MBeans and Their Mappings to XML Elements

The set of WLDF configuration MBeans, along with the diagnostic system module beans for WLDF objects, are organized into a specific hierarchy in a WebLogic domain.

Figure 5-2 shows the hierarchy of the WLDF configuration MBeans and the diagnostic system module beans for WLDF objects in a WebLogic Server domain.

Figure 5-2 WLDF Configuration Bean Tree



The following WLDF MBeans configure WLDF at the server level. They map to XML elements in the `config.xml` configuration file for a domain:

- WLDFServerDiagnosticMBean controls configuration settings for the Data Archive and Diagnostic Images components for a server. It also controls whether diagnostic context for a diagnostic module is globally enabled or disabled. (Diagnostic context is a way to uniquely identify requests and track them as they flow through the system. See Configuring the DyeInjection Monitor to Manage Diagnostic Contexts.)

  This MBean is represented by a <server-diagnostic-config> child element of the <server> element in the `config.xml` file for the server's domain.
- WLDFDataRetirementByAgeMBean specifies how data retirement for a WLDF archive is performed based on the age of records in that archive.
- WLDFSystemResourceMBean contains the name of a descriptor file for a diagnostic module in the *DOMAIN_HOME*`/config/diagnostics` directory and the names of one or more the target servers on which that module is deployed.

This MBean is represented by a <wldf-system-resource> element in the `config.xml` file for the domain.

> **Note:**
>
> You can create multiple diagnostic system modules in a domain. The configurations for the modules are saved in multiple descriptor files in the `config/diagnostics` directory for the domain. The domain's `config.xml` file, therefore, can contain the multiple <wldf-system-resource> elements that represent those modules.

- WLDFResourceBean contains the configuration settings for a diagnostic system module. This bean is represented by a <wldf-resource> element in a *`DIAG_MODULE`*`.xml` diagnostics descriptor file in the domain's `config/diagnostics` directory. (See Figure 5-1 and Example 5-2.) The WLDFResourceBean contains configuration settings for the following components:
  - Harvester: The WLDFHarvesterBean is represented by the <harvester> element in a *`DIAG_MODULE`*`.xml` file.
  - Instrumentation: The WLDFInstrumentationBean is represented by the <instrumentation> element in a *`DIAG_MODULE`*`.xml` file.
  - Policies and Actions: The WLDFWatchNotificationBean is represented by the <watch-notification> element in a *`DIAG_MODULE`*`.xml` file.

  If a WLDFResourceBean is linked from a WLDFSystemResourceMBean, the settings for WLDF components apply to the targeted server. If a WLDFResourceBean is contained within a `weblogic-diagnostics.xml` descriptor file which is deployed as part of an application archive, you can configure only the Instrumentation component, and the settings apply only to that application. In the latter case, the WLDFResourceMBean is not a child of a WLDFSystemResourceMBean.

6

Configuring and Capturing Diagnostic Images

You can use the Diagnostic Image Capture component of the WebLogic Diagnostics Framework (WLDF) to create a diagnostic snapshot or dump of a server's internal runtime state at the time of the capture. The captured information is useful for analyzing the cause of a server failure.If WebLogic Server is configured with Oracle HotSpot, and Java Flight Recorder is enabled, the diagnostic image capture includes WebLogic Server diagnostic data that can be viewed in Java Mission Control.

- How Diagnostic Image Capture Is Persisted in the Server's Configuration
  The configuration for Diagnostic Image Capture is persisted in the `config.xml` file for a domain.
- Content of the Captured Image File
  The Diagnostic Image Capture component captures and combines the images produced by the different server subsystems into a single `.zip` file. In addition to capturing the most common sources of the server state, this component captures images from all the server subsystems including, for example, images produced by the JMS, JDBC, EJB, and JNDI subsystems.

How Diagnostic Image Capture Is Persisted in the Server's Configuration

The configuration for Diagnostic Image Capture is persisted in the `config.xml` file for a domain.

In the `config.xml` file, the image capture is described under the `<server-diagnostic-config>` subelement of the `<server>` element for the server, as shown in Example 6-1:

Example 6-1 Sample Diagnostic Image Capture Configuration

```
<domain>
  <!-- Other domain configuration elements -->
  <server>
    <name>myserver</name>
    <server-diagnostic-config>
      <image-dir>logs\diagnostic_images</image-dir>
      <image-timeout>2</image-timeout>
    </server-diagnostic-config>
    <!-- Other configuration details for this server -->
  </server>
  <!-- Other server configurations in this domain-->
</domain>
```

> **Note:**
>
> Oracle recommends that you do not edit the `config.xml` file directly.

Content of the Captured Image File

The Diagnostic Image Capture component captures and combines the images produced by the different server subsystems into a single `.zip` file. In addition to capturing the most common sources of the server state, this component captures images from all the server subsystems including, for example, images produced by the JMS, JDBC, EJB, and JNDI subsystems.

The most common sources of a server state are captured in a diagnostic image capture, including:

- Configuration
- Log cache state
- Java Virtual Machine (JVM)
- Work Manager state
- JNDI state
- Most recent harvested data

If WebLogic Server is configured with Oracle HotSpot, and Java Flight Recorder is enabled, the diagnostic image capture includes a Java Flight Recorder image, `FlightRecording.jfr`, that can be viewed in Java Mission Control. The contents of the Java Flight Recorder image contains all available data from the Java Flight Recorder, and the volume of data produced by WLDF depends on the diagnostics volume setting. When Java Flight Recorder is enabled, data is always provided by the JVM, and optionally includes data provided by WebLogic Server. Data from additional Oracle components, such as Oracle Dynamic Monitoring System (DMS), may be included in the Java Flight Recorder image as well.

Note:

- A diagnostic image is a heavyweight artifact meant to serve as a server-level state dump for the purpose of diagnosing significant failures. It enables you to capture a significant amount of important data in a structured format and then to provide that data to support personnel for analysis.
- If a non-WebLogic event producer in the WebLogic Server environment, such as DMS, has configured Java Flight Recorder to record data, the WLDF diagnostic image capture includes a Java Flight Recorder image file with the recorded data even if the WLDF diagnostics volume is set to `Off`.
- When WebLogic Server is configured with HotSpot, Java Flight Recorder is not enabled by default. For information about how to enable it, see Using Java Flight Recorder with Oracle HotSpot.

- Data Included in the Diagnostics Image Capture File
- WLST Online Commands for Downloading Diagnostics Image Captures

Data Included in the Diagnostics Image Capture File

Each image is captured as a single file for the entire server. The default location is *SERVER_NAME*`\logs\diagnostic_images`. Each image instance has a unique name, as follows:

```
diagnostic_image_DOMAIN_SERVER_YYYY_MM_DD_HH_MM_SS.zip
```

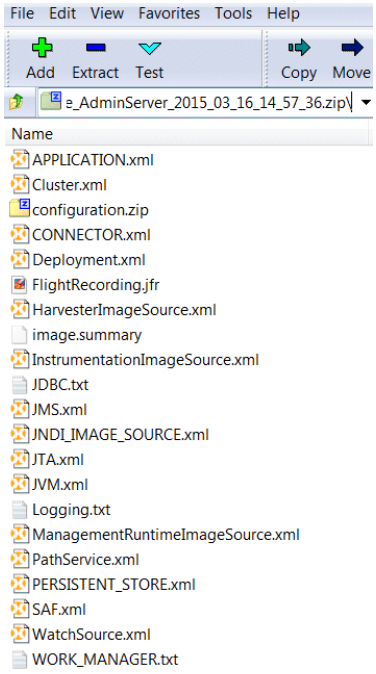
The contents of the file include at least the following information:

- Creation date and time of the image
- Source of the capture request
- Name of each image source included in the image and the time spent processing each of those image sources
- JVM and OS information, if available
- Command line arguments, if available
- WebLogic Server version including patch and build number information

If WLDF is configured with Oracle HotSpot, as described in Configuring Diagnostic Image Capture for Java Flight Recorder, the image also contains the Java Flight Recorder file, `FlightRecording.jfr`. The JFR file can be extracted as described in WLST Online Commands for Downloading Diagnostics Image Captures, and viewed in Java Mission Control.

Figure 6-1 shows the contents of an image file. You can open most of the files in this `.zip` file with a text editor to examine the contents.

Figure 6-1 Contents of an Image File



WLST Online Commands for Downloading Diagnostics Image Captures

WLST online provides the following commands for downloading diagnostic image captures from the server to which WLST is connected:

Table 6-1 WLST Commands for Downloading Image Captures

Command	Summary
`captureAndSaveDiagnosticImage`	Captures a diagnostic image and downloads it locally.
`getAvailableCapturedImages`	Returns a list of diagnostic images that have been created in the image destination directory configured on the server.
`saveDiagnosticImageCaptureFile`	Downloads a specified diagnostic image capture file.
`saveDiagnosticImageCaptureEntryFile`	Downloads a specific entry within a diagnostic image capture. This command is particularly useful for obtaining the Java Flight Recorder diagnostics data for viewing in Java Mission Control.

For information about these commands, and examples of using them, see Diagnostics Commands in *WLST Command Reference for Oracle WebLogic Server*. For examples of WLST scripts that return a list of diagnostic images and retrieve JFR files in them, see WebLogic Scripting Tool Examples.

7

Configuring Diagnostic Archives

The Archive component captures and persists all data events, log records, and metrics collected by the WebLogic Diagnostics Framework (WLDF) from server instances and applications running on them. You can subsequently access archived diagnostic data in online mode (that is, on a running server), or in off-line mode using the WebLogic Scripting Tool (WLST).

This chapter explains how to configure the Archive, and also how to configure WLDF to archive diagnostic data to a file store or a Java Database Connectivity (JDBC) data source:

You can also specify when and under what conditions old data will be removed from the archive, as described in Retiring Data from the Archives.

- Configuring the Archive
  You can configure the diagnostic archive on a per-server basis. The configuration is persisted in the `config.xml` file for a domain, under the `<server-diagnostic-config>` element for the server.
- Configuring a File-Based Store
  WLDF supports the ability to use a file-based store for the Archive. If you choose the use of a file-based store, the only configuration option you must set is the location of the directory where the store is to be maintained. The default directory is `DOMAIN_HOME/servers/SERVER_NAME/data/store/diagnostics`.
- Configuring a JDBC-Based Store
- Retiring Data from the Archives
  To maintain the archived data, you must delete the old archived data periodically. WLDF includes a configuration-based data retirement feature for doing this. The data can be deleted based on the size of the data and time period when it was created.

Configuring the Archive

You can configure the diagnostic archive on a per-server basis. The configuration is persisted in the `config.xml` file for a domain, under the `<server-diagnostic-config>` element for the server.

Example configurations for file-based stores and JDBC-based stores are shown in Example 7-1 and Example 7-7.

> **Note:**
>
> Resetting the system clock while diagnostic data is being written to the archive can produce unexpected results. See Resetting the System Clock Can Affect How Data Is Archived and Retrieved.

Configuring a File-Based Store

WLDF supports the ability to use a file-based store for the Archive. If you choose the use of a file-based store, the only configuration option you must set is the location of the directory where the store is to be maintained. The default directory is `DOMAIN_HOME/servers/SERVER_NAME/data/store/diagnostics`.

When you save to a file-based store, WLDF uses the WebLogic Server persistent store. See Using the WebLogic Persistent Store in *Administering the WebLogic Persistent Store*.

An example configuration for a file-based store is shown in Example 7-1.

Example 7-1 Sample Configuration for File-based Diagnostic Archive (in config.xml)

```
<domain>
  <!-- Other domain configuration elements -->
  <server>
    <name>myserver</name>
    <server-diagnostic-config>
      <diagnostic-store-dir>data/store/diagnostics</diagnostic-store-dir>
      <diagnostic-data-archive-type>FileStoreArchive
      </diagnostic-data-archive-type>
    </server-diagnostic-config>
  </server>
  <!-- Other server configurations in this domain -->
</domain>
```

Configuring a JDBC-Based Store

WLDF supports the ability to create the Archive in a JDBC-based store.To use a JDBC store, the appropriate tables must exist in a database, and JDBC must be configured to connect to that database. For information about how to configure JDBC using the WebLogic Remote Console, see Create a JDBC Store in *Oracle WebLogic Remote Console Online Help*. For additional information about JDBC configuration, see *Administering JDBC Data Sources for Oracle WebLogic Server.*

> **Note:**
>
> If you install multiple WLDF schemas in the same database, you need to provide a way to distinguish among them when accessing the diagnostic archives. You can do this when you configure the diagnostic archive for a server instance by specifying the schema name to use for accessing JDBC-based archive tables in that database. See Configuring JDBC Resources for WLDF.

- Creating WLDF Tables in the Database
- Configuring JDBC Resources for WLDF

Creating WLDF Tables in the Database

If they do not already exist, you must create the database tables used by WLDF to store data in a JDBC-based store. Two tables are required:

- The wls_events table stores data generated from WLDF Instrumentation events.

- The wls_hvst table stores data generated from the WLDF Harvester component.

The SQL Data Definition Language (DDL) used to create tables may differ for different databases, depending on the SQL variation supported by the database.

- Apache Derby
- Oracle Database
- MySQL

Apache Derby

Example 7-2 shows the DDL that you can use to create the wls_events and wls_hvst tables in Apache Derby.

Example 7-2 DDL Definition of the WLDF Tables for Apache Derby

```
-- WLDF Instrumentation and Harvester archive DDLs using Derby

AUTOCOMMIT OFF;

-- DDL for creating wls_events table for instrumentation events

DROP TABLE wls_events;

CREATE TABLE wls_events (
  RECORDID INTEGER NOT NULL GENERATED ALWAYS AS IDENTITY (START WITH 1, INCREMENT BY 1),
  TIMESTAMP BIGINT default NULL,
  CONTEXTID varchar(128) default NULL,
  TXID varchar(32) default NULL,
  USERID varchar(32) default NULL,
  TYPE varchar(64) default NULL,
  DOMAIN varchar(64) default NULL,
  SERVER varchar(64) default NULL,
  SCOPE varchar(64) default NULL,
  MODULE varchar(64) default NULL,
  MONITOR varchar(64) default NULL,
  FILENAME varchar(64) default NULL,
  LINENUM INTEGER default NULL,
  CLASSNAME varchar(250) default NULL,
  METHODNAME varchar(64) default NULL,
  METHODDSC varchar(4000) default NULL,
  ARGUMENTS clob(100000) default NULL,
  RETVAL varchar(4000) default NULL,
  PAYLOAD blob(100000),
  CTXPAYLOAD VARCHAR(4000),
  DYES BIGINT default NULL,
  THREADNAME varchar(250) default NULL
);

-- DDL for creating wls_events table for instrumentation events

DROP TABLE wls_hvst;

CREATE TABLE wls_hvst (
  RECORDID INTEGER NOT NULL GENERATED ALWAYS AS IDENTITY (START WITH 1, INCREMENT BY 1),
  TIMESTAMP BIGINT default NULL,
  DOMAIN varchar(64) default NULL,
  SERVER varchar(64) default NULL,
  TYPE varchar(64) default NULL,
  NAME varchar(250) default NULL,
  ATTRNAME varchar(64) default NULL,
```

```
  ATTRTYPE INTEGER default NULL,
  ATTRVALUE VARCHAR(4000),
  WLDFMODULE VARCHAR(250) default NULL
);

COMMIT;
```

Consult the documentation for your database or your database administrator for specific instructions for creating these tables for your database.

Oracle Database

Example 7-3 shows the DDL that you can use to create the wls_events table in Oracle database.

Example 7-3 DDL Definition of the wls_events Table for Oracle Database

```
SET SERVEROUTPUT ON;

DECLARE
 vCtr     Number;
 vSQL     VARCHAR2(2000);
 vcurr VARCHAR2(256);
BEGIN

  SELECT sys_context( 'userenv', 'current_schema' ) into vcurrSchema from dual;
  dbms_output.put_line('Current Schema: '||vcurrSchema);

  SELECT COUNT(*)
  INTO vCtr
  FROM user_tables
  WHERE table_name = 'WLS_EVENTS';

  IF vCtr = 0 THEN
    dbms_output.put_line('Creating WLS_EVENTS table');
    vSQL := 'CREATE TABLE "WLS_EVENTS" (
    "RECORDID" NUMBER(20,0) DEFAULT NULL,
    "TIMESTAMP" NUMBER(20,0) DEFAULT NULL,
    "CONTEXTID" VARCHAR2(250 BYTE) DEFAULT NULL,
    "TXID" VARCHAR2(250 BYTE) DEFAULT NULL,
    "USERID" VARCHAR2(250 BYTE) DEFAULT NULL,
    "TYPE" VARCHAR2(250 BYTE) DEFAULT NULL,
    "DOMAIN" VARCHAR2(250 BYTE) DEFAULT NULL,
    "SERVER" VARCHAR2(250 BYTE) DEFAULT NULL,
    "SCOPE" VARCHAR2(250 BYTE) DEFAULT NULL,
    "MODULE" VARCHAR2(250 BYTE) DEFAULT NULL,
    "MONITOR" VARCHAR2(250 BYTE) DEFAULT NULL,
    "FILENAME" VARCHAR2(250 BYTE) DEFAULT NULL,
    "LINENUM" NUMBER(10,0) DEFAULT NULL,
    "CLASSNAME" VARCHAR2(250 BYTE) DEFAULT NULL,
    "METHODNAME" VARCHAR2(250 BYTE) DEFAULT NULL,
    "METHODDSC" VARCHAR2(4000 BYTE) DEFAULT NULL,
    "ARGUMENTS" CLOB DEFAULT NULL,
    "RETVAL" VARCHAR2(4000 BYTE) DEFAULT NULL,
    "PAYLOAD" BLOB DEFAULT NULL,
    "CTXPAYLOAD" VARCHAR2(4000 BYTE) DEFAULT NULL,
    "DYES" NUMBER(20,0) DEFAULT NULL,
    "THREADNAME" VARCHAR2(250 BYTE) DEFAULT NULL
   )';
   EXECUTE IMMEDIATE vSQL;
   vSQL := 'CREATE UNIQUE INDEX WLS_EVENTS_RECORD_IDX ON WLS_EVENTS(RECORDID)';
   EXECUTE IMMEDIATE vSQL;
```

```
   vSQL := 'CREATE INDEX WLS_EVENTS_TS_IDX ON WLS_EVENTS(TIMESTAMP)';
   EXECUTE IMMEDIATE vSQL;
  END IF;

  SELECT COUNT(*)
  INTO vCtr
  FROM user_tab_columns
  WHERE table_name = 'WLS_EVENTS' AND column_name = 'THREADNAME';

  IF vCtr = 0 THEN
    dbms_output.put_line('Creating THREADNAME column in WLS_EVENTS table');
    vSQL := 'ALTER TABLE WLS_EVENTS ADD("THREADNAME" VARCHAR2(250 BYTE) DEFAULT NULL)';
    EXECUTE IMMEDIATE vSQL;
  END IF;

  SELECT COUNT(*) INTO vCtr FROM user_sequences
  WHERE sequence_name = 'SEQ_WLS_EVENTS_RECORDID';

  IF vCtr = 0 THEN
    vSQL := 'CREATE SEQUENCE SEQ_WLS_EVENTS_RECORDID MINVALUE 1 MAXVALUE 9999999999999999999 START WITH
1 INCREMENT BY 1 NOCACHE';
    EXECUTE IMMEDIATE vSQL;
  END IF;

  SELECT COUNT(*) INTO vCtr FROM user_triggers
  WHERE table_name = 'WLS_EVENTS';

  IF vCtr = 0 THEN
    vSQL := 'CREATE OR REPLACE TRIGGER TRG_WLS_EVENTS_INSERT
    BEFORE INSERT ON WLS_EVENTS
    REFERENCING NEW AS newRow
    FOR EACH ROW
    BEGIN
      IF :newRow.RECORDID IS NULL THEN
        SELECT SEQ_WLS_EVENTS_RECORDID.nextval INTO :newRow.RECORDID FROM DUAL;
      END IF;
    END;';
    EXECUTE IMMEDIATE vSQL;
  END IF;

END;
/
```

Example 7-4 shows the DDL that you can use to create the wls_hvst table in Oracle database.

Example 7-4 DDL Definition of the wls_hvst Table for Oracle Database

```
SET SERVEROUTPUT ON;

DECLARE
 vCtr     Number;
 vSQL     VARCHAR2(1000);
 vcurrSchema VARCHAR2(256);
BEGIN

  SELECT sys_context( 'userenv', 'current_schema' ) into vcurrSchema from dual;
  dbms_output.put_line('Current Schema: '||vcurrSchema);

  SELECT COUNT(*)
    INTO vCtr
    FROM user_tables
    WHERE table_name = 'WLS_HVST';
```

```
  IF vCtr = 0 THEN
    dbms_output.put_line('Creating WLS_HVST table');
    vSQL := 'CREATE TABLE "WLS_HVST"
    (
      "RECORDID" NUMBER(20,0) NOT NULL,
      "TIMESTAMP" NUMBER(20,0) DEFAULT NULL,
      "DOMAIN" VARCHAR2(250 BYTE) DEFAULT NULL,
      "SERVER" VARCHAR2(250 BYTE) DEFAULT NULL,
      "TYPE" VARCHAR2(250 BYTE) DEFAULT NULL,
      "NAME" VARCHAR2(250 BYTE) DEFAULT NULL,
      "ATTRNAME" VARCHAR2(250 BYTE) DEFAULT NULL,
      "ATTRTYPE" NUMBER(10,0) DEFAULT NULL,
      "ATTRVALUE" VARCHAR2(4000 BYTE) DEFAULT NULL,
      "WLDFMODULE" VARCHAR2(250 BYTE) DEFAULT NULL
    )';
   EXECUTE IMMEDIATE vSQL;
   vSQL := 'CREATE UNIQUE INDEX WLS_HVST_RECORD_IDX ON WLS_HVST(RECORDID)';
   EXECUTE IMMEDIATE vSQL;
   vSQL := 'CREATE INDEX WLS_HVST_TS_IDX ON WLS_HVST(TIMESTAMP)';
   EXECUTE IMMEDIATE vSQL;
  END IF;

  SELECT COUNT(*)
    INTO vCtr FROM user_tab_columns
    WHERE table_name = 'WLS_HVST' AND column_name = 'WLDFMODULE';

  IF vCtr = 0 THEN
    dbms_output.put_line('Creating WLDFMODULE column in WLS_HVST table');
    vSQL := 'ALTER TABLE WLS_HVST ADD("WLDFMODULE" VARCHAR2(250 BYTE) DEFAULT NULL)';
    EXECUTE IMMEDIATE vSQL;
  END IF;

  SELECT COUNT(*) INTO vCtr FROM user_sequences
  WHERE sequence_name = 'SEQ_WLS_HVST_RECORDID';

  IF vCtr = 0 THEN
    vSQL := 'CREATE SEQUENCE SEQ_WLS_HVST_RECORDID MINVALUE 1 MAXVALUE 9999999999999999999 START WITH 1
INCREMENT BY 1 NOCACHE';
    EXECUTE IMMEDIATE vSQL;
  END IF;

  SELECT COUNT(*) INTO vCtr FROM user_triggers
  WHERE table_name = 'WLS_HVST';

  IF vCtr = 0 THEN
    vSQL := 'CREATE OR REPLACE TRIGGER TRG_WLS_HVST_INSERT
    BEFORE INSERT ON WLS_HVST
    REFERENCING NEW AS newRow
    FOR EACH ROW
    BEGIN
      IF :newRow.RECORDID IS NULL THEN
        SELECT SEQ_WLS_HVST_RECORDID.nextval INTO :newRow.RECORDID FROM DUAL;
      END IF;
    END;';
    EXECUTE IMMEDIATE vSQL;
  END IF;

END;
/
```

Consult the documentation for your database or your database administrator for specific instructions for creating these tables for your database.

MySQL

Example 7-5 shows the DDL that you can use to create the wls_events table in MySQL database.

Example 7-5 DDL Definition of the wls_events Table in MySql Database

```
DROP PROCEDURE if exists create_alter_wls_events
/

CREATE PROCEDURE create_alter_wls_events()
language sql
BEGIN
  CREATE TABLE IF NOT EXISTS WLS_EVENTS
  (
    RECORDID BIGINT AUTO_INCREMENT PRIMARY KEY,
    TIMESTAMP BIGINT NOT NULL,
    CONTEXTID VARCHAR(250) default NULL,
    TXID VARCHAR(250) default NULL,
    USERID VARCHAR(250) default NULL,
    TYPE VARCHAR(250) default NULL,
    DOMAIN VARCHAR(250) default NULL,
    SERVER VARCHAR(250) default NULL,
    SCOPE VARCHAR(250) default NULL,
    MODULE VARCHAR(250) default NULL,
    MONITOR VARCHAR(250) default NULL,
    FILENAME VARCHAR(250) default NULL,
    LINENUM INT UNSIGNED default NULL,
    CLASSNAME VARCHAR(250) default NULL,
    METHODNAME VARCHAR(250) default NULL,
    METHODDSC VARCHAR(4000) default NULL,
    ARGUMENTS TEXT(100000) default NULL,
    RETVAL VARCHAR(4000) default NULL,
    PAYLOAD BLOB(100000),
    CTXPAYLOAD VARCHAR(4000),
    DYES BIGINT UNSIGNED default NULL,
    THREADNAME VARCHAR(250) default NULL,
    INDEX(TIMESTAMP)
  );

  IF NOT EXISTS(
    SELECT * FROM `information_schema`.`COLUMNS`
      WHERE COLUMN_NAME='THREADNAME' AND TABLE_NAME='WLS_EVENTS') THEN
      ALTER TABLE `WLS_EVENTS` ADD `THREADNAME` varchar(250) default NULL;
  END IF;

END
/

CALL create_alter_wls_events()
/

DROP PROCEDURE if exists create_alter_wls_events
/
```

Example 7-6 shows the DDL that you can use to create the wls_hvst table in MySQL database.

Example 7-6 DDL Definition of wls_hvst Table in MySql Database

```
DROP PROCEDURE if exists create_alter_wls_hvst
/
```

```
CREATE PROCEDURE create_alter_wls_hvst()
language sql
BEGIN
  CREATE TABLE IF NOT EXISTS WLS_HVST
  (
    RECORDID BIGINT AUTO_INCREMENT PRIMARY KEY,
    TIMESTAMP BIGINT NOT NULL,
    DOMAIN VARCHAR(250) default NULL,
    SERVER VARCHAR(250) default NULL,
    TYPE VARCHAR(250) default NULL,
    NAME VARCHAR(250) default NULL,
    SCOPE VARCHAR(250) default NULL,
    ATTRNAME VARCHAR(250) default NULL,
    ATTRTYPE INT default NULL,
    ATTRVALUE VARCHAR(4000) default NULL,
    WLDFMODULE VARCHAR(250) default NULL,
    INDEX(TIMESTAMP)
  );

  IF NOT EXISTS(
    SELECT * FROM `information_schema`.`COLUMNS`
      WHERE COLUMN_NAME='WLDFMODULE' AND TABLE_NAME='WLS_HVST') THEN
      ALTER TABLE `WLS_HVST` ADD `WLDFMODULE` varchar(250) default NULL;
  END IF;

END
/

CALL create_alter_wls_hvst()
/

DROP PROCEDURE if exists create_alter_wls_hvst
/
```

Consult the documentation for your database or your database administrator for specific instructions for creating these tables for your database.

Configuring JDBC Resources for WLDF

After you create the tables in your database, you must configure JDBC to access the tables. (See *Administering JDBC Data Sources for Oracle WebLogic Server*.) Then, as part of your server configuration, you specify that JDBC resource as the data store to be used for a server's archive.

If multiple WLDF JDBC archive schemas exist in the same database, you can specify the particular schema to use for accessing JDBC-based archive tables in that database. There is no default value for a schema name: If you do not specify one, no schema name is applied when WLDF validates the runtime table, and no schema name is used for the SQL statements. You specify the schema name in the `WLDFServerDiagnosticMBean.DiagnosticJDBCSchemaName` attribute, which you can access from the Diagnostic Archives: Configuration page in the WebLogic Remote Console.

An example configuration for a JDBC-based store is shown in Example 7-7.

Example 7-7 Sample configuration for JDBC-based Diagnostic Archive (in config.xml)

```
<domain>
  <!-- Other domain configuration elements -->
  <server>
    <name>myserver</name>
```

```
    <server-diagnostic-config>
      <diagnostic-data-archive-type>JDBCArchive
      </diagnostic-data-archive-type>
      <diagnostic-jdbc-resource>JDBCResource</diagnostic-jdbc-resource>
    <server-diagnostic-config>
  </server>
  <!-- Other server configurations in this domain -->
</domain>
```

If you specify a JDBC resource but it is configured incorrectly, or if the required tables do not exist in the database, WLDF uses the default file-based persistent store.

Retiring Data from the Archives

To maintain the archived data, you must delete the old archived data periodically. WLDF includes a configuration-based data retirement feature for doing this. The data can be deleted based on the size of the data and time period when it was created.

You can configure size-based data retirement at the server level and age-based retirement at the individual archive level, as described in the following sections:

- Configuring Data Retirement at the Server Level
- Configuring Age-Based Data Retirement Policies for Diagnostic Archives
- Sample Configuration

Configuring Data Retirement at the Server Level

You can set the following data retirement options for a server instance:

- The preferred maximum size of the server instance's data store (<preferred-store-size-limit>) and the interval at which it is checked, on the hour, to see if it exceeds that size (<store-size-check-period>).

  When the size of the store is found to exceed the preferred maximum, an appropriate number of the oldest records in the store are deleted to reduce the size below the specified threshold. This is called "size-based data retirement."

  > **Note:**
  >
  > Size-based data retirement can be used only for file-based stores. These options are ignored for database-based stores.

- Enable or disable data retirement for the server instance.

  For file-based diagnostic stores, this enables or disables the size-based data retirement options discussed above. For both file-based stores and database-based stores, this also enables or disables any age-based data retirement policies defined for individual archives in the store. See Configuring Age-Based Data Retirement Policies for Diagnostic Archives.

Configuring Age-Based Data Retirement Policies for Diagnostic Archives

The data store for a server instance can contain the following types of diagnostic data archives whose records can be retired using the data retirement feature:

- Harvested metrics data (logical name: HarvestedDataArchive)

- Instrumentation events data (logical name: EventsDataArchive)
- Custom data (user-defined name)

> **Note:**
>
> WebLogic Server log files are maintained both at the server level and the domain level. Data is retired from the current log using the log rotation feature. See Configuring WebLogic Logging Services in *Configuring Log Files and Filtering Log Messages for Oracle WebLogic Server*.

Age-based policies apply to individual archives. The data store for a server instance can have one age-based policy for the HarvestedDataArchive, one for the EventsDataArchive, and one each for any custom archives.

When records in an archive exceed the age limit specified for records in that archive, those records are deleted.

Sample Configuration

Data retirement configuration settings are persisted in the `config.xml` configuration file for the server's domain, as shown in Example 7-8.

Example 7-8 Data Retirement Configuration Settings in config.xml

```
<domain>
<!-- other domain configuration settings -->
   <server>
   <name>MedRecServer</name>
   <!-- other server configuration settings -->
   <server-diagnostic-config>
      <diagnostic-store-dir>data/store/diagnostics</diagnostic-store-dir>
      <diagnostic-data-archive-type>FileStoreArchive
         </diagnostic-data-archive-type>
      <data-retirement-enabled>true</data-retirement-enabled>
      <preferred-store-size-limit>120</preferred-store-size-limit>
      <store-size-check-period>1</store-size-check-period>
      <wldf-data-retirement-by-age>
         <name>HarvestedDataRetirementPolicy</name>
         <enabled>true</enabled>
         <archive-name>HarvestedDataArchive</archive-name>
         <retirement-time>1</retirement-time>
         <retirement-period>24</retirement-period>
         <retirement-age>45</retirement-age>
      </wldf-data-retirement-by-age>
      <wldf-data-retirement-by-age>
         <name>EventsDataRetirementPolicy</name>
         <enabled>true</enabled>
         <archive-name>EventsDataArchive</archive-name>
         <retirement-time>10</retirement-time>
         <retirement-period>24</retirement-period>
         <retirement-age>72</retirement-age>
      </wldf-data-retirement-by-age>
   </server-diagnostic-config>
   </server>
</domain>
```

8

Configuring the Harvester for Metric Collection

The Harvester component of the WebLogic Diagnostics Framework (WLDF) gathers metrics from attributes on qualified MBeans instantiated in a running server. The Harvester can also collect metrics from WebLogic Server MBeans and from custom MBeans.

This chapter includes the following sections about the Harvester and how to configure it:

- Harvesting, Harvestable Data, and Harvested Data
- Harvesting Data from the Different Harvestable Entities
- Configuring the Harvester
  The Harvester is configured, and metrics are collected, in the scope of a diagnostic module targeted to one or more server instances. The Harvester configuration includes the sampling period, the type of data to harvest, and the type names for WebLogic Server MBeans and custom MBeans.
- Harvester Performance Considerations

Harvesting, Harvestable Data, and Harvested Data

Harvesting metrics is the process of gathering data that is useful for monitoring the system state and performance.Metrics are exposed to WLDF as attributes on qualified MBeans. The Harvester gathers values from selected MBean attributes at a specified sampling rate. Therefore, you can track potentially fluctuating values over time.
Data must meet certain requirements in order to be *harvestable*, and it must meet further requirements in order to be *harvested*:

- *Harvestable data* is data that can potentially be harvested from *harvestable entities*, including MBean types, instances, and attributes. To be harvestable, an MBean must be registered in the local WebLogic Server Runtime MBean server. Only simple type attributes of an MBean can be harvestable.
- *Harvested data* is data that is currently being harvested. To be harvested, the data must meet all the following criteria:
  - The data must be *harvestable.*
  - The data must be configured to be harvested.
  - For custom MBeans, the MBean must be currently registered with the JMX server.
  - The data must not throw exceptions while being harvested.

The WLDFHarvesterRuntimeMBean provides the set of harvestable data and harvested data. The information returned by this MBean is a snapshot of a potentially changing state. For a description of the information about the data provided by this MBean, see the description of the WLDFHarvesterRuntimeMBean in the *Oracle WebLogic Server MBean Reference*.

You can use the WebLogic Remote Console, the WebLogic Scripting Tool (WLST), or JMX to configure the Harvester to collect and archive the metrics that the server MBeans and the custom MBeans contain.

Harvesting Data from the Different Harvestable Entities

You can configure the Harvester to harvest data from named MBean types, instances, and attributes.In all cases, the Harvester collects the values of attributes of MBean instances, as explained in Table 8-1.

Table 8-1 Sources of Harvested Data from Different Configurations

When this entity is configured to be harvested as...	Data is collected from...
A type (only)	All harvestable attributes in all instances of the specified type
An attribute of a type (type + attribute(s))	The specified attribute in all instances of the specified type
An instance of a type (type + instance(s))	All harvestable attributes in the specified instance of the specified type
An attribute of an instance of a type (type + instance(s) + attribute(s))	The specified attribute in the specified instance of the specified type

All WebLogic Server runtime MBean types and attributes are known at startup. Therefore, when the Harvester configuration is loaded, the set of harvestable WebLogic Server entities is the same as the set of WebLogic Server runtime MBean types and attributes. As types are instantiated, those instances also become known and thus harvestable.

The set of harvestable custom MBean types is dynamic. A custom MBean must be instantiated before its type can be known. (The type does not exist until at least one instance is created.) Therefore, as custom MBeans are registered with and removed from the MBean server, the set of custom harvestable types grows and shrinks. This process of detecting a new type based on the registration of a new MBean is called *type discovery*.

Configuring the Harvester

The Harvester is configured, and metrics are collected, in the scope of a diagnostic module targeted to one or more server instances. The Harvester configuration includes the sampling period, the type of data to harvest, and the type names for WebLogic Server MBeans and custom MBeans.

Example 8-1 shows Harvester configuration elements in a WLDF system resource descriptor file, `myWLDF.xml`. This sample configuration harvests from the ServerRuntimeMBean, the WLDFHarvesterRuntimeMBean, and from a custom (that is, non-WebLogic Server) MBean. The text following the listing explains each element in the listing.

Example 8-1 Sample Harvester Configuration (in DIAG_MODULE.xml)

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<name>myWLDF</name>
  <harvester>
    <enabled>true</enabled>
    <sample-period>5000</sample-period>
    <harvested-type>
      <name>weblogic.management.runtime.ServerRuntimeMBean</name>
    </harvested-type>
    <harvested-type>
```

```
      <name>weblogic.management.runtime.WLDFHarvesterRuntimeMBean</name>
        <harvested-attribute>TotalSamplingTime</harvested-attribute>
        <harvested-attribute>CurrentSnapshotElapsedTime
        </harvested-attribute>
    </harvested-type>
    <harvested-type>
      <name>myMBeans.MySimpleStandard</name>
      <harvested-instance>myCustomDomain:Name=myCustomMBean1
      </harvested-instance>
      <harvested-instance>myCustomDomain:Name=myCustomMBean2
      </harvested-instance>
    </harvested-type>
  </harvester>
<!-- ----- Other elements ----- -->
</wldf-resource>
```


Configuring the Harvester Sampling Period

The <sample-period> element sets the sample period for the Harvester, in milliseconds. For example:

```
<sample-period>5000</sample-period>
```

The sample period specifies the time between each cycle. For example, if the Harvester begins execution at time *T*, and the sample period is *I*, then the next harvest cycle begins at *T+I*. If a cycle takes *A* seconds to complete and if *A* exceeds *I*, then the next cycle begins at *T+A*. If this occurs, the Harvester tries to start the next cycle sooner, to ensure that the average interval is *I*.

Configuring the Types of Data to Harvest

One or more <harvested-type> elements determine the types of data to harvest. Each <harvested-type> element specifies an MBean type from which metrics are to be collected. Optional sub-elements specify the instances and/or attributes to be collected for that type. Set these options as follows:

- The optional <harvested-instance> element specifies that metrics are to be collected only from the listed instances of the specified type. In general, an instance is specified by providing its JMX ObjectName in JMX canonical form. However, you can use pattern-matching to specify instance names in non-canonical form, as described in Using Wildcards in Harvester Instance Names.
- If no <harvested-instance> is present, all instances that are present at the time of each harvest cycle are collected.
- The optional <harvested-attribute> element specifies that metrics are to be collected only for the listed attributes of the specified type. An attribute is specified by providing its name. The first character should be capitalized. For example, an attribute defined with getter method `getFoo()` is named Foo.

The <harvested-attribute> element also supports an expression syntax for "drilling down" into attributes that are complex or aggregate objects, such as lists, maps, simple POJOs (Plain Old Java Objects), and various nestings of these types. See Specifying Complex and Nested Harvester Attributes, for details on this syntax. However, note that the result of these expressions must be a simple intrinsic type (`int`, `boolean`, `String`, and so on) in order to be harvested.

- If no <harvested-attribute> is present, all harvestable attributes defined for the type are collected.
- Attribute and instance lists can be combined in a type.

Specifying Type Names for WebLogic Server MBeans and Custom MBeans

The Harvester supports WebLogic Server MBeans and custom MBeans. WebLogic Server MBeans are those that come packaged as part of the WebLogic Server. Custom MBeans can be harvested as long as they are registered in the local runtime MBean server.

There is a difference in how WebLogic Server and customer types are specified. For WebLogic Server types, the type name is the name of the Java interface that defines the MBean. For example, the server runtime MBean's type name is weblogic.management.runtime.ServerRuntimeMBean.

For custom MBeans, the Harvester follows these rules:

- If the MBean is not a ModelMBean, the type name is the implementing class name. (See Example 8-1.)
- If the MBean is a ModelMBean, the type name is the value of the MBean Descriptor field DiagnosticTypeName.

If neither of these conditions is satisfied (if the MBean is a ModelMBean and there is no value for the MBean Descriptor field DiagnosticTypeName) then the MBean cannot be harvested.

Harvesting from the Domain Runtime MBean Server

The <harvested-type> element supports a <namespace> attribute that lets you harvest metrics from MBeans registered in the Domain Runtime MBean Server. However, Oracle recommends that you limit the usage to harvesting only Domain Runtime-specific MBeans, such as the ServerLifeCycleRuntimeMBean. Harvesting of remote managed server MBeans through the Domain Runtime MBean Server is possible, but is discouraged for performance reasons. It is a best practice to use the resident Harvester in each managed server to capture metrics related to that managed server instance.

The <namespace> attribute can have one of two values:

- ServerRuntime
- DomainRuntime

If the <namespace> attribute is omitted, it defaults to ServerRuntime.

> **Note:**
>
> Harvesting from the Domain Runtime MBean server is available only on the Administration Server. Attempts to harvest Domain Runtime MBeans on a Managed Server are ignored. See Example 8-5.

When Configuration Settings Are Validated

WLDF attempts to validate configuration as soon as possible. Most configuration is validated at system startup and whenever a dynamic change is committed. However, due to limitations in JMX, custom MBeans cannot be validated until instances of those MBeans have been registered in the MBean server.

Sample Configurations for Different Harvestable Types

In Example 8-2, the <harvested-type> element in the *DIAG_MODULE*.xml configuration file specifies that the ServerRuntimeMBean is to be harvested. Because no <harvested-instance> subelement is present, all instances of the type will be collected. However, because there is always only one instance of the server runtime MBean, there is no need to provide a specific list of instances. And because there are no <harvested-attribute> subelements present, all available attributes of the MBean are harvested for each of the two instances.

Example 8-2 Sample Configuration for Collecting All Instances and All Attributes of a Type (in DIAG_MODULE.xml)

```
<harvested-type>
  <name>weblogic.management.runtime.ServerRuntimeMBean</name>
</harvested-type>
```

In Example 8-3, the <harvested-type> element in the *DIAG_MODULE*.xml configuration file specifies that the WLDFHarvesterRuntimeMBean is to be harvested. As above, because there is only one WLDFHarvesterRuntimeMBean, there is no need to provide a specific list of instances. The subelement <harvested-attribute> specifies that only two of the available attributes of the WLDFHarvesterRuntimeMBean will be harvested: TotalSamplingTime and CurrentSnapshotElapsedTime.

Example 8-3 Sample Configuration for Collecting Specified Attributes of All Instances of a Type (in *DIAG_MODULE*.xml)

```
<harvested-type>
  <name>weblogic.management.runtime.WLDFHarvesterRuntimeMBean</name>
    <harvested-attribute>TotalSamplingTime</harvested-attribute>
    <harvested-attribute>CurrentSnapshotElapsedTime
    </harvested-attribute>
</harvested-type>
```

In Example 8-4, the <harvested-type> element in the *DIAG_MODULE*.xml configuration file specifies that a single instance of a custom MBean type is to be harvested. Because this is a custom MBean, the type name is the implementation class. In this example, the two <harvested-instance> elements specify that only two instances of this type will be harvested. Each instance is specified using the canonical representation of its JMX ObjectName. Because no instances of <harvested-attribute> are specified, all attributes will be harvested.

Example 8-4 Sample Configuration for Collecting All Attributes of a Specified Instance of a Type (in DIAG_MODULE.xml)

```
<harvested-type>
  <name>myMBeans.MySimpleStandard</name>
  <harvested-instance>myCustomDomain:Name=myCustomMBean1
  </harvested-instance>
  <harvested-instance>myCustomDomain:Name=myCustomMBean2
  </harvested-instance>
</harvested-type>
```

In Example 8-5, the <harvested-type> element in the *DIAG_MODULE*.xml configuration file specifies that the ServerLifeCycleRuntimeMBean is to be harvested. The <namespace> attribute specifies that this is a DomainRuntime MBean, so this configuration will only be honored on the administration server (see the note in Harvesting from the DomainRuntime MBeanServer). The subelement <harvested-attribute> specifies that only the StateVal attribute will be harvested.

Example 8-5 Sample configuration for Collecting Specified Attributes of the ServerLifeCycleMBean Type (in DIAG_MODULE.xml)

```
<harvested-type>
 <name>weblogic.management.runtime.ServerLifeCycleRuntimeMBean</name>
 <namespace>DomainRuntime</namespace>
 <known-type>true</known-type>
 <harvested-attribute>StateVal</harvested-attribute>
</harvested-type>
```

Harvester Performance Considerations

Because the Harvester tracks all MBeans that are registered in the local WebLogic Server Runtime MBean server, applications that create a high volume of transient MBeans can create performance issues in WLDF.Here, a transient MBean is an MBean with a very short life span that can be registered and unregistered very quickly, typically within the space of a few milliseconds. Such MBeans can create a load stress in the Harvester and the Policies and Actions system, which tracks MBean registrations. This performance problem is particularly a risk when high-volume JMS applications are not coded according to recommended best practices.
When JMS connections are not cached properly, a scenario can develop in which hundreds of connections (and consequently, the corresponding connection, producer, and consumer runtime MBeans) are created and destroyed every second when the system is operating under heavy load. This situation can cause load stress on both the Harvester and the Policies and Actions system.

To avoid this problem, make sure your JMS applications conform to the best coding practices described in Cache and Re-use Client Resources in *Tuning Performance of Oracle WebLogic Server*. As a result, you will not only obtain better WLDF performance, but you will also improve your JMS and overall server performance.

9

Configuring Policies and Actions

The Policies and Actions component of the WebLogic Diagnostics Framework (WLDF) provides the means for monitoring server and application states and then executing actions based on criteria set in the policies.Policies and actions are configured as part of a diagnostic module that is targeted to one or more server instances in a domain.

> **Note:**
>
> As of WebLogic Server 12.2.1, the terms **watch** and **notification** are replaced by **policy** and **action**, respectively. However, the definition of these terms has not changed.

The following sections give an overview of the Policies and Actions component, and also provide an example of a Policies and Actions configuration:

- Policies and Actions
  You can configure policies to analyze log records, data events, and harvested metrics.
- Overview of Policies and Actions Configuration
  A complete policy and action configuration includes settings for one or more policies, one or more actions, and any underlying configurations required for the action media; for example, the SNMP configuration required for an SNMP-based action.
- Sample Policies and Actions Configuration
  A set of policies and actions is configured in a diagnostic module file named `DIAG_MODULE.xml`.

Policies and Actions

You can configure policies to analyze log records, data events, and harvested metrics.

A *policy* identifies a situation that you want to trap for monitoring or diagnostic purposes.

A policy includes:

- A policy expression (with the exception of calendar-based policies)

  The default language for policy expressions is the WLDF query language; however, the WLDF query language is deprecated. You can also use Java Expression Language (EL) for policy expressions.
- An alarm setting
- One or more action handlers

You can also configure policies to enable elasticity in dynamic clusters; that is, to automatically scale a dynamic cluster up or down by a specific number of server instances. You can define policies to enable two broad categories of elasticity:

- Calendar-based scaling — Scaling operations on a dynamic cluster that are executed on a particular date and time.

- Policy-based scaling — Scaling operations on a dynamic cluster that are executed in response to changes in demand.

> **Note:**
>
> To configure an elastic scaling policy for a dynamic cluster, you must create a domain-scope diagnostic system module in which you define the scaling policy, and then target that diagnostic module to the Administration Server.

For more information about enabling elasticity in WebLogic Server, including instructions for downloading and running a demonstration example, see Policy-Based Scaling in *Configuring Elasticity in Dynamic Clusters for Oracle WebLogic Server*.

An *action* is an operation that is executed when a policy expression evaluates to true. WLDF supports the following types of actions:

- Scaling a dynamic cluster
- Java Management Extensions (JMX)
- Java Message Service (JMS)
- Simple Mail Transfer Protocol (SMTP), for example, e-mail
- Simple Network Management Protocol (SNMP)
- Diagnostic image
- Log
- REST
- Script
- Heap dump
- Thread dump

You must associate a policy with an action for a useful diagnostic activity to occur; for example, to notify an administrator about specified states or activities in a running server.

Policies and actions are configured separately from each other. An action can be associated with multiple policies, and a policy can be associated with multiple actions. This provides the flexibility to recombine and re-use policies and actions, according to current needs.

Overview of Policies and Actions Configuration

A complete policy and action configuration includes settings for one or more policies, one or more actions, and any underlying configurations required for the action media; for example, the SNMP configuration required for an SNMP-based action.

The main elements required for configuring policies and actions in a WLDF system resource descriptor file, `DIAG_MODULE.xml`, are shown in Example 9-1. As the listing shows, the base element for defining policies and actions is <watch-notification>. Policies are defined in <watch> elements, and actions are defined in elements named for each of the types of action; for example, <jms-notification>, <jmx-notification>, <smtp-notification>, and <image-notification>.

Example 9-1 A Skeleton Policy and Action Configuration (in DIAG_MODULE.xml)

```
<wldf-resource>
<!-- ----- Other system resource configuration elements ----- -->
  <watch-notification>
  <log-watch-severity>
     <!-- Threshold severity for a log watch to be evaluated further
           (This can be narrowed further at the watch level.) -->
  </log-watch-severity>
   <wldf-resource>
<!-- ----- Other system resource configuration elements ----- -->
  <watch-notification>
  <log-watch-severity>
     <!-- Threshold severity for a log policy to be evaluated further
           (This can be narrowed further at the policy level.) -->
  </log-watch-severity>
    <!-- ----- Policy configuration elements: ----- -->
    <watch>
      <!-- A policy expression -->
    </watch>
    <watch>
      <!-- A policy expression -->
    </watch>
    <!-- Any other policy configurations -->

    <!-- ----- Action configuration elements: ----- -->
    <!-- The following action configuration elements show one of each
         type of supported actions. However, not all types are
         required in any one system resource configuration, and multiples
         of any type are permitted. -->
    <jms-notification>
      <!-- Configuration for a JMS-based action; requires a
           corresponding JMS configuration via a jms-server element and a
           jms-system-resource element -->
    </jms-notification>

    <jmx-notification>
      <!-- Configuration for a JMX-based action -->
    </jmx-notification>
    <smtp-notification>
      <!-- Configuration for an SMTP-based action; requires a
           corresponding SMTP configuration via a mail-session element -->
    </smtp-notification>
    <snmp-notification>
      <!-- Configuration for an SNMP-based action; requires a
           corresponding SNMP agent configuration via an snmp-agent
           element -->
    </snmp-notification>
    <image-notification>
      <!-- Configuration for an image-based action -->
    </image-notification>
  <watch-notification>
<!-- ----- Other configuration elements ----- -->
</wldf-resource>
```

> **Note:**
>
> While the notification media must be configured so they can be used by the actions that depend on them, those configurations are not part of the configuration of the diagnostic module itself. That is, they are not configured in the <wldf-resource> element in the diagnostic module's configuration file.

Each policy and action can be individually enabled and disabled by setting <enabled>true</enabled> or <enabled>false</enabled> for the individual policy or action. In addition, the entire policy and action facility can be enabled and disabled by setting <enabled>true</enabled> or <enabled>false</enabled> for all policies and actions. The default value is <enabled>true</enabled>.

The <watch-notification> element contains a <log-watch-severity> sub-element, which affects how actions are executed by log policies.

If the maximum severity level of the log messages that triggered the policy do not at least equal the provided severity level, then the resulting actions are not executed. Note that this only applies to actions executed by log policies. Do not confuse this element with the <severity> element defined on policies. The <severity> element assigns a severity to the policy itself, whereas the <log-watch-severity> element controls which actions are executed by log-type policies.

Sample Policies and Actions Configuration

A set of policies and actions is configured in a diagnostic module file named `DIAG_MODULE.xml`.

Example 9-2 shows a complete configuration. The details of this example are explained in the following topics:

- Configuring Policies
- Configuring Actions

Example 9-2 Sample Policies and Actions Configuration (in DIAG_MODULE.xml)

```
<?xml version='1.0' encoding='UTF-8'?>
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <!-- Instrumentation must be configured and enabled for instrumentation
       policies -->
  <instrumentation>
    <enabled>true</enabled>
    <wldf-instrumentation-monitor>
      <name>DyeInjection</name>
      <description>Dye Injection monitor</description>
      <dye-mask xsi:nil="true"></dye-mask>       <properties>ADDR1=127.0.0.1</
properties>
    </wldf-instrumentation-monitor>
  </instrumentation>
  <!-- Harvesting does not have to be configured and enabled for harvester
       policies. However, configuring the Harvester can provide advantages;
       for example the data will be archived. -->
  <harvester>
    <name>mywldf1</name>
```

```
    <sample-period>20000</sample-period>
    <harvested-type>
      <name>weblogic.management.runtime.ServerRuntimeMBean</name>
    </harvested-type>
    <harvested-type>
      <name>weblogic.management.runtime.WLDFHarvesterRuntimeMBean</name>
    </harvested-type>
  </harvester>
  <!-- All policies and actions are defined under the
       watch-notification element -->
  <watch-notification>
    <enabled>true</enabled>
    <log-watch-severity>Info</log-watch-severity>
    <!-- A harvester policy configuration -->
    <watch>
      <name>myWatch</name>
      <enabled>true</enabled>
      <rule-type>Harvester</rule-type>
      <rule-expression>${com.bea:Name=myserver,Type=ServerRuntime//
SocketsOpenedTotalCount} &gt;= 1</rule-expression>
      <alarm-type>AutomaticReset</alarm-type>
      <alarm-reset-period>60000</alarm-reset-period>
      <notification>myMailNotif,myJMXNotif,mySNMPNotif</notification>
    </watch>
    <!-- An instrumentation policy configuration -->
    <watch>
      <name>myWatch2</name>
      <enabled>true</enabled>
      <rule-type>EventData</rule-type>
      <rule-expression>
      (MONITOR LIKE 'JDBC_After_Execute') AND
      (DOMAIN = 'MedRecDomain') AND
      (SERVER = 'medrec-adminServer') AND
      ((TYPE = 'ThreadDumpAction') OR (TYPE = TraceElapsedTimeAction')) AND
      (SCOPE = 'MedRecEAR')
      </rule-expression>
      <notification>JMXNotifInstr</notification>
    </watch>
    <!-- A log policy configuration -->
    <watch>
      <name>myLogWatch</name>
      <rule-type>Log</rule-type>
      <rule-expression>MSGID='BEA-000360'</rule-expression>
      <severity>Info</severity>
      <notification>myMailNotif2</notification>
    </watch>
    <!-- A JMX notification -->
    <jmx-notification>
      <name>myJMXNotif</name>
    </jmx-notification>
    <!-- Two SMTP actions -->
    <smtp-notification>
      <name>myMailNotif</name>
      <enabled>true</enabled>
      <mail-session-jndi-name>myMailSession</mail-session-jndi-name>
      <subject>This is a harvester alert</subject>
      <recipient>username@emailservice.com</recipient>
    </smtp-notification>
    <smtp-notification>
      <name>myMailNotif2</name>
      <enabled>true</enabled>
      <mail-session-jndi-name>myMailSession</mail-session-jndi-name>
```

```
      <subject>This is a log alert</subject>
      <recipient>username@emailservice.com</recipient>
    </smtp-notification>
    <!-- An SNMP notification -->
    <snmp-notification>
      <name>mySNMPNotif</name>
      <enabled>true</enabled>
    </snmp-notification>
  </watch-notification>
</wldf-resource>
```

10

Configuring Policies

The WebLogic Diagnostics Framework (WLDF) provides three main types of policies, which are differentiated by the sorts of data each can monitor. The policy types are:

- **Scheduled** policies, which monitor diagnostic data that is generated by runtime MBeans according to a specific schedule. These policies can also be used to execute an action at a specific time or on a schedule.
- **Log** policies, which monitor messages generated into the server or domain logs.
- **Instrumentation** policies, also known as Event Data policies, which monitor events generated by the WLDF Instrumentation component.

This chapter explains how to configure each policy type and includes the following sections:

- How Policies Are Configured
  There are several components of a policy that you configure, such as the type, expression, corresponding actions to be executed when the policy is evaluated to true, and more.
- Configuring Scheduled Policies
- Configuring Log Policies
  Use log policies to monitor the occurrence of specific messages or strings in the server or domain log. Policies of this type are triggered as a result of a log message containing the specified data being issued.
- Configuring Instrumentation Policies
  You use instrumentation policies to monitor the events from the WLDF Instrumentation component. Policies of this type are evaluated as a result of an event being posted by the Instrumentation component, which occurs when code that matches a deployed Instrumentation monitor is exercised.
- Creating Complex Policy Expressions Using WLDF Java EL Extensions
  Oracle expects that the library of smart rules packaged with WLDF are sufficient for meeting the needs of creating scheduled policies that evaluate runtime performance data in a server or cluster. However, if you have a specific scheduled policy need that cannot be satisfied by a smart rule, WLDF also provides a set of extensions to Java EL. These extensions are intended for use in policies that evaluate very specific characteristics or trends in metrics collected from runtime MBean servers in your WebLogic domain.

How Policies Are Configured

There are several components of a policy that you configure, such as the type, expression, corresponding actions to be executed when the policy is evaluated to true, and more.

You can use any of the following tools to configure policies for diagnostic system modules:

- WebLogic Remote Console
- Fusion Middleware Control
- WLST
- REST
- JMX application

This chapter refers primarily to using the WebLogic Remote Console or WLST.

The following table summarizes the attributes, elements, and options that you configure when creating a policy, and also identifies any requirements each configuration item has for specific policy types.

Table 10-1 Elements, Properties, and Options Configured in a WLDF Policy

Item	Description	Policy Requirement
Rule Type	Attribute that determines the policy's type. The default is `Harvester`.	Must be specified for log and instrumentation policies. Optional for scheduled policies.
Expression Language	Attribute that establishes the language used in the policy expression. The two supported languages are Java Expression Language (EL), and WLDF query language (deprecated).	Use EL in all policy types. The WLDF query language is supported, but deprecated.
Policy Expression	Expression that identifies a situation or condition that you want to trap for monitoring or diagnostic purposes. The expression can analyze log records, data events, or MBean metrics, depending on the rule type setting.	Optional for scheduled policies, but required for all others. If a scheduled policy does not include an expression, the policy always executes the associated actions according to the Policy Schedule.
Actions	One or more operations that are executed when a policy expression is evaluated to `true`.	Optional.
Policy Schedule	A calendar-based schedule that determines when a scheduled policy is evaluated.	Required for all scheduled policies. Not available for log or instrumentation policies.
Alarm Options	Options that determine whether, or when, a policy can be evaluated again after it has been evaluated to `true`. The default is `None`, which enables the policy to always be evaluated again.	Optional for all policy types.
Severity Option	Log message severity value that, when the policy is evaluated to `true`, is: 1. Specified for the log message that is generated in the logging system. 2. Passed to the actions that are configured with the policy. The default is `Notice`.	Optional for all policy types.
Enablement Option	Flags that either enable or disable a policy from being evaluated. The default is `enabled`.	Optional for all policy types.

- Rule Type
- Expression Language
- Policy Expression
- Actions
- Policy Schedule

- Alarm Options
- Severity Option
- Enablement Option

Rule Type

When creating a policy, you must define its type in its **rule type** attribute. Policies with different rule types differ in two ways:

- The syntax for specifying the conditions being monitored are unique to the rule type.
- Log and instrumentation policies are triggered in real time, whereas scheduled policies are triggered by settings on the `WLDFScheduleBean` interface, described in Policy Schedule.

The way to define the rule type depends on the tool you use to create the policy:

- If you are using the WebLogic Remote Console or Fusion Middleware Control, the rule type is determined by the policy type you are creating. For each of the policy types you can choose in either console, the following table identifies the corresponding rule type and `WLDFWatchBean.RuleType` attribute value that is defined for that policy:

Table 10-2 WLDFWatchBean.RuleType Attribute Values for Policy Types Created Using Remote Console or Fusion Middleware Control

Policy Type	Rule Type	WLDFWatchBean.RuleType Value
Smart Rule	Harvester	`Harvester`
Calendar Based	Harvester	`Harvester`
Collected Metrics	Harvester	`Harvester`
Server Log	Log	`Log`
Domain Log	Log	`DomainLog`
Event Data	Instrumentation	`EventData`

- If you are using WLST, REST, or JMX to configure a policy, you set the `WLDFWatchBean.RuleType` attribute as follows:

Table 10-3 WLDFWatchBean.RuleType Attribute Values for Policy Types Created Using WLST, REST, or JMX

Policy Type	Rule Type Attribute
Scheduled policy	`Harvester`
Log policy	`Log` - for server log monitoring `DomainLog` - for domain log monitoring
Instrumentation	`EventData` - for instrumentation event monitoring

Expression Language

Policy expressions can be created using either of the following languages:

- Java Expression Language (EL) (recommended)
- WLDF query language (deprecated in WebLogic Server 12.2.1)

See Expression Language in *The Java EE 8 Tutorial*. For more information about Java (EL), see the JSR-000341 Expression Language 3.0 specification at https://jcp.org/aboutJava/communityprocess/final/jsr341/index.html.

If you have diagnostic system modules created with a previous release of WebLogic Server, WLDF supports expressions that use the WLDF query language. If you are creating new policies for either an existing or a new diagnostic system module, Oracle strongly recommends using Java EL as the policy expression language.

> **Note:**
>
> The policies described in this chapter are Java EL based. For information about configuring policies that use the WLDF query language, see WLDF Query Language-Based Policies.

Policy Expression

A policy expression encapsulates all information necessary for specifying a rule that, when evaluated to `true`, causes the associated actions to be executed. When you use Java EL as the expression language, you can construct a policy expression that uses the following out-of-the-box resources to set the conditions that determine whether to fire an associated action:

- Beans

  A bean is a Java object that represents the data available for a policy expression to use, such as metrics from MBeans, log event information, or structured data surfaced by other beans. Beans are accessed in policy expressions using standard JavaBean conventions.

- Functions

  Functions are a set of operations that are provided either by EL itself, or by WLDF, that can be utilized from policy expressions to transform or evaluate data.

- Smart rules

  Smart Rules are special set of functions that encapsulate more complex logic and monitoring capabilities, and have specialized support in both the WebLogic Remote Console and Fusion Middleware Control. They can be used by themselves, or with other expression components as part of a larger, more complex expression.

Actions

Each policy can be associated with one or more actions that are executed whenever the policy evaluates to `true`. See Configuring Actions.

Policy Schedule

All scheduled policies must be configured with a schedule. Scheduling allows policies to be evaluated according to a calendar schedule, at a specific time, after a duration of time, or at timed intervals.

You configure a policy schedule by setting attributes on the `WLDFScheduleBean` interface, which is a property of the `WLDFWatchBean`. You can set these attributes using the WebLogic Remote Console, WLST, REST, or a JMX application. When you are configuring new policies, the

WebLogic Remote Console and Fusion Middleware Control provide convenient assistants and workflows for configuring common scheduling scenarios.

> **Note:**
>
> The `WLDFScheduleBean` is used for policy evaluation only when:
>
> - The configured policy rule type is `"Harvester"`.
> - The configured expression language for the policy is `"EL"`.
>
> Note also that although scheduled policies that use the `WLDFScheduleBean` for scheduling are configured as Harvester types, the WLDF Harvester component is not used for scheduling.

Table 10-4 lists the attributes of the `WLDFScheduleBean` and their default values, which are the same as for the `javax.ejb.ScheduleExpression` interface. In addition, the syntax for specifying a value, range, list, or interval for a specific unit of time is also the same as that described for the `ScheduleExpression` interface. See `https://javaee.github.io/javaee-spec/javadocs/javax/ejb/ScheduleExpression.html`.

Table 10-4 WLDFScheduleBean Attributes and Default Values

Attribute	Description	Default	Allowable Values and Examples
`second`	One or more seconds within a minute	`0`	Allowable values: `0` to `59` Can be a value, range, list, or interval. To specify every *n* seconds of the minute, specify `"*/n"`. For example: • `second = "30"` — (value) run policy every 30 seconds within the minute • `second = "10,20,30"` — (list) run policy on seconds 10, 20 and 30 within the minute • `second = "1-10"` — (range) run policy on each of seconds 1 through 10 within the minute • `second = "30/10"` — (interval) run policy every 10 seconds within the minute, starting at second 30 • `second = "*/5"` — (interval) run policy every 5 seconds within the minute
`minute`	One or more minutes within an hour	`*/5`	Allowable values: `0` to `59` Can be a value, range, list, or interval. To specify every *n* minutes of the hour, specify `"*/n"`. For example: • `minute = "30"` — (value) run policy every 30 minutes `minute = "*/2"` — (interval) run policy every two minutes of the hour
`hour`	One or more hours within a day	`*`	Allowable values: `0` to `23` Can be a value, range, list, or interval. For example: • `hour="16"` — (value) run policy at 16:00. • `hour = "*"` — (range) run policy at every hour within a day.

Table 10-4 (Cont.) WLDFScheduleBean Attributes and Default Values

Attribute	Description	Default	Allowable Values and Examples
`dayOfWeek`	One or more days within a week	`*`	Allowable values: • `0` to `7`, where `0` and `7` represent Sunday. For example, `dayOfWeek="3"` • `Sun`, `Mon`, `Tue`, `Wed`, `Thu`, `Fri`, `Sat`. For example, `dayOfWeek="Mon"` Can be a value, range, or list. For example: • `dayOfWeek = "3"` — run policy on Wednesday • `dayOfWeek = "Mon-Fri"` — run policy each day from Monday to Friday • `dayOfWeek = "Mon, Wed, Fri"` — run policy on Monday, Wednesday, and Friday
`dayOfMonth`	One or more days within a month	`*`	Allowable values: • `1` to `31` • `Last` • `-7` to `-1` • {`1st`, `2nd`, `3rd`, `4th`, `5th`, `Last`} {`Sun`, `Mon`, `Tue`, `Wed`, `Thu`, `Fri`, `Sat`} `Last` represents the last day of the month. `-`*x* (where *x* is in the range `7` to `1`) means *x* days before the last day of the month. `1st`, `2nd`, and so on, specified with a day of the week identifies a single occurrence of that day within the month. Can be a value, range, or list. For example: • `dayOfMonth = "1"` — run policy on first day of the month • `dayOfMonth = "-3"` — run policy on the third day before the end of the month • `dayOfMonth = "2nd Mon"` — run policy on the second Monday of the month • `dayOfMonth = "1st Fri, 3rd Fri"` — run policy on the first and third Friday of the month • `dayOfMonth = "1 to 10"` — run policy on each of the first 10 days of the month
`month`	One or more months within a year	`*`	Allowable values: • `1` to `12`. • `Jan`, `Feb`, `Mar`, `Apr`, `May`, `Jun`, `Jul`, `Aug`, `Sep`, `Oct`, `Nov`, `Dec` Can be a value, range, or list. For example: • `month = "7"` — run policy on the 7th month of the year • `month = "Feb"` — run policy in February • `month = "1 - 3"` — run policy on the first three months of the year • `month = "Jan, Apr, Jul, Oct"` — run policy in January, April, July, and October
`year`	A specific calendar year	`*`	Allowable values: a four-digit calendar year. You can specify one value. For example: • `year = "2015"` — run policy in 2015
`timezone`	Time zone for the schedule	null	Defaults to the local VM time zone. You may use this attribute to specify a non-default time zone ID in whose context the schedule specification is to be evaluated.

Alarm Options

A policy that has been evaluated to `true` is referred to as having been *triggered*. For policies that are run repeatedly, an alarm determines when a policy can be evaluated again after it has been triggered. If a policy is configured with an alarm, a triggered policy is not evaluated again until the alarm is reset. For policies that are evaluated repeatedly, you can optionally define a minimum time that must transpire after a policy has been triggered before the policy can be evaluated again.

An alarm is important to configure for a policy that is run repeatedly to prevent the associated actions from being executed too frequently, such as generating a flood of emails or JMX notifications. For example, if you have a scheduled policy that executes a scale up action on a dynamic cluster, you should set an alarm that delays evaluating the policy again until the dynamic cluster is fully scaled up and is processing incoming requests. This delay is referred to as the *alarm reset period*. Without a proper alarm reset period, the scale up action could be executed again prematurely and counter-productively.

To configure an alarm for a policy, specify the following:

- The alarm type
- The alarm reset period

The following table lists and describes each of the available alarm types:

Table 10-5 Alarm Types

Alarm Type	Description
`None`	Allows the policy to be triggered whenever possible. This is the default.
`AutomaticReset`	Allows the policy to be triggered whenever possible, except that subsequent occurrences cannot occur any sooner than the interval specified in the alarm reset period.
`ManualReset`	Allows the policy to be triggered only once. After it is triggered, you must manually reset it to fire again. You can reset an alarm using a run-time MBean operation, either programmatically or with WLST. For example, you can use the `resetWatchAlarm` operation on the `WLDFWatchNotificationRuntimeMBean`.

Note the following alarm state behaviors:

- When the alarm type is `AutomaticReset`, a policy enters the *alarm state* when triggered and stays in that state until the time interval specified by the alarm reset period has expired.
- If a policy is configured with a `ManualReset` alarm, the policy enters the alarm state when triggered, and remains in that state until you manually reset it.
- When a policy is in the alarm state, the policy is not evaluated again until the alarm is reset.
- If a policy's alarm type is `None`, the configured action can be executed every time that the policy is triggered. The alarm state is never set in these cases.

Severity Option

Whenever a policy is triggered, a message is automatically generated in the logging system. The severity option is an optional value you can configure that:

1. Gets assigned as the severity value of the log message generated in the logging system.
2. Is also passed to the actions that are configured with the policy.

The severity option must be one that is defined for the WebLogic logging service in the `weblogic.logging.Severities` class. The accepted values are `Info`, `Notice`, `Warning`, `Error`, `Critical`, `Alert`, and `Emergency`. The default is `Notice`.

Enablement Option

Each policy can be individually enabled and disabled by using the `Enabled` attribute on that policy. The value you specify for this attribute is `true` or `false`. When disabled, a policy is not evaluated and its configured actions are not executed.

However, note that the `WLDFWatchNotificationBean`, which is the parent of all policy and action configurations in a diagnostic system module, also has an `Enabled` attribute. If the value of the `WLDFWatchNotificationBean.Enabled` attribute is `false`, all individual policies in the diagnostic system modules are disabled regardless of whether its policies are individually configured as enabled.

Configuring Scheduled Policies

Scheduled policies monitor diagnostic data that consists of data coming from MBeans within the WebLogic Server Runtime MBean Server, including the read-only configuration MBeans in the WebLogic Server Runtime MBean Server.These values, called **metrics**, originate from common WebLogic Server JMX data sources such as the following:

- WebLogic Server Runtime MBean Server
- Domain Runtime MBean Server
- JVM platform MBean server

Scheduled policies are useful for monitoring run-time state information in the WebLogic Server environment. Examples of diagnostic data that is useful to monitor using scheduled policies are:

- Changes over time in average JVM heap usage

  If the average amount of free heap reaches a particular threshold that is defined in the policy expression, the configured action is executed, such as sending an email to the system administrator.

- Data from multiple services that are considered together, such as response-time metrics reported by a load balancer and message-backlog metrics from a message queue

  If the combination of data meets a particular set of criteria defined in the policy expression, the policy can fire a scaling action

See also Chaining Policies for information about how to create a policy expression that can reference the state of other policies defined within the same WLDF module as the beans. Policy chaining allows the state of one policy to be part of the expression of another.

The following sections explain how to configure, and show examples of, the three scheduled policy types:

- Configuring Calendar Based Policies
- Configuring Smart Rule Based Policies
- Chaining Policies

Configuring Calendar Based Policies

The simplest type of scheduled policy is the calendar based policy. You can use a calendar based policy to fire any associated actions according to the policy's schedule.

Calendar-based policies are simply scheduled policies with no associated expression. This enables purely schedule-driven action execution; that is, the ability to unconditionally perform a set of actions on a specified schedule. If no expression is provided, when the scheduled time occurs, the policy treats the empty expression as a `true` result and executes the associated actions.

> **Note:**
>
> Calendar based policies are supported only for policies that: have the following configuration attributes:
>
> - The rule type specified as `'Harvester'`
> - The expression language specified as `'EL'`

The following example shows the configuration of a calendar based policy using WLST. This policy fires a scale up action at 3:00 a.m. on December 26.

```
calendarScaleUp=wn.lookupWatch('ChristmasReturnsScaleUpWatch')
if calendarScaleUp == None:
  print "Creating scale-up for the post-Christmas returns rush on Dec 26 at 3am"
  calendarScaleUp=wn.createWatch('ChristmasReturnsScaleUpWatch')
calendarScaleUp.setRuleType('Harvester')
calendarScaleUp.setExpressionLanguage('EL')
calendarScaleUp.getSchedule().setHour('3')
calendarScaleUp.getSchedule().setMinute('0')
calendarScaleUp.getSchedule().setSecond('0')
calendarScaleUp.getSchedule().setDayOfMonth('26')
calendarScaleUp.getSchedule().setMonth('Dec')
calendarScaleUp.setEnabled(false)
calendarScaleUp.addNotification(scaleUp)
```

Configuring Smart Rule Based Policies

Smart rules are prepackaged functions that greatly simplify the creation of policy expressions. The WebLogic Remote Console and Fusion Middleware Control, in particular, each contain a smart rule editor to greatly simplify the task of configuring a smart rule for the policy you are creating.

Smart rules perform a number of complex operations, but surface only a small number of configuration parameters that you set. Details about the specific low level metrics that are collected, how they are used, and so on, are hidden, thereby making them easy to use. Smart rules return only a Boolean value, which determines whether the policy is evaluated to `true`.

You use a smart rule as a predicate in policy expression by simply specifying the parameters required by that smart rule. For example, to evaluate whether a particular increase exists in the average thread pool queue length in the local server, you create a policy that specifies the `ServerHighQueueLength` smart rule as the policy expression and provide the following parameters:

- The sampling period for collecting the value of the `ThreadPoolRuntimeMBean.QueueLength` attribute
- Duration, or the most recent window of time, in which samples are retained
- A threshold value that establishes the maximum acceptable number of threads in the queue

The smart rule takes responsibility for sampling the appropriate metrics over the specified time interval, computing averages, comparing threshold values, and determining whether the smart rule evaluates to `true`.

> **Note:**
>
> Smart rules are supported for use only in scheduled policies that are configured with Java EL as the expression language.

- Types of Diagnostic Data that Smart Rules Evaluate
- Smart Rule Example

Types of Diagnostic Data that Smart Rules Evaluate

Smart rules can monitor trends in metrics in a server or cluster over time, including:

- Average system throughput
- Process CPU load
- Pending user request count
- Idle or stuck thread count
- Incoming request queue size
- System load average
- JVM free heap size
- Any metric value visible from JMX, such as custom MBean values

You can use smart rules as building blocks in policy expressions. In the simplest case, a single smart rule can be used by itself in a policy expression. You can also combine a smart rule with others, as well as with other EL constructs, to form more complex expressions.

For example, you can construct a policy that sends an email notification if all of the following conditions occur simultaneously in a server instance or cluster:

- Low JVM free heap percentage
- High number of stuck threads
- High incoming requests queue size

For details about all the smart rules provided by WLDF, see Smart Rule Reference.

Smart Rule Example

The ClusterLowHeapFreePercent smart rule compares the average free heap across all Managed Servers in a cluster by monitoring the value of the `JVMRuntimeMBean.HeapFreePercent` attribute. A policy expression that uses this smart rule will be evaluated to `true` if a minimum percentage of Managed Servers in the cluster have an average free heap that is less than a particular threshold value.

The `ClusterLowHeapFreePercent` smart rule takes the following input parameters:

- Cluster name
- Sampling period — The frequency with which the value of the `HeapFreePercent` metric is collected
- Retention window — A sliding window of time during which samples are retained. For example, the most recent five minutes.
- *`percentFreeLimit`* — A value that represents the low free heap percentage threshold.
- *`percentServersLimit`* — A percentage of Managed Servers in the cluster that must have an average free heap that is less than *`percentFreeLimit`* to cause the expression to evaluate to `true`.

The following is an example configuration of the `ClusterLowHeapFreePercent` smart rule:

```
wls:ClusterLowHeapFreePercent("myCluster","30 seconds","10 minutes",20,60)
```

For every Managed Server in `myCluster`, this smart rule collects the value of the `HeapFreePercent` every 30 seconds, retaining the most recent 10 minutes of data, and evaluates to `true` if at least 60 per cent of the Managed Servers in `myCluster` have an average free heap percentage that is less than 20 per cent.

This smart rule could be configured to fire an action when it evaluates to `true`, such as sending an email to the system administrator to report that a low free heap condition exists in the cluster. The system administrator can then take remedial action as necessary.

You can use smart rules in conjunction with scaling actions, described in Configuring Elastic Actions, to configure policy based scaling of a dynamic cluster. This capability enables automated elasticity in that cluster. For more information, including a demo that you can download and run, see Policy-Based Scaling in *Configuring Elasticity in Dynamic Clusters for Oracle WebLogic Server*.

Chaining Policies

Within the same diagnostics system module, the expression in one policy can reference other policies as beans within that expression. In this way, complex policy expressions can be reused and "chained" together to allow the state of one policy to be part of the expression of another. This allows more complex, interrelated policies to be written, while keeping such policy configurations more readable and maintainable.

To allow access to policy states within an expression, you can use the resource bean within the global bean name space for each policy. The `resource` bean supports a `Map` attribute named `watches`, where each key in the map is the name of a policy defined within the same diagnostics system module.

Each value in the policy's map is a bean representing the named policy. These policy beans support a simple Boolean alarm attribute, which has the following semantics:

- If the policy is configured with an alarm type other than `None`, the alarm attribute returns `true` if the policy is currently in the alarm state.
- If no alarm type is configured on the policy, the alarm attribute yields the most recently evaluated result.
- If the alarm attribute on a policy bean is accessed before the named policy has successfully completed an evaluation cycle, a `NotEnoughDataException` is thrown. This occurrence also has the effect of invalidating the expression during that evaluation cycle: the policy isn't disabled, but it is effectively a non-result when it occurs.

Configuring Log Policies

Use log policies to monitor the occurrence of specific messages or strings in the server or domain log. Policies of this type are triggered as a result of a log message containing the specified data being issued.

When creating a log policy, you can use the log bean in a policy expression to obtain access to data to log message fields. See log for details about the available log bean attributes.

The following example looks for a log message indicating that the server is entering the RUNNING state:

```
  w=cmo.createWatch("ServerLogRunningState")
  w.setExpressionLanguage('EL')
  w.setRuleType('Log')
  w.setRuleExpression("log.messageId == 'BEA-000365' and
log.logMessage.contains('RUNNING')")
```

You can also use java methods and field accessors to access the data in log, since the log bean is a simple JavaBean object. An equivalent policy expression of the above example is:

```
  w=cmo.createWatch("ServerLogRunningState2")
  w.setExpressionLanguage('EL')
  w.setRuleType('Log')
  w.setRuleExpression("log.getMessageId().contains('000365') &&
log.getLogMessage().contains('RUNNING')")
```

> **Note:**
>
> Any log policies that search for the RUNNING state message ID should search for message ID `BEA-000365`, and not `BEA-000360`. The message ID `BEA-000360` is issued immediately before the state change to RUNNING, and `BEA-000365` is issued immediately afterward. WLDF does not start rule evaluation until the server is in the RUNNING state. Therefore, such log policies are able to find only message ID `BEA-000365`.

Configuring Instrumentation Policies

You use instrumentation policies to monitor the events from the WLDF Instrumentation component. Policies of this type are evaluated as a result of an event being posted by the

Instrumentation component, which occurs when code that matches a deployed Instrumentation monitor is exercised.

Instrumentation policy expressions utilize a single bean named `instrumentationEvent`. This bean provides access to the data that is captured in an Instrumentation event. As with Log, DomainLog, and Collected Metrics policies, you can access data in the Instrumentation event using JavaBean conventions in the policy expression. See the set of fields that are accessible on the instrumentationEvent bean.

The following example shows how to access data in an Instrumentation policy using the `instrumentationEvent` bean:

```
instrumentationEvent.payload > 100000000 && instrumentationEvent.monitor ==
'Servlet_Around_Service'
```

This policy triggers when the monitor event is of type “Servlet_Around_Service” and the payload value (in this case, the execution time of the servlet recorded by the Servlet_Around_Service monitor) is greater than 100000000 nanoseconds (100 milliseconds). You can also use java methods and field accessors to access data in `instrumentationEvent`, since the `instrumentationEvent` bean is a simple JavaBean object . An equivalent policy expression of the example above can be given as:

```
instrumentationEvent.getPayload() > 100000000 &&
instrumentationEvent.getMonitor().equals('Servlet_Around_Service')
```

Example 10-1 shows an example configuration for an Instrumentation policy.

Example 10-1 Sample Configuration for an Instrumentation Policy (in DIAG_MODULE.xml)

```
  <watch-notification>
    <watch>
    <name>myInstWatch</name>
    <enabled>true</enabled>
    <rule-type>EventData</rule-type>
    <rule-expression>instrumentationEvent.payload &gt; 100000000 &amp;&amp;
instrumentationEvent.monitor == 'Servlet_Around_Service'</rule-expression>
    <expression-language>EL</expression-language>
    <alarm-type>ManualReset</alarm-type>
    <notification>mySMTPNotification</notification>
  </watch>
  <smtp-notification>
    <name>mySMTPNotification</name>
    <enabled>true</enabled>
    <mail-session-jndi-name>myMailSession</mail-session-jndi-name>
    <subject xsi:nil="true"></subject>
    <body xsi:nil="true"></body>
    <recipient>username@emailservice.com</recipient>
  </smtp-notification>
</watch-notification>
```

Creating Complex Policy Expressions Using WLDF Java EL Extensions

Oracle expects that the library of smart rules packaged with WLDF are sufficient for meeting the needs of creating scheduled policies that evaluate runtime performance data in a server or cluster. However, if you have a specific scheduled policy need that cannot be satisfied by a smart rule, WLDF also provides a set of extensions to Java EL. These extensions are intended

for use in policies that evaluate very specific characteristics or trends in metrics collected from runtime MBean servers in your WebLogic domain.

The contents of this section are targeted to developers who are knowledgeable of complex programming techniques. Experience with Java EL is highly recommended.

Using WLDF Beans and Functions

WLDF leverages Java EL as the language for writing policy expressions. Java EL is a standard, extensible, and robust scripting language. WLDF has adopted and extended Java EL to provide access to WebLogic diagnostic data and events for writing policy expressions. WLDF provides a set of functions and JavaBean objects for writing policy expressions that use the following diagnostic data and events:

- WebLogic Runtime MBean data
- WebLogic Logging events
- WebLogic Instrumentation events

You can utilize all the features available within Java EL in conjunction with these WLDF extensions to write policy expressions. Collected metrics based policies, which are a type of scheduled policy, can use WLDF-provided beans and functions within their policy expressions. These beans are JavaBean objects that can obtain access to common WebLogic Server JMX data sources, such as the following:

- WebLogic Server Runtime MBean Server
- Domain Runtime MBean Server
- JVM platform MBean server

The following sections explain how to configure collected metrics based policies using beans and functions:

- Writing Collected Metrics Policy Expressions Using Beans
- Writing Collected Metrics Policy Expressions Using Functions
- Writing Collected Metrics Policy Expressions Using Beans
- Writing Collected Metrics Policy Expressions Using Functions

Writing Collected Metrics Policy Expressions Using Beans

Table 10-6 summarizes the beans provided by WebLogic Server. For complete reference information about each of these beans, see WLDF Beans Reference.

Table 10-6 Beans Provided by WebLogic Server

Name	Prefix	Scope	Summary
runtime	`wls`	Only available from partition scope diagnostic system module deployments and partitions	Provides access to MBeans in the local WebLogic Server Runtime MBean Server. These MBeans include both the read-only configuration MBean and RuntimeMBean instances.
domainRuntime	`wls`	Administration Server	Provides access to MBeans on the Domain Runtime MBean Server (Administration Server only).
clusterRuntime	`wls`	Administration Server	Provides domain-wide access to cluster member data (Administraton Server only).

Table 10-6 (Cont.) Beans Provided by WebLogic Server

Name	Prefix	Scope	Summary
platform	`wls`	Administration Server or Managed Server	Provides access to the JVM's platform MBean server. Note that in the majority of cases, the `platform` bean is functionally equivalent to the `runtime` bean: WebLogic Server uses the JVM's platform MBean server to contain the WebLogic run-time MBeans by default.
resource	n/a	Administration Server and Managed Servers	Provides access to beans and state information within a diagnostic system module deployment. Access is restricted to policies that are configured within the same diagnostic system module.

- Accessing MBean Data in Collected Metrics
- Working with Complex MBean Attributes
- Performing Bulk Queries on Collected Metrics from MBeans

Accessing MBean Data in Collected Metrics

The beans described in Table 10-6 provide access to WebLogic Server Runtime MBean metrics. In policy expressions that use Java EL, metric data from each of these runtime MBeans is accessed using a WLDF-provided bean using the following syntax:

`wls.`*`bean-name.attribute-or-operation.attribute-or-operation…`*

All EL-based policy expressions that use the WLDF beans must begin with the namespace prefix `wls` . The prefix `wls` is similar to a namespace that contains all the WLDF beans that can be used in the policy expressions. Beans and their attributes and methods are accessed using standard JavaBean conventions. The following example shows a simple policy expression that returns `true` when the value of `HeapFreePercent` attribute of `JVMRuntimeMBean` is less than 20:

```
wls.runtime.serverRuntime.JVMRuntime.heapFreePercent < 20
```

The preceding policy expression example accesses the value of `HeapFreePercent` in the following sequence:

1. The `runtime` bean is accessed from the `wls` bean namespace.

   The `runtime` bean provides an entry point into the metrics collected by the local runtime MBean and also into the read-only configuration MBean data in the WebLogic Server Runtime MBean Server.

2. The `serverRuntime` attribute is accessed from the `runtime` bean.

   The `serverRuntime` attribute of the `runtime` bean corresponds directly to the `ServerRuntimeMBean` instance in the local running server instance wherever the expression is being evaluated.

3. The `JVMRuntime` attribute, which corresponds to the `JVMRuntimeMBean` instance under the local `ServerRuntimeMBean`, is accessed from the `serverRuntime` bean.

4. The `heapFreePercent` attribute is accessed from the returned `JVMRuntime` instance.

From the `runtime` bean, runtime metrics and monitoring data are available through the `serverRuntime` attribute, and the `domain` attribute provides access to the current configuration data in the local read-only DomainMBean tree. This access allows policies to examine the current in-memory configuration within a policy expression.

MBeans that are accessed as bean attributes from the WLDF-provided expression beans have read-only access to most of the attributes and some operations available to the expression as defined in the *MBean Reference for Oracle WebLogic Server*, with some exceptions for security purposes.

> **Note:**
>
> There are slight differences in syntax between JMX and JavaBean conventions when accessing attributes. For example, JavaBean conventions for accessing the JMX attribute `HeapFreePercent` require using “camel-case” syntax. When using JMX, the attribute is accessed by the name `HeapFreePercent`. However, in EL expressions, the same attribute is accessed as `heapFreePercent`.

Working with Complex MBean Attributes

Some MBean attributes return complex objects; for example, the `HealthState` attribute of the `ServerRuntimeMBean`. Such attributes can be accessed using JavaBean conventions. In the following example, the policy expression returns `true` if the health state of the server is a non-zero value:

```
wls.runtime.serverRuntime.healthState.state != 0
```

Working with Array Attributes

Many WLDF bean attributes return arrays of child MBeans. To work with collections, such as arrays, Java EL provides the `stream` operator to convert arrays and lists into stream objects that can be fed into other Java EL and WLDF functions and operators. In the following example, the policy expression examines the state of all `JDBCDataSourceRuntimeMBean` instances in the local server instance, and returns `true` if any of them are in the `Overloaded` state:

```
wls.runtime.serverRuntime.JDBCServiceRuntime.JDBCDataSourceRuntimeMBeans.stream()
.anyMatch(ds -> ds.state == "Overloaded")
```

The policy expression executes in the following sequence:

1. The `JDBCServiceRuntimeMBean` child is accessed from the `ServerRuntimeMBean`.
2. The array attribute `JDBCDataSourceRuntimeMBeans` is accessed from the `JDBCServiceRuntimeMBean`.
3. The Java EL `stream` operator is utilized to convert the array to a stream so that it can be used with WLDF and standard Java EL collection operations.
4. The `anyMatch` collection operation is used to look for the `Overloaded` state on any of the returned `JDBCDataSourceRuntimeMBean` instances.
5. If the `anyMatch` operation matches the `Overloaded` state, returns `true`.

Performing Bulk Queries on Collected Metrics from MBeans

The MBeans defined in Table 10-6 are used in collected metrics policy expressions. All of these beans support a `query` method that allows to perform a query for a set of MBean attribute values against a homogeneous set of MBeans.

The method takes the following syntax:

`query(target-list, object-name-pattern, attribute-expression)`

The `query` method returns an iterable list of values that is obtained using the *`attribute-expression`* on each matching MBean instance.

Table 10-7 Method Parameters

Parameter	Description
`target-list`	This argument is applicable only for `domainRuntime` bean which is available only for policies executing on the Administration Server. The bean supports an overloaded variant that takes an array of targets. It is a list of servers or clusters in the domain. The argument allows the policy expression to examine MBean values across the domain in the same expression.
`object-name-pattern`	This argument takes any valid JMX ObjectName pattern that is specified as a string value enclosed by single quote (') characters. For example: `'com.bea:Type=ServletRuntime,*'`
`attribute-expression`	This argument is a quoted EL subexpression that is used to access an attribute from each of the MBeans matching the object-name-pattern argument. The *`attribute-expression`* argument can be either of the following types: • A simple attribute available on the MBean. • An attribute of a complex type that uses a JavaBean-style expression to access the values within that complex structure. **Note:** It is expected that *`attribute-expression`* ultimately resolves to a single scalar value, and not a complex structure.

The values returned by the `query` method can be used as a part of the larger policy expression that examines those values.

> **Note:**
>
> The intended use of the `query` method is to operate against a homogeneous set of MBean instances, but there is no enforcement mechanism to ensure that the specified MBeans must all be of the same type. Therefore, if you do specify an `object-name-pattern` that encompasses MBeans of different types, errors can result when the policy expression is evaluated.

Example 10-2 Examples of Using the query Method

Table 10-8 lists some examples of using the `query` method in policy expressions.

> **Note:**
>
> The examples show how to use the `query` method and are not complete policy expressions.

Table 10-8 query Method Examples

Example	Description
`wls.runtime.query('com.bea:Type=ServletRuntime,*', 'ExecutionTimeAverage')`	The `query` method is used for all the instances of `ServletRuntimeMBean` in the local server and returns the value of `ExecutionTimeAverage` for each instance in the returned iterable stream.
`wls.domainRuntime.query(['cluster1'], 'com.bea:Type=ThreadPoolRuntime,*', 'PendingUserRequestCount')`	The `domainRuntime` bean is used to query all values of `PendingUserRequestCount` across all instances of `ThreadPoolRuntimeMBean` in the cluster `cluster1`. Any values found are returned in the `Iterable` set returned by the method call.

The use of `query` method in policy expression and the result set are represented in the following illustration:

Figure 10-1 Result Set of query in Policy Expression

The following is a complete example of a policy expression that uses the `query` method to determine whether the `StuckThreadCount` attribute on any `WorkManagerRuntimeMBean` in the local WebLogic Server instance is greater than zero:

```
wls.runtime.query('com.bea:Type=WorkManagerRuntime,*',
'StuckThreadCount').stream().anyMatch( x -> x > 0 )
```

The values of `StuckThreadCount` for all instances of `WorkManagerRuntimeMBean` are queried, and each value is examined to see if it is greater than zero, which indicates a stuck thread in

the server. The `stream` collection operation is part of the Java EL standard, and is used for converting an iterable set into a stream that can be used with Java EL collection operations, such as `anyMatch` in the example.

Writing Collected Metrics Policy Expressions Using Functions

In addition to the bundled functions and collection operations that come with Java EL by default, there are also a set of WLDF-provided functions for use within policy expressions for common operations with metric data and for retaining a set of metrics with history.

The set of WLDF-provided functions includes:

- `wls:tableChanges`
- `wls:tableAverages`
- `wls:extract`
- `wls:average`
- `wls:changes`
- `wls:aliveServersCount`

For complete details about each EL function provided by WLDF, see Functions Reference.

Functions are invoked using the prefix `wls`:

```
wls:<function-call>
```

For example, `wls:aliveServersCount('cluster1')` invokes the `aliveServersCount()` function provided by WLDF for the cluster `cluster1`.

Collection Operations

WLDF also provides a set of collection operations that can be invoked similar to the collection operations provided by Java EL. The set of WLDF-provided collection operations includes:

- `tableAverages`
- `percenMatch`
- `collection`
- `flatten`

- Examining Trends in Metric Values over Time
- Extracting and Examining Collected Metrics in Policy Expressions
- Lifecycle of Data Collection

Examining Trends in Metric Values over Time

You can look for trends in metric data over time instead of assessing the instantaneous values. Use the `wls:extract` function to extract a table of time series from a specified set of input sources, based on a specified sampling rate schedule and time window.

The `extract` function has the following syntax:

```
wls:extract(sources, sampling rate, retention window)
```

The method returns an iterable set that consists of a two dimensional set of results. The metric input to the function comes from multiple MBean instances during the course of a specific interval of time defined by the `retention window` parameter. The resulting data is similar to a table where each row is a set of values from a particular MBean instance over the time window.

Parameters

Table 10-9 Parameters Description for extract() Function

Parameters	Description
`sources`	Set of metric sources, which can be identified as a `query` method or as a quoted Java EL expression.
`sampling rate`	String that identifies the frequency with which data is collected. You can specify this string as hours, minutes, or seconds. The syntax is flexible, allowing you to specify 30 seconds, for example, as “30s”, “30sec”, or “30 seconds”. **Note:** The frequency only applies to the rate of collection of the metric, and is independent of the overall policy evaluation schedule.
`retention window`	String that identifies the retention window over which to observe values from the sources input with syntax identical to the `sampling rate` parameter. It implements the sliding window algorithm in which the oldest data in the set is aged out when the array is full. See retention window.

Example 10-3 Examples of Using the extract Function

Table 10-10 lists example usages of the `extract` function.

> **Note:**
>
> The examples show how to invoke the `extract` function and are not complete policy expressions.

Table 10-10 extract Function Examples

Example	Description
`wls:extract("wls.runtime.serverRuntime.threadPoolRuntime.pendingUserRequestCount", "30s", "2m")`	The `extract` function is invoked with an EL expression as the first argument which observes and collects the values of the `PendingUserRequestCount` attribute on the `ThreadPoolRuntimeMBean` at 30-second intervals and retains them over a period of 2 minutes. In this example, `ThreadPoolRuntimeMBean` is a singleton, and only the local WebLogic Server instance is monitored. Therefore, only a single row of values is returned in the table of values.

Table 10-10 (Cont.) extract Function Examples

Example	Description
`wls:extract(wls.runtime.query("com.bea:Type=ThreadPoolRuntime,*", "PendingUserRequestCount"), "30s", "2m")`	The `extract` function is used with the result of a `query` method invocation as input.
`wls:extract(wls.domainRuntime.query(['cluster1'], 'com.bea:Type=ThreadPoolRuntime,*', 'PendingUserRequestCount'), '30s', '2m')`	The `extract` function is used with the `query` method of the `domainRuntime` bean to collect the value of `PendingUserRequestCount` attribute on all `ThreadPoolRuntimeMBean` instances on every server in `cluster1`. The result set for this call consists of a row of values for each `ThreadPoolRuntimeMBean` instance in each active server instance in `cluster1` .

Extracting and Examining Collected Metrics in Policy Expressions

The `extract` function returns a table of scalar values. You can use any collection operation to examine or manipulate the result set. WLDF provides more collection operations that are intended for use with the data returned from `extract` function, such as `tableAverages`, `percentMatch`, `collection`, and `flatten`.

Operations	Description
`tableAverages`	Computes the average value for each row in the table.
`percentMatch`	Examines all the computed averages from `tableAverages`.
`collection`	Returns the two dimensional set of values in tabular form, which can be then converted to Java EL collection stream using the `stream` operator and can be directly manipulated in other Java EL collection operators.
`flatten`	Converts the two dimensional set of values returned by `extract` function into a linear collection of values.

The result of `extract` can then be fed into other functions or operations as part of an overall policy expression.

In the following example of a policy expression, the `extract` function collects the value for the `PendingUserRequestCount` attribute across the servers in `cluster1`. The result is combined with the `tableAverages` and `percentMatch` collection operations to produce a boolean value.

```
wls:extract(wls.domainRuntime.query({'cluster1'},
'com.bea:Type=ThreadPoolRuntime,*', 'PendingUserRequestCount'), '30s',
'2m').tableAverages().stream().percentMatch(pendingCount -> pendingCount > 100) >
0.75
```

This policy expression returns `true` when the average value of the attribute `PendingUserRequestCount` over the 2-minutes window is greater than 100 on 75% of the servers in `cluster1`. The policy expression executes in the following sequence:

1. The `extract` function creates a table of values for the attribute `PendingUserRequestCount`, where each row is one set of values from a server in `cluster1` over a 2-minutes window.

2. The `tableAverages` operation computes the average value over the 2-minutes window for each row in the table returned by the `extract` function.
3. `stream` is a standard Java EL collection operation used to convert the vector result of `tableAverages` to a Java EL stream.
4. The `percentMatch` operation examines all the computed averages from `tableAverages`, and computes the percentage of values in that set that are greater than 100.
5. The result of `percentMatch` is a value between 0 and 1 and is compared with 0.75, the desired threshold.

Lifecycle of Data Collection

The `extract` function extracts data from a specified input source over a defined period of time. When the `extract` function is first encountered in an expression by the WLDF policy engine, it starts the collection of the desired metrics indicated in the policy expression. Samples are collected by the policy engine until the policy using the `extract` function is disabled or undeployed.

Policy expressions that use the `extract` function is not evaluated until enough data has been collected for the desired metrics to satisfy the sliding window interval specified in the invocation. If the function invocation specifies that a 5-minutes window of data is required, then 5 minutes of data collection must take place from the moment the policy is deployed before the expression can be successfully evaluated.

In the following example, the expression does not evaluate until 2 minutes of data for the `PendingUserRequestCount` attribute is collected.

```
wls:extract(wls.runtime.query("com.bea:Type=ThreadPoolRuntime,*",
"PendingUserRequestCount"), "30s", "2m")
```

11

Configuring Actions

The WebLogic Diagnostics Framework (WLDF) provides several types of actions that can be executed when a policy evaluates to `true`, such as triggering an elastic scaling action, sending a JMS notification, executing an external command line script, and more.

- Actions Overview
  An action is an operation that is executed when a policy expression evaluates to true. WLDF supports different types of action based on the delivery mechanism of the notification.
- Configuring JMX Actions
  WLDF issues JMX events when an associated policy is triggered for each defined JMX action. You can configure the JMX action to receive all the JMX notification and filter the output as required.
- Configuring JMS Actions
  You can configure JMS actions to send JMS notifications through the JMS topics or queues when the corresponding policy is triggered. You can define how the notification must be delivered such as defining the destination and the connection factory.
- Configuring SNMP Actions
- Configuring Log Actions
  You can create a log action to send a customized message to the server log.
- Configuring REST Actions
  You can use a REST action to send a notification to a REST endpoint that includes a customized message in the notification payload. You can configure the REST endpoint invocation for no authentication or basic authentication.
- Configuring SMTP Actions
  Simple Mail Transfer Protocol (SMTP) actions are used to send messages (e-mail) over the SMTP protocol in response to the triggering of an associated policy. You provide a list of recipients to whom the message is distributed through the configured SMTP session.
- Configuring Image Actions
  An image action causes a diagnostic image to be generated in response to the triggering of an associated policy. You can configure two options for image actions: a directory and a lockout period.
- Configuring Elastic Actions
  WLDF provides scale up and scale down elastic actions that can be performed on dynamic clusters.
- Configuring Script Actions
  You can use the script action to execute an external command-line script. The script can be written in any scripting language.
- Configuring Heap Dump Actions
  You can use a heap dump action to capture heap dumps when certain runtime conditions, defined by a policy expression, are met. Each heap dump is produced in HPROF format, which you can analyze with tools such as the `jmap` utility, which is available in the JDK.

- Configuring Thread Dump Actions
  You can use a thread dump action to capture a specific number of thread dumps, separated by configured time interval, when the runtime conditions that are specified in a corresponding policy are met. Each thread dump file is produced in an individual text file.

Actions Overview

An action is an operation that is executed when a policy expression evaluates to true. WLDF supports different types of action based on the delivery mechanism of the notification.

Topics

The following sections contain background information pertaining to WLDF actions:

- Types of Actions
- Variables for Customizable Actions
- Action Timeout

Types of Actions

WLDF supports the following types of diagnostic actions, based on the delivery mechanism:

- Java Management Extensions (JMX)
- Java Message Service (JMS)
- Simple Network Management Protocol (SNMP)
- Simple Mail Transfer Protocol (SMTP)
- Diagnostic image capture
- Elasticity framework
- REST
- WebLogic logging system
- WebLogic Scripting Tool (WLST)
- Heap dump
- Thread dump

In the configuration file for a diagnostic module, the different types of actions are identified by the following elements in the `config.xml` file for the domain:

- <jmx-notification>
- <jms-notification>
- <snmp-notification>
- <smtp-notification>
- <image-notification>
- <scale-up-action>
- <scale-down-action>
- <rest-notification>
- <log-action>

- <script-action>
- <heap-dump-action>
- <thread-dump-action>

These action types all have <name> and <enabled> configuration options. The value of <name> is used as the value in a <notification> element for a policy, to map the policy to its corresponding action. The <enabled> element, when set to true, enables that action. In other words, the action is executed when an associated policy evaluates to true. Other than <name> and <enabled>, each action type is unique.

Variables for Customizable Actions

The log, SMTP, and REST action types support the generation of customized strings that contain one or more of the variables listed in this topic.

When a triggered policy invokes one of these action types, each variable used in the customized string that is generated by the action is replaced with the value shown in the following table.

Table 11-1 Substitution Variables

Variable Name	Value
`WatchName`	Name of policy that corresponds to the action
`WatchRuleType`	Policy type (for example, `Harvester`, `Log`, or `EventData`)
`WatchRule`	Policy expression
`WatchTime`	Timestamp identifying when the corresponding policy was triggered
`WatchSeverityLevel`	Policy severity option
`WatchData`	Log message
`WatchAlarmType`	Specifies the policy alarm type, which can be `None`, `AutomaticReset`, or `ManualReset`.
`WatchAlarmResetPeriod`	Alarm reset period configured on the `WLDFWatchNotificationRuntimeMBean`.
`WatchDomainName`	WebLogic domain name
`WatchServerName`	Server instance name

Log, REST, and SMTP actions send different types of messages when executed. Each of these actions, while different, has one or more properties that support the use of one or more of the variables defined in . For example, an SMTP message body can be specified as follows to include the policy name, expression, and timestamp indicating when the policy was triggered:

```
"Test ${WatchName} with policy ${WatchRule} fired at ${WatchTime}."
```

For more information about using these substitution variables, see:

- Configuring Log Actions
- Configuring REST Actions
- Configuring SMTP Actions

Action Timeout

All WLDF actions support a timeout, which determines the time, in seconds, for the action to complete execution. By default, the timeout is 0, which disables the action timeout.

You can specify the action timeout using the `WLDFNotificationBean.Timeout` attribute.

See the following topics to set the timeout when configuring an action:

- Configure an action in *Administering Oracle WebLogic Server with Fusion Middleware Control*

Configuring JMX Actions

WLDF issues JMX events when an associated policy is triggered for each defined JMX action. You can configure the JMX action to receive all the JMX notification and filter the output as required.

For each defined JMX action, WLDF issues JMX events (notifications) whenever an associated policy is triggered. Applications can register an action listener with the server's `WLDFWatchNotificationSourceRuntimeMBean` to receive all JMX notifications and filter the provided output. You can also specify a JMX "notification type" string that a JMX client can use as a filter.

Example 11-1 shows an example of a JMX action configuration.

Example 11-1 Example Configuration for a JMX Action

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <watch-notification>
    <!-- One or more policy configurations -->
    <jmx-notification>
      <name>myJMXNotif</name>
      <enabled>true</enabled>
    </jmx-notification>
    <!-- Other action configurations -->
  </watch-notification>
</wldf-resource>
```

Here is an example of a JMX action:

```
 Notification name:    myjmx called. Count= 42.
 Watch severity:         Notice
 Watch time:             Jul 19, 2005 3:40:38 PM EDT
 Watch ServerName:       myserver
 Watch RuleType:         Harvester
 Watch Rule:               ${com.bea:Name=myserver,Type=ServerRuntime//
OpenSocketsCurrentCount} > 1
 Watch Name:             mywatch
 Watch DomainName:       mydomain
 Watch AlarmType:        None
 Watch AlarmResetPeriod: 10000
```

Configuring JMS Actions

You can configure JMS actions to send JMS notifications through the JMS topics or queues when the corresponding policy is triggered. You can define how the notification must be delivered such as defining the destination and the connection factory.

In the system resource configuration file, the elements `<destination-jndi-name>` and `<connection-factory-jndi-name>` define how the notification is to be delivered.

Example 11-2 shows two JMS actions that cause JMS notifications to be sent through the provided topics and queues using the specified connection factory. For this to work properly, JMS must be properly configured in the `config.xml` configuration file for the domain, and the JMS resource must be targeted to this server.

Example 11-2 Example JMS Actions

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <watch-notification>
    <!-- One or more policy configurations -->
    <jms-notification>
      <name>myJMSTopicNotif</name>
      <destination-jndi-name>MyJMSTopic</destination-jndi-name>
      <connection-factory-jndi-name>weblogic.jms.ConnectionFactory
           </connection-factory-jndi-name>
    </jms-notification>
    <jms-notification>
      <name>myJMSQueueNotif</name>
      <destination-jndi-name>MyJMSQueue</destination-jndi-name>
      <connection-factory-jndi-name>weblogic.jms.ConnectionFactory
          </connection-factory-jndi-name>
    </jms-notification>
    <!-- Other action configurations -->
  </watch-notification>
</wldf-resource>
```

The content of the action message gives details of the policy and action.

Configuring SNMP Actions

Simple Network Management Protocol (SNMP) actions are used to post SNMP traps when an associated policy is triggered. Provide the action name to define an SNMP action.To define an SNMP action, provide the action name as shown in Example 11-3. Generated traps contain the names of both the policy and action that caused the trap to be generated. For an SNMP trap to work properly, SNMP must be properly configured in the `config.xml` configuration file for the domain.

Example 11-3 An Example Configuration for an SNMP Action

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <watch-notification>
    <!-- One or more policy configurations -->
```

```
    <snmp-notification>
      <name>mySNMPNotif</name>
    </snmp-notification>
    <!-- Other action configurations -->
  </watch-notification>
</wldf-resource>
```

The trap resulting from the SNMP action configuration shown in Example 11-3 is of type 85. It contains the following values (configured values are shown in angle brackets "<>"):

```
.1.3.6.1.4.1.140.625.100.5   timestamp (e.g. Dec 9, 2004 6:46:37 PM EST
.1.3.6.1.4.1.140.625.100.145  domainName (e.g. mydomain")
.1.3.6.1.4.1.140.625.100.10   serverName (e.g. myserver)
.1.3.6.1.4.1.140.625.100.120  <severity> (e.g. Notice)
.1.3.6.1.4.1.140.625.100.105  <name> [of watch] (e.g.
      simpleWebLogicMBeanWatchRepeatingAfterWait)
.1.3.6.1.4.1.140.625.100.110  <rule-type> (e.g. HarvesterRule)
.1.3.6.1.4.1.140.625.100.115  <rule-expression>
.1.3.6.1.4.1.140.625.100.125  values which caused rule to
    fire (e.g..State =
    null,weblogic.management.runtime.WLDFHarvesterRuntimeMBean.
    TotalSamplingTime = 886,.Enabled =
    null,weblogic.management.runtime.ServerRuntimeMBean.
   OpenSocketsCurrentCount = 1,)
.1.3.6.1.4.1.140.625.100.130  <alarm-type> (e.g. None)
.1.3.6.1.4.1.140.625.100.135  <alarm-reset-period> (e.g. 10000)
.1.3.6.1.4.1.140.625.100.140  <name> [of notification]
                               (e.g.mySNMPNotif)
```

Configuring Log Actions

You can create a log action to send a customized message to the server log.

The customized message can optionally include any of the variables described in Variables for Customizable Actions. The following WLST example shows the configuration of a log action:

```
wn=res.getWatchNotification()

actionName="myaction"
action = wn.lookupLogAction(actionName);
if action is None:
  action = wn.createScriptAction(actionName);
action.setMessage("Message with substitution on server ${WatchServerName} in domain $
{WatchDomainName}");
action.setSubsystemName("SpecialLogAction);
action.setSeverity("Info");
```

When the preceding log action is executed, the custom message, shown in **bold**, uses variables to identify:

- The WebLogic Server instance name, represented by the `${WatchServerName}` variable
- The WebLogic domain name, represented by the variable `${WatchDomainName}`

Configuring REST Actions

You can use a REST action to send a notification to a REST endpoint that includes a customized message in the notification payload. You can configure the REST endpoint invocation for no authentication or basic authentication.

When configuring a REST action, you can create a customized set of notification properties that can optionally use any of the variables described in Variables for Customizable Actions. For example, the following WLST example shows the configuration of a REST action that sends a customized message:

```
wn = res.getWatchNotification();

#No Auth REST invocation
rest1 = wn.createRESTNotification('r1')
rest1.setEndpointURL("http://localhost:7001/rest-no-auth/resources/watch-listener")
customNotif = java.util.Properties()
customNotif.put('message','Policy ${WatchName} with rule ${WatchRule} fired.')
rest1.setCustomNotificationProperties(customNotif)
rest1.setEnabled(true)

#Basic Auth REST invocation
rest2 = wn.createRESTNotification('r2')
rest2.setEndpointURL("http://localhost:7001/rest-basic-auth/resources/watch-listener")
rest2.setHttpAuthenticationMode('Basic')
rest2.setHttpAuthenticationUserName('restuser1')
rest2.setHttpAuthenticationPassword('restuser1')
rest2.setEnabled(true)
```

When the preceding REST action is executed, the REST endpoint is invoked with a message, shown in **bold**, that identifies:

- The name of the triggered policy that executed the corresponding REST action, represented by the `${WatchName}` variable
- The policy expression, represented by the `${WatchRule}` variable

Configuring SMTP Actions

Simple Mail Transfer Protocol (SMTP) actions are used to send messages (e-mail) over the SMTP protocol in response to the triggering of an associated policy. You provide a list of recipients to whom the message is distributed through the configured SMTP session.

To define an SMTP action, first configure the SMTP session. That configuration is persisted in the `config.xml` configuration file for the domain. In *`DIAG_MODULE`*`.xml`, you provide the configured SMTP session using subelement `<mail-session-jndi-name>`, and provide a list of at least one recipient using subelement `<recipients>`. An optional subject and/or body can be provided using subelements <subject> and <body> respectively. If these are not provided, they will be defaulted.

Example 11-4 shows an SMTP action that causes an SMTP (e-mail) message to be distributed through the configured SMTP session, to the configured recipients. In this action configuration, a custom subject and body are provided. If a subject or body are not specified, defaults are provided, showing details of the policy and action.

Example 11-4 Sample Configuration for SMTP Action (in DIAG_MODULE.xml)

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <watch-notification>
    <!-- One or more policy configurations -->
    <smtp-notification>
      <name>mySMTPNotif</name>
```

```
      <mail-session-jndi-name>MyMailSession</mail-session-jndi-name>
      <subject>Critical Problem!</subject>
      <body>A system issue occurred. Call Winston ASAP.
           Reference number 81767366662AG-USA23.</body>
      <recipients>administrator@myCompany.com</recipients>
    </smtp-notification>
    <!-- Other action configurations -->
  </watch-notification>
</wldf-resource>
```

The content of the action message gives details of the policy and action.

WLDF also supports customizing the subject and body elements in the sent email by using any of the variables described in Variables for Customizable Actions.

The following WLST example shows the configuration of an SMTP action that contains customized subject and body text. The subject and body of the message utilize variables to specify the policy name and the timestamp indicating when the policy was triggered:

```
smtp=wn.lookupSMTPNotification('smtp1')
if smtp is None:
  smtp=wn.createSMTPNotification('smtp1')

smtp.setMailSessionJNDIName('test.MailSession')
smtp.setSubject("WatchRule ${WatchName} alert")
smtp.setBody("Test ${WatchName} with rule ${WatchRule} fired at ${WatchTime}.")
smtp.setRecipients(["john.smith@example.com"])
```

When the preceding SMTP action is executed, an email is generated with a custom subject and body, shown in bold, that identifies:

- The name of the policy that executed the SMTP action, represented by the variable `${WatchName}`. This variable is used in both the subject and body.
- The policy expression, represented by the `${WatchRule}` variable
- The timestamp identifying when the corresponding policy was triggered, represented by the ${WatchTime} variable

Configuring Image Actions

An image action causes a diagnostic image to be generated in response to the triggering of an associated policy. You can configure two options for image actions: a directory and a lockout period.

The directory name indicates where the images will be generated. The lockout period determines the number of seconds that must elapse before a new image can be generated after the last one. This is useful for limiting the number of images that will be generated when there is a sequence of server failures and recoveries.

You can specify the directory name relative to the *DOMAIN_HOME*`\servers\`*SERVER_NAME*. The default directory is *DOMAIN_HOME*`\servers\`*SERVER_NAME*`\logs\diagnostic-images`.

Image file names are generated using the current timestamp (for example, `diagnostic_image_myserver_2005_08_09_13_40_34.zip`), so an action can execute many times, resulting in a separate image file each time.

The configuration is persisted in the *DIAG_MODULE*.xml configuration file. Example 11-5 shows an image action configuration that specifies that the lockout time will be two minutes and that the image will be generated to the *DOMAIN_HOME*\servers*SERVER_NAME*\images directory.

Example 11-5 Sample Configuration for Image Action (in DIAG_MODULE.xml)

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <watch-notification>
    <!-- One or more policy configurations -->
    <image-notification>
      <name>myImageNotif</name>
      <enabled>true</enabled>
      <image-lockout>2</image-lockout>
      <image-directory>images</image-directory>
    </image-notification>
    <!-- Other action configurations -->
  </watch-notification>
</wldf-resource>
```

For more information about Diagnostic Images, see Configuring and Capturing Diagnostic Images.

Configuring Elastic Actions

WLDF provides scale up and scale down elastic actions that can be performed on dynamic clusters.

- scale up — Configured using the `WLDFScaleUpActionBean`
- scale down — Configured using the `WLDFScaleDownActionBean`

Each action bean has the following configuration attributes:

- `clusterName` — The name of the dynamic cluster that needs to be scaled
- `scalingSize` — The number of Managed Server instances by which the dynamic cluster needs to be scaled up or down

The scale up and scale down actions attempt to scale the dynamic cluster specified by the `clusterName` parameter, by the number of servers specified as the `scalingSize` value. WLDF interacts with the elasticity framework to scale the dynamic cluster accordingly.

> **Note:**
>
> Note the following:
>
> - To configure automated elasticity for a dynamic cluster, you must create a domain-scope diagnostic system module in which you define the scaling policy, along with its corresponding elastic action, and then target that diagnostic module to the Administration Server.
> - After a scale up or scale down action has been invoked, the scaling action can't be subsequently cancelled.

The following WLST snippet shows the commands for configuring a scale up action. In this example, the dynamic cluster `myCluster` is scaled up by one Managed Server instance:

```
wn=res.getWatchNotification()

scaleUp=wn.lookupScaleUpAction('scaleUp')
if scaleUp == None:
  print "Creating scale up action"
  scaleUp=wn.createScaleUpAction('scaleUp')
scaleUp.setScalingSize(1)
scaleUp.setClusterName(myCluster)
```

The following example shows the WLST commands for configuring a scale down action on `myCluster`:

```
wn=res.getWatchNotification()

scaleDown=wn.lookupScaleDownAction('scaleDown')
if scaleDown == None:
  print "Creating scale down action"
  scaleDown=wn.createScaleDownAction('scaleDown')
scaleDown.setScalingSize(1)
scaleDown.setClusterName(myCluster)
```

For complete details about using these elastic actions, see:

- Elastic Actions in *Configuring Elasticity in Dynamic Clusters for Oracle WebLogic Server*
- Expanding or Reducing Dynamic Clusters in *Administering Clusters for Oracle WebLogic Server*
- Elastic Scaling Operations Cannot Be Cancelled After Starting
  Note that the moment a scaling operation has begun, regardless of whether it is a scale up or scale down operation, it cannot be cancelled. If you configure automated elasticity in a dynamic cluster, such as with calendar-based or policy-based scaling, the elasticity framework does not provide the means to cancel a scaling operation after it has been initiated.
- Limiting Server Shutdown Time During Scale Down Operations
  Shutting down servers during a scale down operation can take a significant amount of time, especially if there are unreplicated sessions. Until unreplicated sessions time out, which can potentially be a long time, the server will not be shut down.

Elastic Scaling Operations Cannot Be Cancelled After Starting

Note that the moment a scaling operation has begun, regardless of whether it is a scale up or scale down operation, it cannot be cancelled. If you configure automated elasticity in a dynamic cluster, such as with calendar-based or policy-based scaling, the elasticity framework does not provide the means to cancel a scaling operation after it has been initiated.

Consequently, if a postprocessor script (invoked by a script interceptor) fails, the parts of the scaling operation that were completed can't be reverted. For more information about script interceptors and postprocessor scripts, see Configuring the Script Interceptor in *Configuring Elasticity in Dynamic Clusters for Oracle WebLogic Server*.

Limiting Server Shutdown Time During Scale Down Operations

Shutting down servers during a scale down operation can take a significant amount of time, especially if there are unreplicated sessions. Until unreplicated sessions time out, which can potentially be a long time, the server will not be shut down.

To limit the length of time required to complete a scale down operation, you can configure the following attributes on the DynamicServersMBean:

Attribute	Description
DynamicClusterShutdownTimeoutSeconds	Timeout period, in seconds, to use while gracefully shutting down a dynamic server instance. If the dynamic server instance does not shut down before the specified timeout period, then it will be forcibly shut down. The default value is 0.
IgnoreSessionsDuringShutdown	Specifies whether to ignore inflight HTTP requests while shutting down dynamic server instances.
WaitForAllSessionsDuringShutdown	Specifies whether to wait for all persisted and nonpersisted inflight HTTP sessions to complete before shutting down dynamic server instances.

By specifying a timeout or ignoring inflight HTTP sessions during shutdown, the shutdown time can be limited. However, note that remaining inflight HTTP sessions may be lost.

Configuring Script Actions

You can use the script action to execute an external command-line script. The script can be written in any scripting language.

To set the execution environment in which the script is run, you can configure the following attributes of the WLDFScriptActionBean:

- PathToScript — The full path to the script, which must be located in the *DOMAIN_HOME*/bin/scripts directory
- WorkingDirectory — The directory from which the WebLogic Server process was run, which is typically the domain root directory.
- Environment — A map of environment variables to set for the child process
- Parameters — An array of parameters or command options to pass to the script
- Timeout — The time, in seconds, for the script action to complete execution. By default, the timeout is 0, which disables the script action timeout.

When the script action is executed by a triggered policy, WLDF invokes the configured script, which is run with the identity of the configured script. The script process executes as a child process of the WebLogic Server process that spawned it. Therefore, the script process has the same operating system identity as the WebLogic Server process; however, it does not inherit any of the parent process environment.

The following example shows configuring a script action using WLST:

```
wn=res.getWatchNotification()

actionName="myaction"
action = wn.lookupScriptAction(actionName);
if action is None:
  action = wn.createScriptAction(actionName);

action.setWorkingDirectory("somedir");
action.setPathToScript("myScript.sh");
action.setParameters(["param1", "param2"]);
action.setTimeout(300);
```

Configuring Heap Dump Actions

You can use a heap dump action to capture heap dumps when certain runtime conditions, defined by a policy expression, are met. Each heap dump is produced in HPROF format, which you can analyze with tools such as the `jmap` utility, which is available in the JDK.

You create a heap dump action by configuring the `WLDFHeapDumpActionBean` and the `WLDFServerDiagnosticMBean` in a domain scope diagnostic system module – that is, a diagnostic system modules that is deployed in the domain partition. When configuring a heap dump action, you can specify the following:

- Whether or not to include only objects that can be referenced (that is, not garbage-collected, or awaiting garbage collection), which you specify in the `LiveSetOnly` attribute of the `WLDFHeapDumpActionBean`. The default value is `true`.
- The location each server's diagnostic dumps directory where the heap dumps are stored. You can specify this directory in the `DiagnosticDumpsDir` attribute of the `WLDFServerDiagnosticMBean`.
- The number of heap dump files that are retained, which prevents filling up the file system with generated heap dumps. You can specify the number in the `MaxHeapDumpCount` attribute of the `WLDFServerDiagnosticMBean`. The default value is `8`.

The generated heap dump files are named using the following syntax:

```
HeapDump_$SERVER_$MODULE_$POLICY_$ACTION_$timestamp.hprof
```

In the preceding syntax:

- `$SERVER` represents the name of the WebLogic Server instance that generated the heap dump.
- `$MODULE` represents the name of the diagnostics system module that contains the action configuration.
- `$POLICY` represents the name of the policy that executed the heap dump action.
- `$ACTION` represents the name of the `WLDFHeapDumpActionBean`.
- `$timestamp` represents time when the heap dump was generated, which takes the form of *`yyyy_mm_dd_HH_MM_SS`*.

> **Note:**
>
> Note the following:
>
> - Heap dumps may contain sensitive information. Therefore, make sure that you place appropriate access protections on the directories into which heap dumps are generated.
> - If a heap dump action is in progress, an attempt by another heap dump action to generate a heap dump is rejected and a message is generated in the server log.

The `jmap` utility is described in the Java SE 8 documentation, available at `http://docs.oracle.com/javase/8/`.

Example 11-6 An Example Configuration for a Heap Dump Action

The following WLST example shows the configuration of a heap dump action:

```
# Start an edit session in edit tree
edit()
startEdit()
cd("/")

if cmo.lookupWLDFSystemResource("mywldf") == None:
  print "Creating WLDF resource"
  cmo.createWLDFSystemResource("mywldf")

cd("/WLDFSystemResources/mywldf/WLDFResource/mywldf/WatchNotification/mywldf")

# Create a heap dump action
cmo.createHeapDumpAction('myHeapDump')
cd("HeapDumpActions/myHeapDump")
# Set it to capture a full heap, not just the live setLiveSetOnly - default is "true"
cmo.setLiveSetOnly(false)

save()
activate()
```

Configuring Thread Dump Actions

You can use a thread dump action to capture a specific number of thread dumps, separated by configured time interval, when the runtime conditions that are specified in a corresponding policy are met. Each thread dump file is produced in an individual text file.

You create a thread dump action by configuring the `WLDFThreadDumpActionBean` and the `WLDFServerDiagnosticMBean` in a domain scope diagnostic system module – that is, a diagnostic system modules that is deployed in the domain partition. When configuring a thread dump action, you specify the following:

- The number of thread dumps to be captured, which you specify in the `ThreadDumpCount` attribute of the `WLDFThreadDumpActionBean`. The default value is `3`.
- The interval between successive thread dumps, which you specify in the `ThreadDumpDelaySeconds` attribute of the `WLDFThreadDumpActionBean`. The default value is 10 seconds.
- The location each server's diagnostic dumps directory where the thread dumps are stored, which you can specify with the `DiagnosticDumpsDir` attribute of the `WLDFServerDiagnosticMBean`.
- The number of thread dump files that are retained, which prevents filling up the file system with generated thread dumps. You specify the number using the `MaxThreadDumpCount` attribute of the `WLDFServerDiagnosticMBean`. The default value is 100.

The generated thread dump files are named using the following syntax:

```
HeapDump_$SERVER_$MODULE_$POLICY_$ACTION_$timestamp.hprof
```

In the preceding syntax:

- `$SERVER` represents the name of the WebLogic Server instance that generated the thread dump.
- `$MODULE` represents the name of the diagnostics system module that contains the action configuration.

- `$POLICY` represents the name of the policy that executed the thread dump action.
- `$ACTION` represents the name of the `WLDFThreadDumpActionBean`.
- `$timestamp` represents time when the thread dump was generated, which takes the form of *`yyyy_mm_dd_HH_MM_SS`*.

> **Note:**
>
> - Thread dumps may contain sensitive information. Therefore, make sure that you place appropriate access protections on the directories into which thread dumps are generated.
> - If a thread dump action is in progress, an attempt by another thread dump action to generate a thread dump is rejected and a message is generated in the server log.

Example 11-7 An Example Configuration for a Thread Dump Action

The following WLST example shows the configuration of a thread dump action:

```
# Start an edit session in edit tree
edit()
startEdit()
cd("/")

if cmo.lookupWLDFSystemResource("mywldf") == None:
  print "Creating WLDF resource"
  cmo.createWLDFSystemResource("mywldf")

cd("WLDFSystemResources/mywldf/WLDFResource/mywldf/WatchNotification/mywldf")

# Create a Thread Dump action
cmo.createThreadDumpAction('myThreadDump')
cd("ThreadDumpActions/myThreadDump")

# set it to capture 5 dumps at 30 second intervals
cmo.setThreadDumpCount(5)
cmo.setThreadDumpDelaySeconds(30)

save()
activate()
```

12

Configuring Instrumentation

The Instrumentation component of the WebLogic Diagnostics Framework (WLDF) provides a mechanism for adding diagnostic code to WebLogic Server instances and the applications running on them.The key features provided by WLDF Instrumentation are:

- **Diagnostic monitors**

  A *diagnostic monitor* is a dynamically manageable unit of diagnostic code that is inserted into server or application code at specific locations. You define monitors by scope (system or application) and type (standard, delegating, or custom).

- **Diagnostic actions**

  A *diagnostic action* is the action a monitor takes when it is triggered during program execution.

- **Diagnostic context**

  A *diagnostic context* is contextual information, such as unique request identifier and flags that indicate the presence of certain request properties such as originating IP address or user identity. The diagnostic context provides a means for tracking program execution and for controlling when monitors trigger their diagnostic actions. See Configuring the DyeInjection Monitor to Manage Diagnostic Contexts.

WLDF provides a library of predefined diagnostic monitors and actions. You can also create application-scoped custom monitors in which you control the locations in the application where diagnostic code is inserted.

The following sections introduce the Instrumentation components and explain how to configure them and also the different kinds of diagnostic monitors and actions:

- Concepts and Terminology
  Learn a comprehensive list of common terms and some basic concepts that apply to the Instrumentation component of WLDF.
- Instrumentation Configuration Files
  Instrumentation is configured as part of a diagnostics descriptor, which is an XML configuration file whose name and location depend on whether you are implementing system-level (server-scoped) or application-level (application-scoped) instrumentation.
- XML Elements Used for Instrumentation
  You can configure instrumentation and diagnostic monitors using the XML elements such as `<Instrumentation>` and `<wldf-instrumentation-monitor>`.
- Configuring Server-Scoped Instrumentation
  You can configure instrumentation as part of diagnostic descriptor file to implement the system-level instrumentation. You can define the configuration of one or more server-scope diagnostic monitors in the descriptor file.
- Configuring Application-Scoped Instrumentation
  Instrumentation is the only component that is deployable to applications. It must be enabled on the server to which the application is deployed. You can enable and disable diagnostic monitors without redeploying an application.

Concepts and Terminology

Learn a comprehensive list of common terms and some basic concepts that apply to the Instrumentation component of WLDF.

Instrumentation Scope

You can provide instrumentation services at the system level (servers and clusters) and at the application level. Many concepts, services, configuration options, and implementation features are the same for both levels. However, there are differences, which are discussed throughout this document. The term **server-scoped instrumentation** refers to instrumentation configuration and features specific to WebLogic Server instances and clusters. By contrast, **application-scoped instrumentation** refers to configuration and features specific to applications deployed on WebLogic Server instances. The scope is built in to each diagnostic monitor; you cannot modify a monitor's scope.

Configuration and Deployment

Server-scoped instrumentation for a server or cluster is configured and deployed as part of a diagnostic module, an XML configuration file located in the *DOMAIN_HOME*`/config/diagnostics` directory, and linked from `config.xml`.

Application-scoped instrumentation is also configured and deployed as a diagnostics module, in this case an XML configuration file named `weblogic-diagnostics.xml`, which is packaged with the application archive in the *ARCHIVE_PATH*`/META-INF` directory for the deployed application.

Joinpoints, Pointcuts, and Diagnostic Locations

Instrumentation code is inserted (or **woven**) into server and application code at precise locations. The following terms are used to describe these locations:

- A **joinpoint** is a specific location in a class; for example, the entry point, or exit point, or both, of a method or a call site within a method.
- A **pointcut** is an expression that specifies a set of joinpoints, for example all methods related to scheduling, starting, and executing work items. The XML element that specifies a pointcut is <pointcut>. Pointcuts are described in Defining Pointcuts for Custom Monitors.
- A **diagnostic location** is the position relative to a joinpoint where the diagnostic activity will take place. Diagnostic locations are **Before**, **After**, and **Around**. The XML element that identifies a diagnostic location is <location-type>.

Diagnostic Monitor Types

A diagnostic monitor is categorized by its scope and its type. The scope is either server-scoped or application-scoped. The type is determined by the monitor's pointcut, diagnostic location, and actions. For example, Servlet_Around_Service is an application-scoped delegating monitor that can be used to trigger diagnostic actions at the entry to and exit from specific servlet and JSP methods.

There are three types of diagnostic monitors:

- A **standard monitor** performs specific, predefined diagnostic actions at specific, predefined pointcuts and locations. These actions, pointcuts, and locations are hard-coded in the monitor. You can enable or disable the monitor, but you cannot modify its behavior.

  The only standard server-scoped monitor is the DyeInjection monitor, which you can use to create diagnostic context and to configure dye injection at the server level. See Configuring the DyeInjection Monitor to Manage Diagnostic Contexts.

  The only standard application-scoped monitor is HttpSessionDebug, which you can use to inspect an HTTP Session object.

- A **delegating monitor** has its scope, pointcuts, and locations hard-coded in the monitor, but you select the actions that the monitor performs. That is, the monitor delegates its actions to the ones you select. Delegating monitors are either server-scoped or application-scoped.

  A delegating monitor by itself is incomplete. To have a delegating monitor perform useful work, you must assign at least one action to it.

  Not all actions are compatible with all monitors.

  If you configure a delegating monitor using WLST or by editing a descriptor file manually, you must make sure that the actions are compatible with that monitor. WLDF validates a delegating monitor when its XML configuration file is loaded at deployment time.

  See WLDF Instrumentation Library, for a list of the delegating monitors and actions provided by the WLDF Instrumentation Library.

- A **custom monitor** is a special case of delegating monitor that:
  - Is available only for application-scoped instrumentation
  - Does not have a predefined pointcut or location

  To configure a custom monitor, you assign it a name, define the pointcut and the diagnostics location that the monitor uses, and assign actions from the set of predefined diagnostic actions. The <pointcut> and <location type> elements are mandatory for a custom monitor.

Table 12-1 summarizes the differences among the types of monitors.

Table 12-1 Diagnostic Monitor Types

Monitor Type	Scope	Pointcut	Location	Action
Standard monitor	Server	Fixed	Fixed	Fixed
Delegating monitor	Server or Application	Fixed	Fixed	Configurable
Custom monitor	Application	Configurable	Configurable	Configurable

You can restrict when a diagnostic action is triggered by setting a **dye mask** on a monitor. This mask determines the dye flags in the diagnostic context that trigger actions. See <wldf-instrumentation-monitor> XML Elements, for information about setting a dye mask for a monitor.

> **Note:**
>
> Diagnostic context, dye injection, and dye filtering are described in Configuring the DyeInjection Monitor to Manage Diagnostic Contexts.

Diagnostic Actions

Diagnostic actions execute diagnostic code that is appropriate for the associated delegating or custom monitor (standard monitors have predefined actions). For a delegating or custom monitor to perform any useful work, you must configure at least one action for that monitor.

The WLDF diagnostics library provides the following actions, which you can attach to a monitor by including the action's name in an <action> element of the *DIAG_MODULE*.xml configuration file:

- DisplayArgumentsAction
- MethodInvocationStatisticsAction
- MemoryAllocationStatisticsAction
- StackDumpAction
- ThreadDumpAction
- TraceAction
- TraceElapsedTimeAction
- TraceMemoryAllocationAction

Actions must be correctly matched with monitors. For example, the TraceElapsedTime action is compatible with a delegating or custom monitor whose diagnostic location type is Around. See WLDF Instrumentation Library, for more information.

Instrumentation Configuration Files

Instrumentation is configured as part of a diagnostics descriptor, which is an XML configuration file whose name and location depend on whether you are implementing system-level (server-scoped) or application-level (application-scoped) instrumentation.

The Instrumentation component is configured as follows:

- System-level instrumentation configuration is stored in one or more diagnostics descriptors in the following directory:

  DOMAIN_HOME/config/diagnostics

  This directory can contain multiple system-level diagnostic descriptor files. File names are arbitrary but must be terminated with .xml; for example, myDiag.xml. Each file can contain configuration information for one or more of the following deployable diagnostic components:

  – Harvester

  - Instrumentation
  - Policies and Actions

  The configuration of one or more diagnostic monitors can be defined in an <instrumentation> section in the descriptor file. Server-scoped instrumentation can be enabled, disabled, and reconfigured without restarting the server.

  Only one WLDF system resource (and hence one system-level diagnostics descriptor file) can be active for a server or cluster at any given time. The active descriptor is linked to and targeted from the following configuration file:

  `DOMAIN_HOME/config/config.xml`

  See Configuring Diagnostic System Modules. For general information about the creation, content, and parsing of configuration files in WebLogic Server, see Domain Configuration Files in *Understanding Domain Configuration for Oracle WebLogic Server*.

- Application-level instrumentation configuration is packaged within an application's archive in the following location:

  `META-INF/weblogic-diagnostics.xml`

  Because instrumentation is the only diagnostics component that is deployable to applications, this descriptor can contain only instrumentation configuration information.

  > **Note:**
  >
  > For instrumentation to be available for an application, instrumentation must be enabled on the server to which the application is deployed. (Server-scoped instrumentation is enabled and disabled in the <instrumentation> element of the diagnostics descriptor for the server.

  You can enable and disable diagnostic monitors without redeploying an application. However, you may need to redeploy the application after modifying other instrumentation features; for example, defining pointcuts or adding or removing monitors. Whether you need to redeploy depends on how you configure the instrumentation and how you deploy the application. There are three options:

  - Define and change the instrumentation configuration for the application directly, without using a JSR-88 deployment plan
  - Configure and deploy the application using a deployment plan that has placeholders for instrumentation settings
  - Enable the HotSwap feature when starting the server, and deploy using a deployment plan that has placeholders for instrumentation settings

  For more information about these choices, see Using Deployment Plans to Dynamically Control Instrumentation Configuration.

  For more information about deploying and modifying diagnostic application modules, see Deploying WLDF Application Modules.

The diagnostics XML schema is located at:

`http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/weblogic-diagnostics.xsd`

Each diagnostics descriptor file must begin with the following lines:

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
```

For an overview of WLDF resource configuration, see Understanding WLDF Configuration .

XML Elements Used for Instrumentation

You can configure instrumentation and diagnostic monitors using the XML elements such as `<Instrumentation>` and `<wldf-instrumentation-monitor>`.

This section provides descriptor fragments and tables that summarize information about the XML elements used to configure:

- <Instrumentation> XML Elements
- <wldf-instrumentation-monitor> XML Elements
- Mapping <wldf-instrumentation-monitor> XML Elements to Monitor Types

<Instrumentation> XML Elements

Table 12-2 describes the `<instrumentation>` elements in the *DIAG_MODULE*.xml file. The following configuration fragment illustrates the use of those elements:

```
<wldf-resource>
  <name>MyDiagnosticModule</name>
<instrumentation>
   <enabled>true</enabled>
   <!-- The following <include> element would apply only to an
        application-scoped Instrumentation descriptor -->
   <include>example.com.*</include>
    <!-- &lt;wldf-instrumentation-monitor&gt; elements to define diagnostic
        monitors for this diagnostic module -->
</instrumentation>
<!-- Other elements to configure this diagnostic module -->
</wldf-resource>
```

Table 12-2 <instrumentation> XML Elements in the DIAG_MODULE.xml Configuration File

Element	Description
`<instrumentation>`	The element that begins an instrumentation configuration.
`<enabled>`	If true, instrumentation is enabled. If false, no instrumented code is inserted in classes in this instrumentation scope, and all diagnostic monitors within this scope are disabled. The default value is false. You must enable instrumentation at the server level to enable instrumentation for the server and for any applications deployed to it. You must further enable instrumentation at the application level to enable instrumentation for the application (that is, in addition to enabling the server-scoped instrumentation).

Table 12-2 (Cont.) <instrumentation> XML Elements in the DIAG_MODULE.xml Configuration File

Element	Description
`<include>`	An optional element specifying the list of classes where instrumented code can be inserted. Wildcards (*) are supported. You can specify multiple `<include>` elements. If specified, a class must satisfy an `<include>` pattern for it to be instrumented. Applies only to application-scoped instrumentation. Any specified `<include>` or `<exclude>` patterns are applied to the application scope as a whole. **Note:** You can also specify `<include>` and `<exclude>` patterns for specific diagnostic monitors. See the entries for `<include>` and `<exclude>` in Table 12-1. As classes are loaded, they must pass an include/exclude pattern check before any instrumentation code is inserted. Even if a class passes the include/exclude pattern checks, whether or not it is instrumented depends on the diagnostic monitors included in the configuration descriptor. An application-scoped delegating monitor from the library has its own predefined classes and pointcuts. A custom monitor specifies its own pointcut expression. Therefore, a class can pass the include/exclude checks and still not be instrumented. **Note:** Instrumentation is inserted in applications at class load time. A large application that is loaded often may benefit from a judicious use of `<include>` elements, `<exclude>` elements, or both. You can probably ignore these elements for small applications or for medium-to-large applications that are loaded infrequently.
`<exclude>`	An optional element specifying the list of classes where instrumented code cannot be inserted. Wildcards (*) are supported. You can specify multiple `<exclude>` elements. If specified, classes satisfying an `<exclude>` pattern are not instrumented. Applies only to application-scoped instrumentation. See the preceding description of the `<include>` element.

<wldf-instrumentation-monitor> XML Elements

Diagnostic monitors are defined in `<wldf-instrumentation-monitor>` elements, which are children of the `<instrumentation>` element in the following descriptor:

- The *`DIAG_MODULE`*`.xml` descriptor for server-scoped instrumentation
- The `META-INF/weblogic-diagnostics.xml` descriptor for application-scoped instrumentation

The following fragment shows the configuration for a delegating monitor and a custom monitor in an application. (You could modify this fragment for server-scoped instrumentation by replacing the application-scoped monitors with server-scoped monitors.)

```
<instrumentation>
   <enabled>true</enabled>
     <wldf-instrumentation-monitor>
      <name>Servlet_Before_Service</name>
      <enabled>true</enabled>
      <dye-mask>USER1</dye-mask>
      <dye-filtering-enabled>true</dye-filtering-enabled>
      <action>TraceAction</action>
    </wldf-instrumentation-monitor>
```

```
    <wldf-instrumentation-monitor>
      <name>MyCustomMonitor</name>
      <enabled>true</enabled>
      <action>TraceAction</action>
      <location-type>before</location-type>
        <pointcut>call( * com.example. * get*(...));</pointcut>
    </wldf-instrumentation-monitor>
</instrumentation>
```

Note that the Servlet_Before_Service monitor sets a dye mask and enables dye filtering. This will be useful only if instrumentation is enabled at the server level and the DyeInjection monitor is enabled and properly configured. See Configuring the DyeInjection Monitor to Manage Diagnostic Contexts, for information about configuring the DyeInjection monitor.

Table 12-3 describes the `<wldf-instrumentation-monitor>` elements.

Table 12-3 <wldf-instrumentation-monitor> XML Elements in the DIAG_MODULE.xml or weblogic-diagnostics.xml file

Element	Description
`<wldf-instrumentation-monitor>`	The element that begins a diagnostic monitor configuration.
`<enabled>`	If true, the monitor is enabled. If false, the monitor is disabled. You enable or disable each monitor separately. The default value is true.
`<name>`	The name of the monitor. For standard and delegating monitors, use the names of the predefined monitors in WLDF Instrumentation Library, For custom monitors, an arbitrary string that identifies the monitor. The name for a custom monitor must be unique; that is, it cannot duplicate the name of any monitor in the library.
`<description>`	An optional element describing the monitor.
`<action>`	An optional element, which applies to delegating and custom monitors. If you do not specify at least one action, the monitor will not generate any information. You can specify multiple `<action>` elements. An action must be compatible with the monitor type. For the list of predefined actions for use by delegating and custom monitors, see WLDF Instrumentation Library.
`<dye-filtering-enabled>`	An optional element. If true, dye filtering is enabled for the monitor. If false, dye-filtering is disabled. The default value is false. In order to use dye filtering, the DyeInjection monitor must be configured appropriately at the server level.
`<dye-mask>`	An optional element. If dye filtering is enabled, the dye mask, when compared with the values in the diagnostic context, determines whether actions are taken. See Configuring the DyeInjection Monitor to Manage Diagnostic Contexts, for information about dyes and dye filtering.
`<properties>`	An optional element. Sets name=value pairs for dye flags. Currently applies only to the DyeInjection monitor.
`<location-type>`	An optional element, whose value is one of before, after, or around. The location type determines when an action is triggered at a pointcut: before the pointcut, after the pointcut, or both before and after the pointcut. Applies only to custom monitors; standard and delegating monitors have predefined location types. A custom monitor must define a location type and a pointcut.

Table 12-3 (Cont.) <wldf-instrumentation-monitor> XML Elements in the DIAG_MODULE.xml or weblogic-diagnostics.xml file

Element	Description
<pointcut>	An optional element. A pointcut element contains an expression that defines joinpoints where diagnostic code will be inserted. Applies only to custom monitors; standard and delegating monitors have predefined pointcuts. A custom monitor must define a location type and a pointcut. Pointcut syntax is documented in Defining Pointcuts for Custom Monitors.
<include>	An optional element specifying the list of classes where instrumented code can be inserted. Wildcards (*) are supported. You can specify multiple <include> elements. If specified, a class must satisfy an <include> pattern for it to be instrumented. Applies only to application-scoped instrumentation. Any specified <include> or <exclude> patterns are applied only to the monitor defined in the parent <wldf-instrumentation-monitor> element. **Note:** You can also specify <include> and <exclude> patterns for an entire instrumented application scope. See the entries for <include> and <exclude> in Table 12-1. As classes are loaded, they must pass an include/exclude pattern check before any instrumentation code is inserted. Even if a class passes the include/exclude pattern checks, whether or not it is instrumented depends on the diagnostic monitors included in the configuration descriptor. An application-scoped delegating monitor from the library has its own predefined classes and pointcuts. A custom monitor specifies its own pointcut expression. Therefore a class can pass the include/exclude checks and still not be instrumented. **Note:** Instrumentation is inserted in applications at class load time. A large application that is loaded often may benefit from a judicious use of <include> and/or <exclude> elements. You can probably ignore these elements for small applications or for medium-to-large applications that are loaded infrequently.
<exclude>	An optional element specifying the list of classes where instrumented code cannot be inserted. Wildcards (*) are supported. You can specify multiple <exclude> elements. If specified, classes satisfying an <exclude> pattern are not instrumented. Applies only to diagnostic monitors in application-scoped instrumentation. See the <include> description, above.

Note the following additional information about the <dye-filtering-enabled> and <dye-mask> elements:

- When a DyeInjection monitor is enabled and configured for a server or a cluster, you can use dye filtering in downstream delegating and custom monitors to inspect the dyes injected into a request's diagnostic context by that DyeInjection monitor.
- The configuration of the DyeInjection monitor determines which bits are set in the 64-bit dye vector associated with a diagnostic context. When the <dye-filtering-enabled> attribute is enabled for a monitor, its diagnostic activity is suppressed if the dye vector in a request's diagnostic context does not match the monitor's configured dye mask. If the dye vector matches the dye mask (a bitwise AND), the application can execute its diagnostic actions:

```
(dye_vector & dye_mask == dye_mask)
```

Thus, the dye filtering mechanism allows monitors to take diagnostic actions only for specific requests, without slowing down other requests. See Configuring the DyeInjection Monitor to Manage Diagnostic Contexts, for detailed information about diagnostic contexts and dye vectors.

Mapping <wldf-instrumentation-monitor> XML Elements to Monitor Types

Table 12-4 identifies the `<wldf-instrumentation-monitor>` elements that apply to each monitor type. An X indicates that an element applies to the corresponding monitor; N/A indicates that it does not.

Table 12-4 Mapping Instrumentation XML Elements to Monitor Types

Element	Standard	Delegating	Custom
`<wldf-instrumentation-monitor>`	X	X	X
`<name>`	X	X	X
`<description>`	X	X	X
`<enabled>`	X	X	X
`<action>`	N/A	X	X
`<dye-filtering-enabled>`	N/A	X	X
`<dye-mask>`	N/A	X	X
`<properties>`	X[1]	N/A	N/A
`<location-type>`	N/A	N/A	X
`<pointcut>`	N/A	N/A	X

1 Currently used only by the DyeInjection monitor to set name=value pairs for dye flags.

Configuring Server-Scoped Instrumentation

You can configure instrumentation as part of diagnostic descriptor file to implement the system-level instrumentation. You can define the configuration of one or more server-scope diagnostic monitors in the descriptor file.

To enable instrumentation at the server level, and to configure server-scoped monitors, perform the following steps:

1. Decide how many WLDF system resources you want to create.

   You can have multiple *DIAG_MODULE*`.xml` diagnostic descriptor files in a domain. In addition, for each server or cluster in a domain, you can deploy multiple diagnostic descriptor files simultaneously. However, one reason for creating more than one file is for flexibility. For example, you could have five diagnostic descriptor files in the *DOMAIN_HOME*`/config/diagnostics` directory. Each file contains a different instrumentation (and perhaps Harvester and Policies and Actions) configuration. You then deploy the descriptor file that corresponds to the particular monitors you want active.

2. Decide which server-scoped monitors you want to include in a configuration:

   - If you plan to use dye filtering on a server, or on any applications deployed on that server, configure the DyeInjection monitor.

- If you plan to use one or more of the server-scoped delegating monitors, decide which monitors to use and which actions to associate with each monitor.

3. Create and configure the configuration file(s).
   - If you create a configuration file with an editor or with the WebLogic Scripting Tool (WLST), you must correctly match actions to monitors.
   - See the Domain Configuration Files in *Understanding Domain Configuration for Oracle WebLogic Server* for information about configuring `config.xml`.
4. Validate and deploy the descriptor file. For server-scoped instrumentation, you can add and remove monitors and enable or disable monitors while the server is running.

Example 12-1 contains a sample server-scoped instrumentation configuration file that enables instrumentation and configures the DyeInjection standard monitor and the Connector_Before_Work delegating monitor. A single <instrumentation> element contains all instrumentation configuration for the module. Each diagnostic monitor is defined in a separate <wldf-instrumentation-monitor> element.

Example 12-1 Sample Server-Scoped Instrumentation (in DIAG_MODULE.xml)

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <instrumentation>
    <enabled>true</enabled>
    <wldf-instrumentation-monitor>
      <name>DyeInjection</name>
      <description>Inject USER1 and ADDR1 dyes</description>
      <enabled>true</enabled>
      <properties>USER1=weblogic
       ADDR1=127.0.0.1</properties>
    </wldf-instrumentation-monitor>
    <wldf-instrumentation-monitor>
      <name>Connector_Before_Work</name>
      <enabled>true</enabled>
      <action>TraceAction</action>
      <dye-filtering-enabled>true</dye-filtering-enabled>
      <dye-mask>USER1</dye-mask>
    </wldf-instrumentation-monitor>
  </instrumentation>
</wldf-resource>
```

Configuring Application-Scoped Instrumentation

Instrumentation is the only component that is deployable to applications. It must be enabled on the server to which the application is deployed. You can enable and disable diagnostic monitors without redeploying an application.

At the application level, WLDF instrumentation is configured as a deployable module, which is then deployed as part of the application.

> **Note:**
>
> Application classes and libraries that are put on the system classpath are not instrumented. Application class instrumentation works only on classes that are loaded by application classloaders. If application classes are put on the system classpath, either deliberately or inadvertently, they will be loaded by the system classloader. As a result no deployment time weaving is performed on those classes.

The following sections provide information you need to configure application-scoped instrumentation:

- Comparing System-Scoped to Application-Scoped Instrumentation
- Overview of the Steps Required to Instrument an Application
- Creating a Descriptor File for a Delegating Monitor
- Creating a Descriptor File for a Custom Monitor

Comparing System-Scoped to Application-Scoped Instrumentation

Instrumenting an application is similar to instrumenting at the system level, but with the following differences:

- Applications can use standard, delegating, and custom monitors.
  - The only server-scoped standard monitor is DyeInjection. The only application-scoped standard monitor is HttpSessionDebug. See the entry for HttpSessionDebug in Diagnostic Monitor Library.
  - Delegating monitors are either server-scoped or application-scoped. Applications must use the application-scoped delegating monitors.
  - All custom monitors are application-scoped.
- The server's instrumentation settings affect the application. In order to enable instrumentation for an application, instrumentation must be enabled for the server on which the application is deployed. If server instrumentation is enabled at the time of deployment, instrumentation will be available for the application. If instrumentation is not enabled on the server at the time of deployment, enabling instrumentation in an application will have no effect.
- Application instrumentation is configured with a `weblogic-diagnostics.xml` descriptor file. You create a `META-INF/weblogic-diagnostics.xml` file, configure the instrumentation, and put the file in the application's archive. When the archive is deployed, the instrumentation is automatically inserted when the application is loaded.
- You can use a *deployment plan* to dynamically update configuration elements without redeploying the application. See Using Deployment Plans to Dynamically Control Instrumentation Configuration.

The XML descriptors for application-scoped instrumentation are defined in the same way as for server-scoped instrumentation. You can configure instrumentation for an application solely by using the delegating monitors and diagnostic actions available in the WLDF Instrumentation Library. You can also create your own custom monitors; however, the diagnostic actions that you attach to these monitors must be taken from the WLDF Instrumentation Library.

Table 12-5 compares the function and scope of system and application diagnostic modules.

Table 12-5 Comparing System and Application Modules

Module Type	Add or Remove Objects Dynamically	Add or Remove Objects with Console	Modify with JMX Remotely	Modify with JSR-88 (non-remote)	Modify with Console	Enable/Disable Dye Filtering and Dye Mask Dynamically
System Module	Yes	Yes	Yes	No	Yes (via JMX)	Yes
Application Module	Yes, when HotSwap is enabled No, when HotSwap is not enabled: module must be redeployed	Yes	No	Yes	Yes (via plan)	Yes

Overview of the Steps Required to Instrument an Application

> **Note:**
>
> As of WebLogic Server 10.3, you are not required to create a `weblogic-diagnostics.xml` file in the application's `META-INF` directory, as was the case in previous WebLogic Server releases. However, you can still use this method to initially configure diagnostic monitors for your application.

To implement a diagnostic monitor for an application, perform the following steps:

1. Make sure that instrumentation is enabled on the server. See Configuring Server-Scoped Instrumentation.
2. Create a well formed `META-INF/weblogic-diagnostics.xml` descriptor file for the application. If you want to add any monitors that will be automatically enabled each time the application is deployed:
   - Enable the <instrumentation> element: <enabled>true</enabled>.
   - Add and enable at least one diagnostic monitor, with appropriate actions attached to it. (A monitor will generate diagnostic events only if the monitor is enabled and actions that generate events are attached to it.).

   See Creating a Descriptor File for a Delegating Monitor, and Creating a Descriptor File for a Custom Monitor, for samples of well-formed descriptor files.

   See Defining Pointcuts for Custom Monitors, for information about creating a pointcut expression.
3. Put the descriptor file in the application archive.
4. Deploy the application. See Deploying WLDF Application Modules.

Creating a Descriptor File for a Delegating Monitor

The following example shows a well-formed `META-INF/weblogic-diagnostics.xml` descriptor file for an application-scoped delegating monitor. At a minimum, this file must contain the lines shown in bold. In this example, there is only one monitor defined (Servlet_Before_Service). However, you can define multiple monitors in the descriptor file.

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <instrumentation>
    <enabled>true</enabled>
    <wldf-instrumentation-monitor>
      <name>Servlet_Before_Service</name>
      <enabled>true</enabled>
      <dye-mask>USER1</dye-mask>
      <dye-filtering-enabled>true</dye-filtering-enabled>
      <action>TraceAction</action>
    </wldf-instrumentation-monitor>
  </instrumentation>
</wldf-resource>
```

The Servlet_Before_Service monitor is an application-scoped monitor selected from the WLDF monitor library. It is hard coded with a pointcut that sets joinpoints at method entry for several servlet or JSP methods. Because the application enables dye filtering and sets the USER1 flag in its dye mask, the TraceAction action will be invoked only when the dye vector in the diagnostic context passed to the application also has its USER1 flag set.

The dye vector is set at the system level via the DyeInjection monitor as per the DyeInjection monitor configuration when the request enters the server. For example, if the DyeInjection monitor is configured with property USER1=weblogic and the request was originated by user weblogic, the USER1 dye flag in the dye vector will be set.

Therefore, the Servlet_Before_Service monitor in this application is essentially quiescent until it inspects a dye vector and finds the USER1 flag set. This filtering reduces the amount of diagnostic data generated, and ensures that the generated data is of interest to the administrator.

Creating a Descriptor File for a Custom Monitor

The following is an example of a well-formed `META-INF/weblogic-diagnostics.xml` file for a custom monitor. At a minimum, the file must contain the lines shown in bold.

Example 12-2 Sample Custom Monitor Configuration (in DIAG_MODULE.xml)

```
<?xml version="1.0" encoding="UTF-8"?>
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
 <instrumentation>
     <enabled>true</enabled>
     <wldf-instrumentation-monitor>
       <name>MyCustomMonitor</name>
       <enabled>true</enabled>
       <action>TraceAction</action>
       <location-type>before</location-type>
       <pointcut>call( * com.example.* get* (...));</pointcut>
```

```
    </wldf-instrumentation-monitor>
  </instrumentation>
</wldf-resource>
```

The <name> for a custom monitor is an arbitrary string chosen by the developer. Because this monitor is custom, it has no predefined locations when actions should be invoked; the descriptor file must define the location type and pointcut expression. In this example, the TraceAction action will be invoked before (<location-type>before</location-type) any methods defined by the pointcut expression is invoked. Table 12-6 shows how the pointcut expression from Example 12-2 is parsed. (Note the use of wildcard characters.)

Table 12-6 Description of a Sample Pointcut Expression

Pointcut Expression	Description
`call( * com.example.* get* (...))`	`call( )`: Trigger any defined actions when the methods whose joinpoints are defined by the remainder of this pointcut expression are invoked.
`call( * com.example.* get* (...))`	`*`: Return value. The wildcard indicates that the methods can have any type of return value.
`call( * com.example.* get* (...))`	`com.example.*`: Methods from class com.example and its sub-packages are eligible.
`call( * com.example.* get* (...))`	`get*`: Any methods whose name starts with the string get is eligible.
`call( * com.example.* get* (...))`	`(...)`: The ellipsis indicates that the methods can have any number of arguments.

This pointcut expression matches all methods in all classes in package com.example and its sub-packages. The methods can return values of any type, including void, and can have any number of arguments of any type. Instrumentation code will be inserted before these methods are called, and, just before those methods are called, the TraceAction action will be invoked.

See Defining Pointcuts for Custom Monitors, for a description of the grammar used to define pointcuts.

- Defining Pointcuts for Custom Monitors
- Annotation-based Pointcuts

Defining Pointcuts for Custom Monitors

Custom monitors provide more flexibility than delegating monitors because you create pointcut expressions to control where diagnostics actions are invoked. As with delegating monitors, you must select actions from the action library.

A joinpoint is a specific, well-defined location in a program. A pointcut is an expression that specifies a set of joinpoints. This section describes how you define expressions for pointcuts using the following pointcut syntax.

You can specify two types of pointcuts for custom monitors:

- *call*: Take an action when a method is invoked.
- *execution*: Take an action when a method is executed.

The syntax for defining a pointcut expression is as follows:

```
pointcutExpr  :=  orExpr  ( 'OR' orExpr ) *
orExpr := andExpr ( 'AND' andExpr ) *
andExpr := 'NOT' ? termExpr
termExpr := exec_pointcut | call_pointcut | '(' pointcutExpr ')'
exec_pointcut := 'execution' '(' modifiers?
                                 returnSpec
                                 classSpecWithAnnotations
                                 methodSpec '(' parameterList ')'
                               ')'
call_pointcut := 'call' '(' returnSpec
                            classSpec
                            methodSpec '(' parameterList ')'
                          ')'
modifiers := modifier ( 'OR' modifier ) * modifier := 'public' | 'protected' | 'private'
| 'static'
returnSpec :=  '*' | typeSpec
classSpecWithAnnotations := '@' IDENTIFIER ( 'OR' IDENTIFIER ) * | classSpec
classSpec := '+' ? classOrMethodPattern | '*'
typeSpec :=  '%' ? ( primitiveType | classSpec ) ( '[]' )*
methodSpec :=  classOrMethodPattern
parameterList := param ( ',' param ) *
param := typeSpec | '...'
primitiveType := 'byte' | 'char' | 'boolean' | 'short' | 'int' | 'float' | 'long' |
'double' | 'void'
classOrMethodPattern :=  '*' ? IDENTIFIER '*'? | '*'
```

The following rules apply:

- The asterisk wildcard character (*****) can be used in class types and method names.
- An ellipsis (**...**) in the argument list signifies a variable number of arguments of any types beyond the argument.
- A percent character (`%`) prefix designates the value of a non-static class instantiation, parameter, or return specification as not containing nor exposing sensitive information. The use of this operator is particularly useful with the DisplayArgumentsAction action, which captures method arguments or return values. If this prefix character is not explicitly used, an asterisk string is substituted for the value that is returned; this behavior ensures that sensitive data in your application is not inadvertently transmitted when an instrumentation event captures input arguments to, or return values from, a joinpoint.

  > **Note:**
  >
  > The `%` operator cannot be applied to an ellipsis or to a wildcarded type within a pointcut expression.

- A plus sign (**+**) prefix to a class type identifies all subclasses, sub-interfaces or concrete classes implementing the specified class/interface pattern.
- A pointcut expression specifies a pattern to identify matching joinpoints. An attempt to match a joinpoint against it will return a boolean, indicating a valid match (or not).
- Pointcut expressions can be combined with AND, OR and NOT boolean operators to build complex pointcut expression trees.

For example, the following pointcut matches method executions of all public initialize methods in all classes in package com.foo.bar and its sub-packages. The initialize methods may return values of any type, including void, and may have any number of arguments of any types.

```
execution(public * com.example.* initialize(...))
```

The following pointcut matches the method calls (call sites) on all classes that directly or indirectly implement the com.example.MyInterface interface (or a subclass, if it happens to be a class). The method names must start with get, be public, and return an int value. The method must accept exactly one argument of type java.lang.String:

```
call(int +com.example.MyInterface get*(java.lang.String))
```

The following example shows how to use boolean operators to build a pointcut expression tree:

```
call(void com.example.* set*(java.lang.String)) OR
call( * com.example.* get*())
```

The following example illustrates how the previous expression tree would be rendered as a <pointcut> element in a configuration file:

```
<pointcut>call(void com.example.* set*(java.lang.String)) OR
call( * com.example.* get*())</pointcut>
```

Annotation-based Pointcuts

You can use JDK-style annotations in class and method specifiers of execution points. A class or method specifier starting with `@` is interpreted as an annotation name.

When used as a class specifier, the annotation matches all classes that are annotated with it. While performing the match, only annotation names are considered. Annotation attributes are ignored.

For example, consider the following pointcut:

```
execution(public void @Service @Invocation (...)
```

The preceding pointcut matches methods that:

- Are public method
- Return void
- Are contained in a class that is annotated with @Service
- Have a method annotated with @Invocation
- Contain any number of arguments.

> **Note:**
>
> Annotation-based specifiers can be used only with execution pointcuts. They cannot be used with call pointcuts.

Annotation-based class and method specifiers can use the following wildcard characters:

- The asterisk wildcard (`*`) matches everything.
- The asterisk wildcard (`*`) at the beginning matches class/interface or method names that end with the given string. For example, `*Bean` matches with `weblogic.management.configuration.ServerMBean`.
- The asterisk wildcard (`*`) at the end matches class/interface or method names that end with the given string. For example, weblogic.* matches all classes and interfaces that are in weblogic and its sub-packages.
- You can specify a pointcut based on names of inner classes. For example:

```
public class Foo {
      class Bar {
         public int getValue() {...}
      }
   }
```

You can define a pointcut that covers the `getValue` method of the inner class `Bar` using the following specification:

```
execution (public int Foo$Bar getValue(...));
```

You can also use wildcard characters as follows. The following pointcut matches only the getter methods in the inner class `Bar` of class `Foo`:

```
execution ( * Foo$Bar get*(...));
```

You can also use leading and trailing wildcard characters. The following examples also match the getter methods in class `Foo$Bar`:

```
execution ( * Foo$Ba* get*(...));
   execution ( * *oo$Bar get*(...));
   execution ( * *oo$Ba* get*(...));
```

13

Configuring the DyeInjection Monitor to Manage Diagnostic Contexts

The Instrumentation component of the WebLogic Diagnostics Framework (WLDF) also provides a way to uniquely identify requests, such as HTTP or RMI requests, and track them as they flow through the system.You can configure WLDF to check for certain characteristics of every request that enters the system, such as the originating user or client address, and attach a *diagnostic context* to that request. This feature allows you to take measurements of specific requests, such as elapsed time, to get an idea of how all requests are being processed as they flow through the system.
The diagnostic context consists of two pieces: a unique Context ID, and a 64-bit dye vector that represents the characteristics of the request. The Context ID associated with a given request is recorded in the Event Archive and can be used to:

- *Throttle* instrumentation event generation, that is determine how often events are generated when specified conditions are met
- Associate log records with a request
- Filter searches of log or event records using the WLDF Accessor component (see Accessing Diagnostic Data With the Data Accessor).

For an example of how to use WLST to create a DyeInjection monitor dynamically, see Example: Dynamically Creating DyeInjection Monitors.

This chapter includes the following sections:

- Contents, Life Cycle, and Configuration of a Diagnostic Context
  A diagnostic context contains a unique *Context ID* and a 64-bit *dye vector*. The dye vector contains flags which are set to identify the characteristics of the diagnostic context associated with a request.
- Overview of the Process
  The DyeInjection monitor examines the request to see if any of the configured dye values in the dye vector match attributes of the request. You can configure the DyeInjection monitor to identify the requests and track their flow. The tracking of the requests helps to see how the requests are processed as they flow through the system.
- Configuring the Dye Vector by Using the DyeInjection Monitor
  You configure the Dye Vector by using the DyeInjection monitor to monitor the requests in a system. Every request is checked against the configuration of the DyeInjection monitor, and a diagnostic context is created and attached to the request.
- Using Throttling to Control the Volume of Instrumentation Events
  You can use throttling to control the number of requests that the monitors process in a diagnostic module.
- Using weblogic.diagnostics.context
  The weblogic.diagnostics.context package provides applications with access to a diagnostic context.

Contents, Life Cycle, and Configuration of a Diagnostic Context

A diagnostic context contains a unique *Context ID* and a 64-bit *dye vector*. The dye vector contains flags which are set to identify the characteristics of the diagnostic context associated with a request.

Currently, 32 bits of the dye vector are used, one for each available dye flag (see Table 13-1).

Context Life Cycle and the Context ID

The diagnostic context for a request is created and initialized when the request enters the system (for example, when a client makes an HTTP request). The diagnostic context remains attached to the request, even as the request crosses thread boundaries and Java Virtual Machine (JVM) boundaries. The diagnostic context lives for the duration of the life cycle of the request.

Every diagnostic context is identified by a Context ID that is unique in the domain. Because the Context ID travels with the request, it is possible to determine the events and log entries associated with a given request as it flows through the system.

Dyes, Dye Flags, and Dye Vectors

Contextual information travels with a request as a 64-bit dye vector, where each bit is a flag to identify the presence of a *dye*. Each dye represents one attribute of a request; for example, an originating user, an originating client IP address, access protocol, and so on.

When a dye flag for a given attribute is set, it indicates that the attribute is present. When the flag is not set, it indicates the attribute is not present.

For example, consider a configuration where:

- the flag ADDR1 is configured to indicate a request that originated from IP address 127.0.0.1.
- the flag ADDR2 is configured to indicate a request that originated from IP address 127.0.0.2.
- the flag USER1 is configured to indicate a request that originated from user admin@avitek.com.

If a request from IP address 127.0.0.1 enters the system from a user other than admin@avitek.com, the ADDR1 flag in the dye vector for the request is set. The ADDR2 and USER1 dye flags remain unset.

If a request from admin@avitek.com enters the system from an IP address other than 127.0.0.1 or 127.0.0.2, the USER1 flag in the dye vector for the request is set. The ADDR1 and ADDR2 dye flags remain unset.

If a request from admin@avitek.com from IP address 127.0.0.2 enters the system, both the USER1 and ADDR2 flags in the dye vector for this request are set. The ADDR1 flag remains unset.

Diagnostic and monitoring features that take advantage of the diagnostic context can examine the dye vector to determine if one or more attributes are present (that is, the associated flag is set). In the example above, you could configure a diagnostic monitor to trace every request that is dyed with ADDR1; that is, every request originating from IP address 127.0.0.1. You could also configure a diagnostic monitor that traces every request that is dyed with both ADDR1 and USER1; that is, every request originating from user admin@avitek.com at IP address 127.0.0.1 (requests from other users at 127.0.0.1 would *not* be traced).

The dye vector also contains a THROTTLE dye, which is used to set how often incoming requests are dyed. For more information about this special dye, see THROTTLE Dye Flag.

For a list of the available dyes and the attributes they represent, see Dyes Supported by the DyeInjection Monitor. The process of configuring dye vectors and using them is discussed throughout the rest of this chapter.

Where Diagnostic Context Is Configured

Diagnostic context is configured as part of a diagnostic module. You use the DyeInjection monitor at the server level to configure the diagnostic context. The DyeInjection monitor is a *standard* diagnostic monitor, so you cannot modify its behavior. The joinpoints where the DyeInjection monitor is woven into the code are those locations where a request can enter the system.

The *diagnostic action* is to check every request against the DyeInjection monitor's configuration, then create and attach a diagnostic context to the request, setting the dye flags as appropriate. If the dye flags that are set for a request match the dye flags that are configured for a downstream diagnostic monitor, an event with the request's associated Context ID is added to the Event Archive. So, for example, if a request has only the USER1 and ADDR1 dye flags set, and there is a diagnostic monitor configured to trace requests with both the USER1 and ADDR1 flags set (but no other flags set), an event is added to the Event Archive.

For information about diagnostic monitor types, pointcuts (which define the joinpoints), and diagnostic actions, see Configuring Instrumentation.

Overview of the Process

The DyeInjection monitor examines the request to see if any of the configured dye values in the dye vector match attributes of the request. You can configure the DyeInjection monitor to identify the requests and track their flow. The tracking of the requests helps to see how the requests are processed as they flow through the system.

This overview describes the configuration and use of context in a server-scoped diagnostic module.

1. Configure a dye vector via the DyeInjection Module. See Configuring the Dye Vector via the DyeInjection Monitor.
2. When any request enters the system, WLDF creates and instantiates a diagnostic context for the request. The context includes a unique Context ID and a dye vector.
3. The DyeInjection monitor, if enabled at the server level within a WLDF diagnostic module, examines the request to see if any of the configured dye values in the dye vector match attributes of the request. For example, it checks to see if the request originated from the user associated with USER1 or USER2, and it checks to see if the request came from the IP address associated with ADDR1 or ADDR2.

4. For each dye value that matches a request attribute, the DyeInjection monitor sets the associated dye bits within the diagnostic context. For example, if the DyeInjection monitor is configured with `USER1=weblogic`, `USER2=admin@avitek.com`, ADDR1=`127.0.0.1`, `ADDR2=127.0.0.2`, and the request originated from user weblogic at IP address 127.0.0.2, it will set the USER1 and ADDR2 dye bits within the dye vector.
5. As the request flows through the system, the diagnostic context (which includes the dye vector) flows with it as well. This 64-bit dye vector contains only flags, not values. So, in this example, the dye vector contains only two flags that are explicitly set (USER1 and ADDR2). It does not contain the actual user name and IP address associated with USER1 and ADDR2.

> **Note:**
>
> All dye vectors also contain one of the implicit PROTOCOL dyes, as explained in Configuring the Dye Vector via the DyeInjection Monitor.

6. The administrator configures a diagnostic monitor (either application-scoped or server-scoped) to be active within downstream code, setting the monitor's dye mask as USER1 and ADDR2.
7. The diagnostic monitor will perform its associated action(s) if the dye flags that are set in the diagnostic context's dye vector match the dye mask of the diagnostic monitor.

   In this example, the monitor will perform its action(s) if the USER1 and ADDR2 flags are set in the dye vector. In addition, an event associated with the request will be written to the Event Archive.

Configuring the Dye Vector by Using the DyeInjection Monitor

You configure the Dye Vector by using the DyeInjection monitor to monitor the requests in a system. Every request is checked against the configuration of the DyeInjection monitor, and a diagnostic context is created and attached to the request.

To create diagnostic contexts for all requests coming into the system:

1. Create a diagnostic module for the server (or servers) you want to monitor in the **Summary of Diagnostic Modules** page. See Creating a Custom Diagnostic System Module Based on a Built-in.
2. Click the name of the newly created module to open the **Settings for <*MODLE_NAME*>** page.
3. In the **Configuration - Instrumentation** tab, select the **Enabled** check box.
4. In the **Diagnostic Monitors in this Module** tab, add the **DyeInjection** monior by using the **Add/Remove** button.
5. Click the DyeInjection monitor to open the **Settings for DyeInjection** page.
6. Select the **Enable** check box. (Only one DyeInjection monitor can be used with a diagnostic module at a time.)

You configure the DyeInjection monitor by assigning values to dyes. The available dye flags are described in Table 13-1.

For example, you could set the flags as follows: `USER1=weblogic`, `USER2=admin@avitek.com`, `ADDR1=127.0.0.1`, `ADDR2=127.0.0.2`, and so forth. Basically, you want to set the values of one or more flags to the user(s), IP address(es) whose requests you want to monitor.

For example, to monitor all requests initiated by a user named `admin@avitek` from a client at IP address 127.0.0.1, assign the value `admin@avitek` to `USER1` and assign the value 127.0.0.1 to `ADDR1`.

Dyes Supported by the DyeInjection Monitor

The dyes available in the dye vector are listed and explained in the following table.

Table 13-1 Request Protocols for Supported Diagnostic Context Dyes

Dye Flags	Description
ADDR1 ADDR2 ADDR3 ADDR4	Use the ADDR1, ADDR2, ADDR3 and ADDR4 dyes to specify the IP addresses of clients that originate requests. These dye flags are set in the diagnostic context for a request if the request originated from an IP address specified by the respective property (ADDR1, ADDR2, ADDR3, ADDR4) of the DyeInjection monitor. These dyes cannot be used to specify DNS names.
CONNECTOR1 CONNECTOR2 CONNECTOR3 CONNECTOR4	Use the CONNECTOR1, CONNECTOR2, CONNECTOR3 and CONNECTOR4 dyes to identify characteristics of connector drivers. These dye flags are set by the connector drivers to identify request properties specific to their situations. You do not configure these directly in the descriptor files. The connector drivers can assign values to these dyes (using the Connector API), so information about the connections can be carried in the diagnostic context.
COOKIE1 COOKIE2 COOKIE3 COOKIE4	COOKIE1, COOKIE2, COOKIE3 and COOKIE4 are set in the diagnostic context for an HTTP/S request, if the request contains the cookie named weblogic.diagnostics.dye and its value is equal to the value of the respective property (COOKIE1, COOKIE2, COOKIE3, COOKIE4) of the DyeInjection monitor.
DYE_0 DYE_1 DYE_2 DYE_3 DYE_4 DYE_5 DYE_6 DYE_7	DYE_0 to DYE_7 are available only for use by application developers. See Using weblogic.diagnostics.context .

Table 13-1 (Cont.) Request Protocols for Supported Diagnostic Context Dyes

Dye Flags	Description
PROTOCOL_HTTP PROTOCOL_IIOP PROTOCOL_JRMP PROTOCOL_RMI PROTOCOL_SOAP PROTOCOL_SSL PROTOCOL_T3	The DyeInjection monitor implicitly identifies the protocol used for a request and sets the appropriate dye(s) in the dye vector, according to the protocol(s) used. PROTOCOL_HTTP is set in the diagnostic context of a request if the request uses HTTP or HTTPS protocol. PROTOCOL_IIOP is set in the diagnostic context of a request if it uses Internet Inter-ORB Protocol (IIOP). PROTOCOL_JRMP is set in the diagnostic context of a request if it uses the Java Remote Method Protocol (JRMP). PROTOCOL_RMI is set in the diagnostic context of a request if it uses the Java Remote Method Invocation (RMI) protocol. PROTOCOL_SSL is set in the diagnostic context of a request if it uses the Secure Sockets Layer (SSL) protocol. PROTOCOL_T3 is set in the diagnostic context of a request if the request uses T3 or T3s protocol
THROTTLE	The THROTTLE dye is set in the diagnostic context of a request if it satisfies requirements specified by THROTTLE_INTERVAL and/or THROTTLE_RATE properties of the DyeInjection monitor.
USER1 USER2 USER3 USER4	Use the USER1, USER2, USER3 and USER4 dyes to specify the user names of clients that originate requests. These dye flags are set in the diagnostic context for a request if the request was originated by a user specified by the respective property (USER1, USER2, USER3, USER4) of the DyeInjection monitor.

PROTOCOL Dye Flags

You must explicitly set the values for the dye flags USER*n*, ADDR*n*, COOKIE*n*, and CONNECTOR*n*. in the DyeInjection monitor. However, the flags PROTOCOL_HTTP, PROTOCOL_IIOP, ROTOCOL_JRMP, PROTOCOL_RMI, PROTOCOL_SOAP, PROTOCOL_SSL, and PROTOCOL_T3 are set implicitly by WLDF. When the DyeInjection monitor is enabled, every request is injected with the appropriate protocol dye. For example, every request that arrives via HTTP is injected with the PROTOCOL_HTTP dye.

THROTTLE Dye Flag

The THROTTLE dye flag can be used to control the volume of incoming requests that are dyed. THROTTLE is configured differently from the other flags, and WLDF uses it differently. See Using Throttling to Control the Volume of Instrumentation Events, for more information.

When Diagnostic Contexts Are Created

When the DyeInjection monitor is enabled in a diagnostic module, a diagnostic context is created for every incoming request. The DyeInjection monitor is enabled by default when you enable instrumentation in a diagnostic module. This ensures that a diagnostic Context ID is available so that events can be correlated. Even if no properties are explicitly set in the DyeInjection monitor, the diagnostic context for every request will contain a unique Context ID and a dye vector with one of the implicit PROTOCOL dyes.

If the DyeInjection monitor is disabled, no diagnostic contexts will be created for any incoming requests.

Using Throttling to Control the Volume of Instrumentation Events

You can use throttling to control the number of requests that the monitors process in a diagnostic module.

Throttling is configured using the THROTTLE dye, which is defined in the DyeInjection monitor.

> **Note:**
>
> The USER*n* and ADDR*n* dyes allow inspection of requests from specific users or IP addresses. However, they do not provide a means to look at arbitrary user transactions. The THROTTLE dye provides that functionality by allowing sampling of requests.

Configuring the THROTTLE Dye

Unlike other dyes in the dye vector, the THROTTLE dye is configured through two properties.

- THROTTLE_INTERVAL sets an interval (in milliseconds) after which a new incoming request is dyed with the THROTTLE dye.

  If the THROTTLE_INTERVAL is greater than 0, the DyeInjection monitor sets the THROTTLE dye flag in the dye vector of an incoming request if the last request dyed with THROTTLE arrived at least *`THROTTLE_INTERVAL`* before the new request. For example, if THROTTLE_INTERVAL=3000, the DyeInjection monitor waits at least 3000 milliseconds before it will dye an incoming request with THROTTLE.

- THROTTLE_RATE sets the rate (in terms of the number of incoming requests) by which new incoming requests are dyed with the THROTTLE dye.

  If THROTTLE_RATE is greater than 0, the DyeInjection monitor sets the THROTTLE dye flag in the dye vector of an incoming request when the number of requests since the last request dyed with THROTTLE equals *`THROTTLE_RATE`*. For example, if THROTTLE_RATE = 6, every sixth request is dyed with THROTTLE.

You can use THROTTLE_INTERVAL and THROTTLE_RATE together. If either condition is satisfied, the request is dyed with the THROTTLE dye.

If you assign a value to either THROTTLE_INTERVAL or THROTTLE_RATE (or both, or neither), you are configuring the THROTTLE dye.

Example 13-1 shows the resulting configuration in the descriptor file for the diagnostics module.

Example 13-1 Sample THROTTLE Configuration in the DyeInjection Monitor, in DIAG_MODULE.xml

```
<wldf-resource>
  <name>MyDiagnosticModule</name>
  <instrumentation>
    <wldf-instrumentation-monitor>
      <name>DyeInjection</name>
```

```
      <properties>
        THROTTLE_INTERVAL=3000
        THROTTLE_RATE=6
      </properties>
    </wldf-instrumentation-monitor>
  </instrumentation>
<!-- Other elements to configure this diagnostic monitor -->
</wldf-resource>
```

Example 13-2 shows the configuration for a JDBC_Before_Start_Internal delegating monitor where the THROTTLE dye is set in the dye mask for the monitor.

Example 13-2 Sample Configuration for Setting THROTTLE in a Dye Mask of a Delegating Monitor, in DIAG_MODULE.xml

```
<wldf-resource>
  <name>MyDiagnosticModule</name>
  <instrumentation>
    <wldf-instrumentation-monitor>
      <name>JDBC_Before_Start_Internal</name>
      <enabled>true</enabled>
      <dye-mask>THROTTLE</dye-mask>
    </wldf-instrumentation-monitor>
  </instrumentation>
<!-- Other elements to configure this diagnostic monitor -->
</wldf-resource>
```

How Throttling is Handled by Delegating and Custom Monitors

Dye masks and dye filtering provide a mechanism for restricting which requests are passed to delegating and custom monitors for handling, based on properties of the requests. The presence of a property in a request is indicated by the presence of a dye, as discussed in Configuring the Dye Vector via the DyeInjection Monitor. One of those dyes can be the THROTTLE dye, so that you can filter on THROTTLE, just like any other dye.

The items in the following list explain how throttling is handled:

- If dye filtering for a delegating or custom monitor is enabled and that monitor has a dye mask, filtering is performed based on the dye mask. That mask may include the THROTTLE dye, but it does not have to. If THROTTLE is included in a dye mask, then THROTTLE must also be included in the request's dye vector for the request to be passed to the monitor. However, if THROTTLE is not included in the dye mask, all qualifying requests are passed to the monitor, whether their dye vectors include THROTTLE or not.
- If dye filtering for a delegating or custom monitor is not enabled and neither THROTTLE property is set in the DyeInjection monitor, dye filtering will not take place and throttling will not take place.
- If dye filtering for a delegating or custom monitor is not enabled and THROTTLE is configured in the DyeInjection monitor, delegating monitors ignore dye masks but do check for the presence of the THROTTLE dye in all requests. Only those requests dyed with THROTTLE are passed to the delegating monitors for handling. Therefore, by setting a THROTTLE_RATE and/or THROTTLE_INTERVAL in the DyeInjection monitor, you reduce the number of requests handled by all delegating monitors. You do not have to configure dye masks for all your delegating monitors to take advantage of throttling.
- If dye filtering for a delegating or custom monitor is enabled and the only dye set in a dye mask is THROTTLE, only those requests that are dyed with THROTTLE are passed to the delegating monitor. This behavior is the same as when dye filtering is not enabled and THROTTLE is configured in the DyeInjection monitor.

Using weblogic.diagnostics.context

The weblogic.diagnostics.context package provides applications with access to a diagnostic context.

An application can use the weblogic.diagnostics.context.DiagnosticContextHelper APIs to perform the following functions:

- Inspect a diagnostics context's immutable context ID.
- Inspect the settings of the dye flags in a context's dye vector.
- Retrieve an array of valid dye flag names.
- Set, or unset, the DYE_0 through DYE_7 flags in a context's dye vector. (Note that there is no way to set these flag bits via XML. You can configure DyeInjection monitor <properties> to set the non-application-specific flag bits via XML, but setDye() is the only method for setting DYE_0 through DYE_7 in a dye vector.)
- Attach a payload (a String) to a diagnostic context, or read an existing payload.

An application cannot:

- Set any flags in a dye vector other than the eight flags reserved for applications.
- Prevent another application from setting the same application flags in a dye vector. A well-behaved application can test whether a dye flag is set before setting it.
- Prevent another application from replacing a payload. A well-behaved application can test for the presence of a payload before adding one.

> **Note:**
>
> The diagnostic context payload can be viewed by other code in the same execution context; it can flow out of the process along with the `Work` instance; and it can be overwritten by other code running in the same execution context. Therefore, you should ensure the following behavior in your applications:
>
> - Avoid including any sensitive data in the payload that, for example, could be returned by the `getPayload()` method.
> - Do not create a dependency on any particular data being available in the context payload. For example, applications should not rely on a particular context ID being present. If an application uses the contents of the payload, the application should first verify that the contents match what is expected.

A monitor, or another application, that is downstream from the point where an application has set one or more of the DYE_0 through DYE_7 flags can set a dye mask to check for those flags, and take an action when the flag(s) are present in a context's dye vector. If a payload is attached to the diagnostics context, any action taken by that monitor will result in the payload being archived, and thus available through the accessor component.

Example 13-3 is a short example which (implicitly) creates a diagnostic context, prints the context ID, checks the value of the DYE_0 flag, and then sets the DYE_0 flag.

Example 13-3 Example: DiagnosticContextExample.java

```
package weblogic.diagnostics.examples;
import weblogic.diagnostics.context.DiagnosticContextHelper;
public class DiagnosticContextExample {
 public static void main(String args[]) throws Exception {
   System.out.println("\nContextId=" +
     DiagnosticContextHelper.getContextId());
     System.out.println("isDyedWith(DYE_0)=" +
       DiagnosticContextHelper.isDyedWith(DiagnosticContextHelper.DYE_0));
     DiagnosticContextHelper.setDye(DiagnosticContextHelper.DYE_0, true);
     System.out.println("isDyedWith(DYE_0)=" +
       DiagnosticContextHelper.isDyedWith(DiagnosticContextHelper.DYE_0));
 }
}
```

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Accessing Diagnostic Data With the Data Accessor

The Data Accessor component of the WebLogic Diagnostics Framework (WLDF) accesses diagnostic data from various sources, including log records, data events, and harvested metrics.Using the Data Accessor, you can:

- Perform data lookups by type, component, and attribute
- Perform time-based filtering and, when accessing events, filtering by severity, source, and content
- Access diagnostic data in tabular form

You can also use the Data Accessor online (when a server is running) and offline (when a server is not running).

Data Stores Accessed by the Data Accessor

The Data Accessor retrieves diagnostic information from other WLDF components. Captured information is segregated into logical data stores, called diagnostic data stores, which are separated by the types of diagnostic data. For example, server logs, HTTP logs, and harvested metrics are captured in separate data stores.

WLDF maintains diagnostic data on a per-server basis. Therefore, the Data Accessor provides access to data stores for individual servers.

Diagnostic data stores can be modeled as tabular data. Each record in the table represents one item, and the columns describe characteristics of the item. Different data stores may have different columns. However, most data stores have some of the same columns, such as the time when the data was collected.

The Data Accessor can retrieve the following information about data stores used by WLDF for a server:

- A list of supported data store types, including:
  - HarvestedDataArchive

  - EventsDataArchive
  - ServerLog
  - DomainLog
  - HTTPAccessLog
  - DataSourceLog
  - WebAppLog
  - ConnectorLog
  - JMSMessageLog
  - JMSSAFMessageLog
  - CUSTOM
- A list of available data store instances
- The layout of each data store (information that describes the columns in the data store)

You can use the WLDFAccessRuntimeMBean to discover such data stores, determine the nature of the data they contain, and access their data selectively using a query.

For complete documentation about WebLogic logs, see Understanding WebLogic Logging Services in *Configuring Log Files and Filtering Log Messages for Oracle WebLogic Server*.

Accessing Diagnostic Data Online

Data Accessor provides access to data stores for individual servers. You can access diagnostic data from a running server.

You can access the data using one of the following ways:

- WebLogic Remote Console
- JMX APIs
- WebLogic Scripting Tool (WLST)
- WLDF query language

Accessing Data Using the Remote Console

You do not use the Data Accessor explicitly in the WebLogic Remote Console, but information collected by the Accessor is displayed, for example, in the Summary of Log Files page. See View Logs and Configure Logs in the *Oracle WebLogic Remote Console Online Help*.

Accessing Data Programmatically Using Runtime MBeans

The Data Accessor provides the following runtime MBeans for discovering data stores and retrieving data from them:

- Use the WLDFAccessRuntimeMBean to do the following:

  - Get the logical names of the available data stores on the server.
  - Look up a WLDFDataAccessRuntimeMBean to access the data from a specific data source, based on its logical name. The different data stores are uniquely identified by their logical names.

  See WLDFAccessRuntimeMBean in the *MBean Reference for Oracle WebLogic Server*.

- Use the WLDFDataAccessRuntimeMBean to retrieve data stores based on a search condition, or query. You can optionally specify a time interval with the query, to retrieve data records within a specified time duration. This MBean provides metadata about the columns of the data set and the earliest and latest timestamp of the records in the data store.

  Data Accessor runtime MBeans are currently created and registered lazily. So, when a remote client attempts to access them, they may not be present and an InstanceNotFoundException may be thrown.

  The client can retrieve the WLDFDataAccessRuntime's attribute of the WLDFAccessRuntime to cause all known data access runtimes to be created, for example:

```
ObjectName objName =
    new ObjectName("com.bea:ServerRuntime=" + serverName +
                   ",Name=Accessor," +
                   "Type=WLDFAccessRuntime," +
                   "WLDFRuntime=WLDFRuntime");
rmbs.getAttribute(objName, "WLDFDataAccessRuntimes");
```

  See WLDFDataAccessRuntimeMBean in the *MBean Reference for Oracle WebLogic Server*.

Using WLST to Access Diagnostic Data Online

Use the WLST `exportDiagnosticDataFromServer()` command to access diagnostic data from a running server. For the syntax and examples of this command, see Diagnostics Commands in the *WLST Command Reference for WebLogic Server*.

Using the WLDF Query Language with the Data Accessor

To query data from data stores, use the WLDF query language. For Data Accessor query language syntax, see WLDF Query Language.

Accessing Diagnostic Data Offline

You can use the WLST `exportDiagnosticData()` command to access historical diagnostic data from an offline server. For the syntax and examples of this command, see Diagnostics Commands in the *WLST Command Reference for WebLogic Server*.

> **Note:**
>
> You can use exportDiagnosticData to access archived data only from the machine on which the data is persisted.
>
> You cannot discover data store instances using the offline mode of the Data Accessor. You must already know what they are.

Accessing Diagnostic Data Programmatically

You can use the JMX API to access diagnostic data stored by WLDF.Example 14-1 shows the source Java code for a utility that uses the Accessor to query the different archive data stores.

Example 14-1 Sample Code to Use the WLDF Accessor

```
/*
 * WLAccessor.java
 *
 * Demonstration utility that allows query of the different ARCV data stores
 * via the WLDF Accessor.
 *
 */

 import javax.naming.Context;
 import weblogic.jndi.Environment;
 import java.util.Hashtable;
 import java.util.Iterator;
 import java.util.Properties;
 import weblogic.management.ManagementException;
 import weblogic.management.runtime.WLDFAccessRuntimeMBean;
 import weblogic.management.runtime.WLDFDataAccessRuntimeMBean;
 import weblogic.diagnostics.accessor.ColumnInfo;
 import weblogic.diagnostics.accessor.DataRecord;
 import java.io.File;
 import java.io.FileInputStream;
 import java.io.FileNotFoundException;
 import java.io.IOException;

 import javax.management.MBeanServerConnection;
 import javax.management.remote.JMXConnector;
 import javax.management.remote.JMXConnectorFactory;
 import javax.management.remote.JMXServiceURL;
 import javax.management.ObjectName;
 import weblogic.management.mbeanservers.runtime.RuntimeServiceMBean;
 import weblogic.management.runtime.ServerRuntimeMBean;
 import weblogic.management.jmx.MBeanServerInvocationHandler;
 import weblogic.management.configuration.ServerMBean;

 /**
  * Demonstration utility that allows query of the different ARCV data stores
  * via the WLDF Accessor. The class looks up the appropriate accessor and
  * executes the query given the specified query parameters.
  *
  * To see information about it's usage, compile this file and run
  *
  *   java WLAccessor usage
  */
public class WLAccessor {

  /** Creates a new instance of WLAccessor */
  public WLAccessor(Properties p) {
  initialize(p);
  }

  /**
  * Retrieve the specfied WLDFDataAccessRuntimeMBean instance for querying.
  */
  public WLDFDataAccessRuntimeMBean getAccessor(String accessorType)
  throws Throwable
```

```
{
// Get the runtime MBeanServerConnection
MBeanServerConnection runtimeMBS = this.getRuntimeMBeanServerConnection();

// Lookup the runtime service for the connected server
ObjectName rtSvcObjName = new ObjectName(RuntimeServiceMBean.OBJECT_NAME);
RuntimeServiceMBean rtService = null;

  rtService = (RuntimeServiceMBean)
    MBeanServerInvocationHandler.newProxyInstance(
      runtimeMBS, rtSvcObjName
      );

  // Walk the Runtime tree to the desired accessor instance.
  ServerRuntimeMBean srt = rtService.getServerRuntime();

  WLDFDataAccessRuntimeMBean ddar =
    srt.getWLDFRuntime().getWLDFAccessRuntime().
    lookupWLDFDataAccessRuntime(accessorType);

  return ddar;
}

/**
 * Execute the query using the given parameters, and display the formatted
 * records.
 */
public void queryEventData() throws Throwable
{
  String logicalName = "EventsDataArchive";
  WLDFDataAccessRuntimeMBean accessor = getAccessor(accessorType);

  ColumnInfo[] colinfo = accessor.getColumns();
  inform("Query string: " + queryString);

  int recordsFound = 0;
  Iterator actualIt =
    accessor.retrieveDataRecords(beginTime, endTime, queryString);
  while (actualIt.hasNext()) {
    DataRecord rec = (DataRecord)actualIt.next();
    inform("Record[" + recordsFound + "]: {");
    Object[] values = rec.getValues();
    for (int colno=0; colno < values.length; colno++) {
      inform("[" + colno + "]  "
             + colinfo[colno].getColumnName() +
             " (" +  colinfo[colno].getColumnTypeName() + "):   " +
              values[colno]);
    }
    inform("}");
    inform("");
    recordsFound++;
  }
  inform("Found " + recordsFound + " results");
}

/**
 * Main method that implements the tool.
 * @param args the command line arguments
 */
public static void main(String[] args) {
  try {
    WLAccessor acsr = new WLAccessor(handleArgs(args));
```

```
    acsr.queryEventData();
  } catch (UsageException uex) {
    usage();
  } catch (Throwable t) {
    inform("Caught exception, " + t.getMessage(), t);
    inform("");
    usage();
  }
}

public static class UsageException extends Exception {}

/**
 * Process the command line arguments, which are provided as name/value pairs.
*/
public static Properties handleArgs(String[] args) throws Exception
{
  Properties p = checkForDefaults();
  for (int i = 0; i < args.length; i++) {
    if (args[i].equalsIgnoreCase("usage"))
      throw new UsageException();

    String[] nvpair = new String[2];
    int token = args[i].indexOf('=');
    if (token < 0)
      throw new Exception("Invalid argument, " + args[i]);
    nvpair[0] = args[i].substring(0,token);
    nvpair[1] = args[i].substring(token+1);
    p.put(nvpair[0], nvpair[1]);
  }
  return p;
}

/**
 * Look for a default properties file
 */
public static Properties checkForDefaults() throws IOException {
  Properties defaults = new Properties();
  try {
    File defaultprops = new File("accessor-defaults.properties");
    FileInputStream defaultsIS = new FileInputStream(defaultprops);
    //inform("loading options from accessor-defaults.properties");
    defaults.load(defaultsIS);
    } catch (FileNotFoundException fnfex) {
    //inform("No accessor-defaults.properties found");
  }
  return defaults;
}
public static void inform(String s) {
  System.out.println(s);
}
public static void inform(String s, Throwable t) {
  System.out.println(s);
  t.printStackTrace();
}

private MBeanServerConnection getRuntimeMBeanServerConnection()
  throws IOException
{
  // construct jmx service url

  // "service:jmx:[url]/jndi/[mbeanserver-jndi-name]"
```

```
    JMXServiceURL serviceURL =
      new JMXServiceURL(
        "service:jmx:" + getServerUrl() +
        "/jndi/" + RuntimeServiceMBean.MBEANSERVER_JNDI_NAME
        );

    // specify the user and pwd. Also specify weblogic provide package
    inform("user name [" + username + "]");
    inform("password [" + password + "]");
    Hashtable h = new Hashtable();
    h.put(Context.SECURITY_PRINCIPAL, username);
    h.put(Context.SECURITY_CREDENTIALS, password);
    h.put(JMXConnectorFactory.PROTOCOL_PROVIDER_PACKAGES,
          "weblogic.management.remote");
    // get jmx connector
    JMXConnector connector = JMXConnectorFactory.connect(serviceURL, h);

    inform("Using JMX Connector to connect to " + serviceURL);
    return connector.getMBeanServerConnection();
  }

  private void initialize(Properties p) {
    serverUrl = p.getProperty("url","t3://localhost:7001");
    username = p.getProperty("user","weblogic");
    password = p.getProperty("pass","password");
    queryString = p.getProperty("query","SEVERITY IN
('Error','Warning','Critical','Emergency')");
    accessorType = p.getProperty("type","ServerLog");

    try {
      beginTime = Long.parseLong(p.getProperty("begin","0"));

      String end = p.getProperty("end");
      endTime = (end==null) ? Long.MAX_VALUE : Long.parseLong(end);
    } catch (NumberFormatException nfex) {
      throw new RuntimeException("Error formatting time bounds", nfex);
    }
  }

  private static void usage() {
    inform("");
    inform("");
    inform("Usage: ");
    inform("");
    inform("  java WLAccessor [options]");
    inform("");
    inform("where [options] can be any combination of the following: ");
    inform("");
    inform("    usage                   Prints this text and exits");
    inform("    url=<url>               default: 't3://localhost:7001'");
    inform("    user=<username>         default: 'weblogic'");
    inform("    pass=<password>         default: 'password'");
    inform("    begin=<begin-timestamp> default: 0");
    inform("    end=<end-timestamp>     default: Long.MAX_VALUE");
    inform("    query=<query-string>    default: \"SEVERITY IN
('Error','Warning','Critical','Emergency')\"");
    inform("    type=<accessor-type>    default: 'ServerLog'");
    inform("");
    inform("Example:");
    inform("");
    inform("    java WLAccessor user=system pass=gumby1234 url=http://myhost:8000 \\");
    inform("       query=\"SEVERITY = 'Error'\" begin=1088011734496 type=ServerLog");
```

```
    inform("");
    inform("");
    inform("");
    inform("All properties (except \"usage\") can all be specified in a file ");
    inform("in the current working directory. The file must be named: ");
    inform("");
    inform("           \"accessor-defaults.properties\"");
    inform("");
    inform("Each property specified in the defaults file can still be ");
    inform("overridden on the command-line as shown above");
    inform("");
  }

  /** Getter for property serverUrl.
   * @return Value of property serverUrl.
   *
   */
  public java.lang.String getServerUrl() {
    return serverUrl;
  }

  /** Setter for property serverUrl.
   * @param serverUrl New value of property serverUrl.
   *
   */
  public void setServerUrl(java.lang.String serverUrl) {
    this.serverUrl = serverUrl;
  }

  protected String serverName = null;
  protected String username = null;
  protected String password = null;
  protected String queryString = "";
  private String serverUrl = "t3://localhost:7001";
  private String accessorType = null;

  private long endTime = Long.MAX_VALUE;
  private long beginTime = 0;

  private WLDFAccessRuntimeMBean dar = null;

}
```

Resetting the System Clock Can Affect How Data Is Archived and Retrieved

Resetting the system clock to an earlier time while diagnostic data is being written to the WLDF Archive or logs can cause unexpected results when you query that data based on a timestamp.For example, consider the following sequence of events:

1. At 2:00 p.m., a diagnostic event is archived as RECORD_200, with a timestamp of 2:00:00 PM.
2. At 2:30 p.m., a diagnostic event is archived as RECORD_230, with a timestamp of 2:30:00 PM.
3. At 3:00 p.m., the system clock is reset to 2:00 p.m.
4. At 2:15 p.m. (after the clock was reset), a diagnostic event is archived as RECORD_215, with a timestamp of 2:15:00 PM.

5. You issue a query to retrieve records generated between 2:00 and 2:20 p.m.

The query will not retrieve RECORD_215, because the 2:30:00 PM timestamp of RECORD_230 ends the query.

15

Deploying WLDF Application Modules

The WebLogic Diagnostics Framework (WLDF) supports the ability to configure and manage instrumentation for an application by configuring and deploying a diagnostics application module as resource that is scoped to that application.The configuration of the diagnostics application module is persisted in a descriptor file that you deploy with the application. A diagnostic application module deployed in this way is available only to the application in which it is enclosed. Using application-scoped diagnostic application modules ensures that an application always has access to the required resources and simplifies the process of deploying the application in new environments.

> **Note:**
>
> Note the following:
>
> - Only the Instrumentation component can be used with applications (see Configuring Application-Scoped Instrumentation).
> - For instrumentation to be available for an application, instrumentation must be enabled on the server to which the application is deployed. (Server-scoped instrumentation is enabled and disabled in the `<instrumentation>` element of the diagnostics descriptor for the server.)
> - You can deploy an application using a deployment plan, which permits dynamic configuration updates.

The following sections explain how to deploy diagnostic application modules:

- Deploying a Diagnostic Module as an Application-Scoped Resource
- Using Deployment Plans to Dynamically Control Instrumentation Configuration
  WebLogic Server supports deployment plans, as specified in the Jakarta EE Deployment Specification API (JSR-88). With deployment plans, you can modify the configuration of an application after it is built, without having to modify the application archives.
- Using a Deployment Plan: Overview
  You can use a deployment plan to dynamically control the configuration options of an application-scoped diagnostic module.
- Creating a Deployment Plan Using weblogic.PlanGenerator
  The PlanGenerator tool inspects all Jakarta EE deployment descriptors in the selected application, and creates a deployment plan with null variables for all relevant WebLogic Server deployment properties that configure external resources for the application.
- Sample Deployment Plan for Diagnostics
  You can create a simple deployment plan for diagnostics using PlanGenerator.
- Enabling Java HotSwap
  You can enable Java HotSwap to update the configuration of the application with the modified deployment plan values.

- Deploying an Application with a Deployment Plan
  To take advantage of the dynamic control provided by a deployment plan, you must deploy the application with the plan.
- Updating an Application with a Modified Plan
  You can change configuration settings by modifying the deployment plan and then updating or redeploying the application, depending on whether HotSwap is enabled.

Deploying a Diagnostic Module as an Application-Scoped Resource

To deploy a diagnostic module as an application-scoped resource, you configure the module in a descriptor file named `weblogic-diagnostics.xml`. You then package the descriptor file with the application archive in the *`ARCHIVE_PATH`*`/META-INF` directory for the deployed application.

For example:

```
C:\Oracle\Middleware\Oracle_Home\user_projects\applications\medrec\dist\standalone\exploded\medrec\META-INF\weblogic-diagnostics.xml
```

You can deploy the diagnostic module in both exploded and unexploded archives.

> **Note:**
>
> If the EAR archive contains WAR, RAR or EJB modules that have the `weblogic-diagnostics.xml` descriptors in their `META-INF` directory, those descriptors are ignored.

You can use any of the standard WebLogic Server tools provided for controlling deployment, including the WebLogic Administrative Console or the WebLogic Scripting Tool (WLST).

For information about creating modules and deploying applications, see *Deploying Applications to Oracle WebLogic Server*.

Because of the different ways that diagnostic application modules and diagnostic system modules are deployed, there are some differences in how you can reconfigure them and when those changes take place, as shown in Table 15-1. The details of how to work with diagnostic application modules is described throughout this section. See Configuring Instrumentation, for information about working with diagnostic system modules.

Table 15-1 Comparing System and Application Modules

Monitor Type	Add/Remove Objects Dynamically	Add/Remove Objects with Console	Modify with JMX Remotely	Modify with JSR-88 (non-remote)	Modify with Console
System Module	Yes	Yes	Yes	No	Yes - via JMX

Table 15-1 (Cont.) Comparing System and Application Modules

Monitor Type	Add/Remove Objects Dynamically	Add/Remove Objects with Console	Modify with JMX Remotely	Modify with JSR-88 (non-remote)	Modify with Console
Application Module	Yes, when HotSwap[1] is enabled No, when HotSwap is not enabled: module must be redeployed	Yes	No	Yes	Yes - via plan

1 See Using Deployment Plans to Dynamically Control Instrumentation Configuration, for information about HotSwap.

Using Deployment Plans to Dynamically Control Instrumentation Configuration

WebLogic Server supports deployment plans, as specified in the Jakarta EE Deployment Specification API (JSR-88). With deployment plans, you can modify the configuration of an application after it is built, without having to modify the application archives.

For complete documentation on using deployment plans in WebLogic Server, see Configuring Applications for Production Deployment in *Deploying Applications to Oracle WebLogic Server*.

If you want to reconfigure an application that was deployed without a deployment plan, you must undeploy, unarchive, reconfigure, re-archive, and then redeploy the application. With a configuration plan, you can dynamically change many configuration options simply by updating the plan, without modifying the application archive.

If you enable a feature called Java HotSwap (see Enabling Java HotSwap) before deploying your application with a deployment plan, you can dynamically update all instrumentation settings without redeploying the application. If you do not enable HotSwap, or if you do not use a deployment plan, changes to some instrumentation settings require redeployment, as shown in Table 15-2.

Table 15-2 When Application Instrumentation Configuration Changes Take Effect

Scenario / Settings to Use =>	Add and remove monitors	Attach and detach actions	Enable and disable monitors
Application deployed with a deployment plan, HotSwap enabled	Dynamic	Dynamic	Dynamic
Application deployed with a deployment plan, HotSwap not enabled	Must redeploy application[1]	Dynamic	Dynamic
Application deployed without a deployment plan	Must redeploy application	Must redeploy application	Must redeploy application

1 If HotSwap is not enabled, you can "remove" a monitor, but that just disables it. The instrumentation code is still woven into the application code. You cannot re-enable it through a modified plan.

You can use a deployment plan to dynamically update configuration elements without redeploying the application.

- <enabled>
- <dye-filtering-enabled>
- <dye-mask>
- <action>

Using a Deployment Plan: Overview

You can use a deployment plan to dynamically control the configuration options of an application-scoped diagnostic module.

The general process for creating and using a deployment plan is as follows:

1. Create a well-formed `weblogic-diagnostics.xml` descriptor file for the application.

   Oracle recommends that you create an empty descriptor. This provides full flexibility for dynamically modifying the configuration. It is possible to create monitors in the original descriptor file and then use a deployment plan to override the settings. However, you will be unable to completely remove monitors without redeploying. If you add monitors using a deployment plan to an empty descriptor, all such monitors can be removed. For information about configuring diagnostic application modules, see Configuring Application-Scoped Instrumentation.

   The schema for `weblogic-diagnostics.xml` is available at `http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/weblogic-diagnostics.xsd`.
2. Place the descriptor file `weblogic-diagnostics.xml`, in the top-level `META-INF` directory of the appropriate archive.
3. Create a deployment plan, for example by using weblogic.PlanGenerator. See Creating a Deployment Plan Using weblogic.PlanGenerator.
4. Start the server, optionally enabling Java HotSwap. See Enabling Java HotSwap.
5. Deploy the application using the deployment plan. See Deploying an Application with a Deployment Plan).
6. When needed, edit the plan and update the application with the plan. See Updating an Application with a Modified Plan.

Creating a Deployment Plan Using weblogic.PlanGenerator

The PlanGenerator tool inspects all Jakarta EE deployment descriptors in the selected application, and creates a deployment plan with null variables for all relevant WebLogic Server deployment properties that configure external resources for the application.

You can use the weblogic.PlanGenerator tool to create an initial deployment plan, and interactively override specific properties of the `weblogic-diagnostics.xml` descriptor.

To create the plan, use the following syntax:

```
java weblogic.PlanGenerator -plan output-plan.xml [options]
   application-path
```

For example:

```
java weblogic.PlanGenerator -plan foo.plan -dynamics /test/apps/mywar
```

> **Note:**
>
> The -dynamics options specifies that the plan should be generated to include only those options that can be dynamically updated.

For more information about creating and using deployment plans, see Configuring Applications for Production Deployment in *Deploying Applications to Oracle WebLogic Server*.

For more information about using PlanGenerator, see weblogic.PlanGenerator Command Line Reference and Exporting an Application for Deployment to New Environments in *Deploying Applications to Oracle WebLogic Server*

Sample Deployment Plan for Diagnostics

You can create a simple deployment plan for diagnostics using PlanGenerator.

Example 15-1 shows a simple deployment plan generated using weblogic.PlanGenerator. (For readability, some information has been removed.) The plan enables the Servlet_Before_Service monitor and attaches to it the actions DisplayArgumentsAction and StackDumpAction.

Example 15-1 Sample Deployment Plan

```
<?xml version='1.0' encoding='UTF-8'?>
<deployment-plan xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
global-variables="false">
  <application-name>jsp_expr_root</application-name>

  <variable-definition>
    <!-- Add two additional actions to Servlet_Before_Service monitor -->
    <variable>
      <name>WLDFInstrumentationMonitor_Servlet_Before_Service_Actions_113050559713922</name>
      <value>"DisplayArgumentsAction","StackDumpAction"</value>
    </variable>
    <-- Enable the Servlet_Before_Service monitor -->
    <variable>
      <name>WLDFInstrumentationMonitor_Servlet_Before_Service_Enabled_113050559713927</name>
      <value>true</value>
    </variable>
  </variable-definition>

  <module-override>
    <module-name>jspExpressionWar</module-name>
    <module-type>war</module-type>
    <module-descriptor external="false">
      <root-element>weblogic-web-app</root-element>
      <uri>WEB-INF/weblogic.xml</uri>
    </module-descriptor>
    <module-descriptor external="false">
    <root-element>web-app</root-element>
    <uri>WEB-INF/web.xml</uri>
    </module-descriptor>
    <module-descriptor external="false">
      <root-element>wldf-resource</root-element>
      <uri>META-INF/weblogic-diagnostics.xml</uri>
      <variable-assignment>
        <name>WLDFInstrumentationMonitor_Servlet_Before_Service_Actions_113050559713922</name>
```

```
        <xpath>/wldf-resource/instrumentation/wldf-instrumentation-monitor/
[name="Servlet_Before_Service"]/action</xpath>
        </variable-assignment>
        <variable-assignment>
          <name>WLDFInstrumentationMonitor_Servlet_Before_Service_Enabled_113050559713927</name>
          <xpath>/wldf-resource/instrumentation/wldf-instrumentation-monitor/
[name="Servlet_Before_Service"]/enabled</xpath>
        </variable-assignment>
      </module-descriptor>
    </module-override>
  <config-root xsi:nil="true"></config-root>
</deployment-plan>
```

For a list and documentation of diagnostic monitors and actions that you can specify in the deployment plan, see WLDF Instrumentation Library.

Enabling Java HotSwap

You can enable Java HotSwap to update the configuration of the application with the modified deployment plan values.

To enable Java HotSwap, start the server with the following command line switch:

```
-javaagent:$WL_HOME/server/lib/diagnostics-agent.jar
```

Deploying an Application with a Deployment Plan

To take advantage of the dynamic control provided by a deployment plan, you must deploy the application with the plan.

You can use any of the standard WebLogic Server tools for controlling deployment, including the WebLogic Remote Console or the WebLogic Scripting Tool (WLST). For example, the following WLST command deploys an application with a corresponding deployment plan.

```
wls:/mydomain/serverConfig> deploy('myApp', './myApp.ear', 'myserver',
      'nostage', './plan.xml')
```

After deployment, the effective diagnostic monitor configuration is a combination of the original descriptor, combined with the overridden attribute values from the plan. If the original descriptor did not include a monitor with the given name and the plan overrides an attribute of such a monitor, the monitor is added to the set of monitors to be used with the application. This way, if your application is built with an empty `weblogic-diagnostics.xml` descriptor, you can add diagnostic monitors to the application during or after the deployment process without having to modify the application archive.

Updating an Application with a Modified Plan

You can change configuration settings by modifying the deployment plan and then updating or redeploying the application, depending on whether HotSwap is enabled.

See Enabling Java HotSwap to see when you can simply update the application and when you must redeploy it. You can use any of the standard WebLogic Server tools for updating or redeploying, including the WebLogic Remote Console or the WebLogic Scripting Tool (WLST).

If you enabled HotSwap, you can update the configuration for the application with the modified plan values by *updating* the application with the plan. For example, the following WLST command updates an application with a plan:

```
wls:/mydomain/serverConfig> updateApplication('BigApp',
         'c:/myapps/BigApp/newPlan/plan.xml', stageMode='STAGE',
         testMode='false')
```

If you did not enable HotSwap, you must *redeploy* the application for certain changes to take effect. For example, the following WLST command redeploys an application using a plan:

```
wls:/mydomain/serverConfig> redeploy('myApp' 'c:/myapps/plan.xml')
```

16

Configuring and Using WLDF Programmatically

As an alternative to using the WebLogic Remote Console or Fusion Middleware Control to enable, configure, and monitor the WebLogic Diagnostics Framework (WLDF), you can also use the JMX API or the WebLogic Scripting Tool (WLST) to perform these tasks programmatically.

See the following for additional information about how to develop and deploy JMX applications and to use WLST:

- *Developing Applications for Oracle WebLogic Server*
- *Developing Manageable Applications Using JMX for Oracle WebLogic Server*
- *Developing Custom Management Utilities Using JMX for Oracle WebLogic Server*
- *Deploying Applications to Oracle WebLogic Server*
- Understanding the WebLogic Scripting Tool

How WLDF Generates and Retrieves Data

The process WLDF uses to generate and retrieve diagnostic data largely depends on how its main components are configured.

In general, diagnostic data is generated and retrieved by WLDF components following this process:

- The WLDF XML descriptor file settings for the Harvester, Instrumentation, Image Capture, and Policies and Actions components determine the type and amount of diagnostic data generated while a server is running.
- The diagnostic context and instrumentation settings filter and monitor this data as it flows through the system. Data is harvested, actions are executed, events are generated, and configured notifications are sent.
- The Archive component stores the data.
- The Accessor component retrieves the data.

Configuration is primarily an administrative task, accomplished either through the WebLogic Remote Console or through WLST scripts. Deployable descriptor modules, XML configuration files, are the primary method for configuring diagnostic resources at both the system level (servers and clusters) and at the application level. (For information about configuring WLDF resources, see Understanding WLDF Configuration.)

Output retrieval via the Accessor component can be either an administrative or a programmatic task.

Mapping WLDF Components to Beans and Packages

When you create diagnostic system modules using the WebLogic Remote Console or WLST, WebLogic Server creates MBeans (managed beans) for each module. You can access these MBeans using JMX or WLST. Because WLST is a JMX client; any task you can perform using WLST you can also perform programmatically through JMX.
Table 16-1 lists the beans and packages associated with WLDF and its components.
Figure 16-1 groups the beans by type.

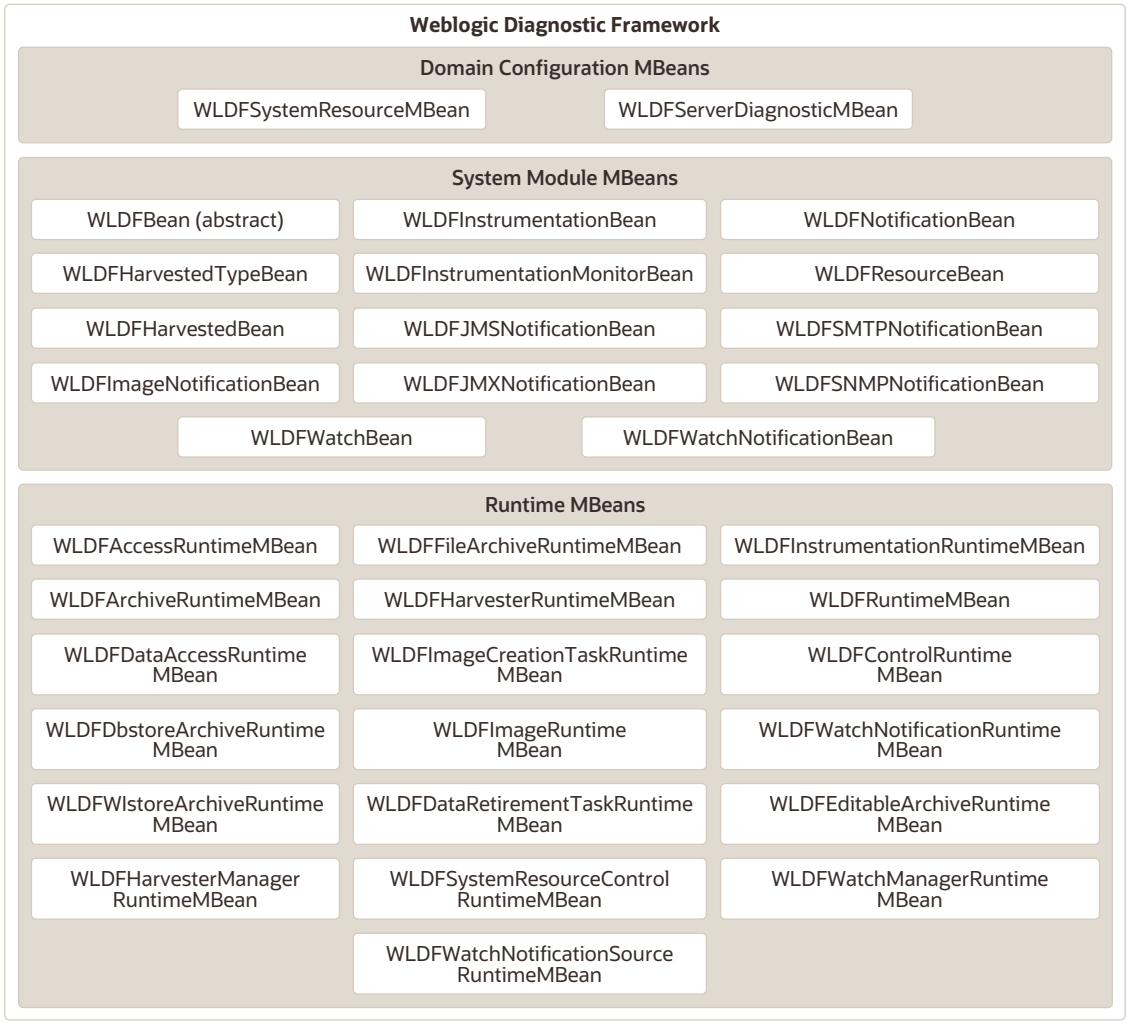
Table 16-1 Mapping WLDF Components to Beans and Packages

Component	Beans / Packages
WLDF	WLDFServerDiagnosticMBean WLDFSystemResourceMBean WLDFBean (abstract) WLDFResourceBean WLDFRuntimeMBean
Diagnostic Image	WLDFImageNotificationBean WLDFImageCreationTaskRuntimeMBean WLDFImageRuntimeMBean
Instrumentation	WLDFInstrumentationBean WLDFInstrumentationMonitorBean WLDFInstrumentationRuntimeMBean
Diagnostic Context	Package: weblogic.diagnostics.context DiagnosticContextHelper DiagnosticContextConstants
Harvester	WLDFHarvesterBean WLDFHarvestedTypeBean WLDFHarvesterRuntimeMBean
Policies and Actions	WLDFNotificationBean WLDFWatchNotificationBean WLDFJMSNotificationBean WLDFJMXNotificationBean WLDFSMTPNotificationBean WLDFSNMPNotificationBean WLDFWatchNotificationRuntimeMBean Package: weblogic.diagnostics.watch JMXWatchNotification WatchNotification

Table 16-1 (Cont.) Mapping WLDF Components to Beans and Packages

Component	Beans / Packages
Archive	WLDFArchiveRuntimeMBean WLDFDbstoreArchiveRuntimeMBean WLDFFileArchiveRuntimeMBean WLDFWlstoreArchiveRuntimeMBean
Accessor	WLDFAccessRuntimeMBean WLDFDataAccessRuntimeMBean
Runtime Control	WLDFControlRuntimeMBean WLDFSystemResourceControlRuntimeMBean

Figure 16-1 WLDF Configuration MBeans, Runtime MBeans, and System Module Beans



Programming Tools

WLDF supports the use of multiple tools, such as WLST, JMX, and REST, for performing tasks programmatically.

For example, you can use these tools to do the following:

- Create and modify diagnostic descriptor files to configure the WLDF Harvester, Instrumentation, and Policies and Actions components at the server level.
- Use JMX to access WLDF operations and attributes.
- Use JMX to create custom MBeans that contain harvestable data. You can then configure the Harvester to collect that data and configure policies and actions to monitor the values.
- Write Java programs that perform the following tasks:
  - Capture notifications using JMX listeners.
  - Capture notifications using JMS.
  - Retrieve archived data through the Accessor. (The Accessor, as are the other components, is surfaced as JMX; you can use WLST or straight JMX programming to retrieve diagnostic data.)
- Configuration and Runtime APIs

Configuration and Runtime APIs

The configuration and runtime APIs configure and monitor WLDF. Both the configuration and runtime APIs are exposed as MBeans.

- The configuration MBeans and system module Beans create and configure WLDF resources, and determine their runtime behavior.
- The runtime MBeans monitor the runtime state and the operations defined for the different components.

You can use the APIs to configure, activate, and deactivate data collection; to configure policies, actions, alarms, and diagnostic image captures; and to access data.

- Configuration APIs
- Runtime APIs

Configuration APIs

The Configuration APIs define interfaces that are used to configure the following WLDF components:

- Data Collectors: You can use the configuration APIs to configure and control Instrumentation, Harvesting, and Image Capture.
  - For the Instrumentation component, you can enable, disable, create, and destroy server-level instrumentation and instrumentation monitors.

> **Note:**
>
> The configuration APIs do not support configuration of application-level instrumentation. However, configuration changes for application-level instrumentation can be effected using Java Specification Request (JSR) 88 APIs.

  - For the Harvester component, you can add and remove types to be harvested, specify which attributes and instances of those types are to be harvested, and set the sample period for the Harvester.
  - For the Diagnostic Image Capture component, you can set the name and path of the directory in which the image capture is to be stored and the events image capture interval, that is, the time interval during which recently archived events are captured in the diagnostic image.
- Policies and Actions: You can use the configuration APIs to enable, disable, create, and destroy policies and actions. You can also use the configuration APIs to:
  - Set the policy type, policy expressions, and severity for policies
  - Set alarm type and alarm reset period for actions
  - Configure a policy to execute a diagnostic image capture
  - Add and remove actions from policies
- Archive: Set the archive type and the archive directory

Runtime APIs

The runtime APIs define interfaces that are used to monitor the runtime state of the WLDF components. Instances of these APIs are instantiated on instances of individually managed servers. These APIs are defined as runtime MBeans, so JMX clients can easily access them.

The runtime APIs encapsulate all other runtime interfaces for the individual WLDF components. These APIs are included in the weblogic.management.runtime package.

You can use the runtime APIs to monitor the following WLDF components:

- Data Collectors—You can use the runtime APIs to monitor the Instrumentation, Harvester, and the Image Capture components.
  - For the Instrumentation component, you can monitor joinpoint count statistics, the number of classes inspected for instrumentation monitors, the number of classes modified, and the time it takes to inspect a class for instrumentation monitors.
  - For the Harvester component, you can query the set of harvestable types, harvestable attributes, and harvestable instances (that is, the instances that are currently harvestable for specific types). And, you can also query which types, attributes, and instances are currently configured for harvesting. The sampling interval and various runtime statistics pertaining to the harvesting process are also available.
  - For the Image Capture component, you can specify the destination and lockout period for diagnostic images and initiate image captures.
- Policies and Actions: You can use the runtime APIs to monitor the Policies and Actions and Archive components.

  - For the Policies and Actions component, you can reset policy alarms and monitor statistics about policy expression evaluations and policies triggered, including information about the analysis of alarms, events, log records, and harvested metrics.
- Archive: You can monitor information about the archive, such as file name and archive statistics.
- Data Accessor—You can use the runtime APIs to retrieve the diagnostic data persisted in the different archives. The runtime APIs also support data filtering by allowing you to specify a query expression to search the data from the underlying archive. You can monitor information about column type maps (a map relating column names to the corresponding type names for the diagnostic data), statistics about data record counts and timestamps, and cursors (cursors are used by clients to fetch data records).

WLDF Packages

WLDF provides two packages you can use to perform select operations programmatically.

- weblogic.diagnostics.context contains:
  - DiagnosticContextConstants, which defines the indices of dye flags supported by the WebLogic diagnostics system.
  - DiagnosticContextHelper, which provides applications limited access to the diagnostic context.
- weblogic.diagnostics.watch contains:
  - JMXWatchNotification, an extended JMX notification object which includes additional information about the notification. This information is contained in the referenced WatchNotification object returned from method getExtendedInfo.
  - WatchNotification, which defines an action for a policy.

Programming WLDF: Examples

WLDF provides a number of beans and packages you can use to access and modify information about a running server. The following examples show how to use these components:
In addition, see the WLST and JMX examples in WebLogic Scripting Tool Examples.

- Example: DiagnosticContextExample.java
- Example: HarvesterMonitor.java
- Example: JMXAccessorExample.java

Example: DiagnosticContextExample.java

The following example uses the DiagnosticContextHelper class from the weblogic.diagnostics.context package to get and set the value of the DYE_0 flag. (For information about diagnostic contexts, see Configuring the DyeInjection Monitor to Manage Diagnostic Contexts.)

To compile and run the program:

1. Copy the DiagnosticContextExample.java example (Example 16-1) to a directory and compile it with:

```
javac -d . DiagnosticContextExample.java
```

This will create the ./weblogic/diagnostics/examples directory and populate it with DiagnosticContextExample.class.

2. Run the program. The command syntax is:

```
java weblogic.diagnostics.examples.DiagnosticContextExample
```

Sample output is similar to:

```
# java weblogic.diagnostics.examples.DiagnosticContextExample
ContextId=5b7898f93bf010ce:40305614:1048582efd4:-8000-0000000000000001
isDyedWith(DYE_0)=false
isDyedWith(DYE_0)=true
```

Example 16-1 Example: DiagnosticContextExample.java

```
package weblogic.diagnostics.examples;
import weblogic.diagnostics.context.DiagnosticContextHelper;
public class DiagnosticContextExample {
  public static void main(String args[]) throws Exception {
    System.out.println("ContextId=" +
       DiagnosticContextHelper.getContextId());
    System.out.println("isDyedWith(DYE_0)=" +
       DiagnosticContextHelper.isDyedWith(DiagnosticContextHelper.DYE_0));
    DiagnosticContextHelper.setDye(DiagnosticContextHelper.DYE_0, true);
    System.out.println("isDyedWith(DYE_0)=" +
         DiagnosticContextHelper.isDyedWith(DiagnosticContextHelper.DYE_0));
  }
}
```

Example: HarvesterMonitor.java

The HarvesterMonitor program uses the Harvester JMX notification to identify when a harvest cycle has occurred. It then retrieves the new values using the Accessor. All access is performed through JMX.

For information about the Harvester component, see Configuring the Harvester for Metric Collection.

A description of notification listeners and the HarvesterMonitor.java code are provided in the following sections:

- Notification Listeners
- HarvesterMonitor.java

Notification Listeners

Notification listeners provide an appropriate implementation for a particular transport medium. For example, SMTP notification listeners provide the mechanism to establish an SMTP connection with a mail server and send an e-mail with the notification instance that it receives. JMX, SNMP, JMS and other types of listeners provide their respective implementations as well.

> **Note:**
>
> You can develop plug-ins that propagate events generated by the WebLogic Diagnostics Framework using transport mediums other than SMTP, JMX, SNMP, or JMS. One approach is to use the JMX NotificationListener interface to implement an object, and then propagate the notification according to the requirements of the selected transport medium.

Table 16-2 describes each notification listener type that is provided with WebLogic Server and the relevant configuration settings for each type.

Table 16-2 Notification Listener Types

Notification Medium	Description	Configuration Parameter Requirements
JMS	Propagated via JMS Message queues or topics.	Required: Destination JNDI name. Optional: Connection factory JNDI name (use the default JMS connection factory if not present).
JMX	Propagated via standard JMX notifications.	None required. Uses predefined singleton for posting the event.
SMTP	Propagated via regular e-mail.	Required: MailSession JNDI name and Destination e-mail. Optional: Subject and body (if not specified, use default)
SNMP	Propagated via SNMP traps and the WebLogic Server SNMP Agent.	None required, but the SNMPTrapDestination MBean must be defined in the WebLogic SNMP agent.

By default, all notifications executed from policies are stored in the server log file in addition to being executed through the configured medium.

HarvesterMonitor.java

To compile and run the HarvesterMonitor program:

1. Copy the HarvesterMonitor.java example (Example 16-2) to a directory and compile it with:

   ```
   javac -d . HarvesterMonitor.java
   ```

   This creates the `./weblogic/diagnostics/examples` directory and populates it with `HarvesterMonitor.class` and `HarvesterMonitor$HarvestCycleHandler.class`.

2. Start the monitor. The command syntax is:

   ```
   java HarvesterMonitor <server> <port> <uname> <pw> [<types>]
   ```

   You need access to a WebLogic Server instance, and know the server's name, port number, administrator's login name, and the administrator's password.

   You can provide an optional list of harvested type names. If provided, the program displays only the values for those types. However, for each selected type, the monitor displays the

complete set of collected values; there is no way to constrain the values that are displayed for a selected type.

Only values that are explicitly configured for harvesting are displayed. Values collected solely to support policies (implicit values) are not displayed.

The following command requires that '**.**' is in the `CLASSPATH` variable, and that you run the command from the directory where you compiled the program. The command connects to the `myserver` server, at port 7001, as user `weblogic` (and also the password, shown as *password*):

```
java weblogic.diagnostics.examples.HarvesterMonitor myserver 7001
  weblogic password
```

See Example 16-3 for an example of output from the HarvesterMonitor.

Example 16-2 Example: HarvesterMonitor.java

```
package weblogic.diagnostics.examples;
import weblogic.management.mbeanservers.runtime.RuntimeServiceMBean;
import javax.management.*;
import javax.management.remote.*;
import javax.naming.Context;
import java.util.*;
public class HarvesterMonitor {

  private static String accessorRuntimeMBeanName;
   private static ObjectName accessorRuntimeMBeanObjectName;
  private static String harvRuntimeMBeanName;
   private static ObjectName harvRuntimeMBeanObjectName;
  private static MBeanServerConnection rmbs;
  private static ObjectName getObjectName(String objectNameStr) {
    try { return new ObjectName(getCanonicalName(objectNameStr)); }
    catch (RuntimeException x) { throw x; }
    catch (Exception x) { x.printStackTrace(); throw new
                          RuntimeException(x); }
  }
  private static String getCanonicalName(String objectNameStr) {
    try { return new ObjectName(objectNameStr).getCanonicalName(); }
    catch (RuntimeException x) { throw x; }
    catch (Exception x) { x.printStackTrace(); throw new
                           RuntimeException(x); }
  }
  private static String serverName;
   private static int port;
   private static String userName;
   private static String password;
  private static ArrayList typesToMonitor = null;
  public static void main(String[] args) throws Exception {
    if (args.length < 4) {
       System.out.println(
           "Usage: java weblogic.diagnostics.harvester.HarvesterMonitor " +
           "<serverName> <port> <userName> <password> [<types>]" +
            weblogic.utils.PlatformConstants.EOL +
            "   where <types> (optional) is a comma-separated list " +
            "of types to monitor.");
       System.exit(1);
    }
    serverName = args[0];
    port = Integer.parseInt(args[1]);
    userName = args[2];
    password = args[3];
    accessorRuntimeMBeanName = getCanonicalName(
```

```
      "com.bea:ServerRuntime=" + serverName +
       ",Name=HarvestedDataArchive,Type=WLDFDataAccessRuntime" +
       ",WLDFAccessRuntime=Accessor,WLDFRuntime=WLDFRuntime");
 accessorRuntimeMBeanObjectName =
      getObjectName(accessorRuntimeMBeanName);
 harvRuntimeMBeanName = getCanonicalName(
      "com.bea:ServerRuntime=" + serverName +
      ",Name=WLDFHarvesterRuntime,Type=WLDFHarvesterRuntime" +
      ",WLDFRuntime=WLDFRuntime");
 harvRuntimeMBeanObjectName = getObjectName(harvRuntimeMBeanName);
 if (args.length > 4) {
   String typesStr = args[4];
   typesToMonitor = new ArrayList();
   int index;
   while ((index = typesStr.indexOf(",")) > 0) {
     String typeName = typesStr.substring(0,index).trim();
     typesToMonitor.add(typeName);
     typesStr = typesStr.substring(index+1);
   }
   typesToMonitor.add(typesStr.trim());
 }
 rmbs = getRuntimeMBeanServerConnection();
 new HarvesterMonitor().new HarvestCycleHandler();
 while(true) {Thread.sleep(100000);}
}
static protected String JNDI = "/jndi/";
static public MBeanServerConnection getRuntimeMBeanServerConnection()
    throws Exception {
 JMXServiceURL serviceURL;
 serviceURL =
     new JMXServiceURL("t3",
     "localhost",
     port,
     JNDI + RuntimeServiceMBean.MBEANSERVER_JNDI_NAME);
 System.out.println("ServerName=" + serverName);
 System.out.println("URL=" + serviceURL);
 Hashtable h = new Hashtable();
 h.put(Context.SECURITY_PRINCIPAL, userName);
 h.put(Context.SECURITY_CREDENTIALS, password);
 h.put(JMXConnectorFactory.PROTOCOL_PROVIDER_PACKAGES,
       "weblogic.management.remote");
 JMXConnector connector = JMXConnectorFactory.connect(serviceURL,h);
 return connector.getMBeanServerConnection();
}
class HarvestCycleHandler implements NotificationListener {
 // used to track harvest cycles
 private int timestampIndex;
 private int domainIndex;
 private int serverIndex;
 private int typeIndex;
 private int instNameIndex;
 private int attrNameIndex;
 private int attrTypeIndex;
 private int attrValueIndex;
 long lastSampleTime = System.currentTimeMillis();
 HarvestCycleHandler() throws Exception{
   System.out.println("Harvester monitor started...");
   try {
     setUpRecordIndices();
     rmbs.addNotificationListener(harvRuntimeMBeanObjectName,
                                  this, null, null);
   }
```

```
  catch (javax.management.InstanceNotFoundException x) {
    System.out.println("Cannot find JMX data. " +
                       "Is the server name correct?");
    System.exit(1);
  }
}
private void setUpRecordIndices() throws Exception {
  Map columnIndexMap = (Map)rmbs.getAttribute(
      accessorRuntimeMBeanObjectName, "ColumnIndexMap");
  timestampIndex =            ((Integer)columnIndexMap.get("TIMESTAMP")).intValue();
  domainIndex =
      ((Integer)columnIndexMap.get("DOMAIN")).intValue();
  serverIndex =
      ((Integer)columnIndexMap.get("SERVER")).intValue();
  typeIndex =
      ((Integer)columnIndexMap.get("TYPE")).intValue();
  instNameIndex =
      ((Integer)columnIndexMap.get("NAME")).intValue();
  attrNameIndex =
      ((Integer)columnIndexMap.get("ATTRNAME")).intValue();
  attrTypeIndex =
      ((Integer)columnIndexMap.get("ATTRTYPE")).intValue();
  attrValueIndex =            ((Integer)columnIndexMap.get("ATTRVALUE")).intValue();
}
public synchronized void handleNotification(Notification notification,
                                            Object handback) {
   System.out.println("\n-----------------------------------------");
  long thisSampleTime = System.currentTimeMillis()+1;
  try {
    String lastTypeName = null;
    String lastInstName = null;
    String cursor = (String)rmbs.invoke(accessorRuntimeMBeanObjectName,
                    "openCursor",
                    new Object[]{new Long(lastSampleTime),
                    new Long(thisSampleTime), null},
                    new String[]{ "java.lang.Long",
                    "java.lang.Long", "java.lang.String" } );
    while (((Boolean)rmbs.invoke(accessorRuntimeMBeanObjectName,
                    "hasMoreData",
                    new Object[]{cursor},
                    new String[]{"java.lang.String"})).booleanValue()) {
      Object[] os = (Object[])rmbs.invoke(accessorRuntimeMBeanObjectName,
                    "fetch",
                    new Object[]{cursor},
                    new String[]{"java.lang.String"});
      for (int i = 0; i < os.length; i++) {
        Object[] values = (Object[])os[i];
        String typeName = (String)values[typeIndex];
        String instName = (String)values[instNameIndex];
        String attrName = (String)values[attrNameIndex];
        if (!typeName.equals(lastTypeName)) {
          if (typesToMonitor != null &&
              !typesToMonitor.contains(typeName)) continue;
          System.out.println("\nType " + typeName);
          lastTypeName = typeName;
        }
        if (!instName.equals(lastInstName)) {
          System.out.println("\n  Instance " + instName);
          lastInstName = instName;
        }
        Object attrValue = values[attrValueIndex];
        System.out.println("    - " + attrName + "=" + attrValue);
```

```
          }
        }
        lastSampleTime = thisSampleTime;
      }
      catch (Exception e) {e.printStackTrace();}
    }
  }
}
```

Example 16-3 contains sample output from the `HarvesterMonitor` program:

Example 16-3 Sample Output from HarvesterMonitor

```
ServerName=myserver
URL=service:jmx:t3://localhost:7001/jndi/weblogic.management.mbeanservers.runtime
Harvester monitor started...
-------------------------------------------------------
Type weblogic.management.runtime.WLDFHarvesterRuntimeMBean
Instance
com.bea:Name=WLDFHarvesterRuntime,ServerRuntime=myserver,Type=WLDFHarvesterRuntime,WLDFRu
ntime=WLDFRuntime
    - TotalSamplingTime=202048863
    - CurrentSnapshotElapsedTime=1839619
Type weblogic.management.runtime.ServerRuntimeMBean
  Instance com.bea:Name=myserver,Type=ServerRuntime
    - RestartRequired=false
    - ListenPortEnabled=true
    - ActivationTime=1118319317071
    - ServerStartupTime=40671
    - ServerClasspath= [deleted long classpath listing]
    - CurrentMachine=
    - SocketsOpenedTotalCount=1
    - State=RUNNING
    - RestartsTotalCount=0
    - AdminServer=true
    - AdminServerListenPort=7001
    - ClusterMaster=false
    - StateVal=2
    - CurrentDirectory=C:\testdomain\.
    - AdminServerHost=10.40.8.123
    - OpenSocketsCurrentCount=1
    - ShuttingDown=false
    - SSLListenPortEnabled=false
    - AdministrationPortEnabled=false
    - AdminServerListenPortSecure=false
    - Registered=true
```

Example: JMXAccessorExample.java

The following example program uses JMX to print log entries to standard out. All access is performed through JMX. (For information about the Accessor component, see Accessing Diagnostic Data With the Data Accessor.)

To compile and run the program:

1. Copy the JMXAccessorExample.java example (Example 16-4) to a directory and compile it with:

   ```
   javac -d . JMXAccessorExample.java
   ```

   This creates the `./weblogic/diagnostics/examples` directory and populates it with `JMXAccessorExample.class`.

2. Start the program. The command syntax is:

   ```
   java weblogic.diagnostics.example.JMXAccessor <logicalName> <query>
   ```

   You need access to a WebLogic Server instance, and have the server's name, port number, administrator's login name, and the administrator's password.

   The `logicalName` is the name of the log. Valid names are: `HarvestedDataArchive`, `EventsDataArchive`, `ServerLog`, `DomainLog`, `HTTPAccessLog`, `ServletAccessorHelper.WEBAPP_LOG`, `RAUtil.CONNECTOR_LOG`, `JMSMessageLog`, and `CUSTOM`.

   Construct the query using the syntax described in WLDF Query Language. For the `JMXAccessorExample` program, an empty query (an empty pair of double quotation marks, "") returns all entries in the log.

   The following command requires that '.' is in the `CLASSPATH` variable, and that you run the command from the directory where you compiled the program. The program uses the IIOP (Internet Inter-ORB Protocol) protocol to connect to port 7001, as user `weblogic`, with a password shown as *password*, and prints all entries in the `ServerLog` to standard out:

   ```
   java weblogic.diagnostics.examples.JMXAccessorExample ServerLog ""
   ```

   You can modify the example to use a username/password combination for your site.

Example 16-4 JMXAccessorExample.java

```
package weblogic.diagnostics.examples;
import java.io.IOException;
import java.net.MalformedURLException;
import java.util.Hashtable;
import java.util.Iterator;
import javax.management.MBeanServerConnection;
import javax.management.MalformedObjectNameException;
import javax.management.ObjectName;
import javax.management.remote.JMXConnector;
import javax.management.remote.JMXConnectorFactory;
import javax.management.remote.JMXServiceURL;
import javax.naming.Context;
public class JMXAccessorExample {
  private static final String JNDI = "/jndi/";
  public static void main(String[] args) {
    try {
      if (args.length != 2) {
        System.err.println("Incorrect invocation. Correct usage is:\n" +
          "java weblogic.diagnostics.examples.JMXAccessorExample " +
          "<logicalName> <query>");
        System.exit(1);
      }
      String logicalName = args[0];
      String query = args[1];
      MBeanServerConnection mbeanServerConnection =
        lookupMBeanServerConnection();
      ObjectName service = new

ObjectName(weblogic.management.mbeanservers.runtime.RuntimeServiceMBean.OBJECT_NAME);
      ObjectName serverRuntime =
        (ObjectName) mbeanServerConnection.getAttribute(service,
         "ServerRuntime");
      ObjectName wldfRuntime =
        (ObjectName) mbeanServerConnection.getAttribute(serverRuntime,
         "WLDFRuntime");
      ObjectName wldfAccessRuntime =
```

```
        (ObjectName) mbeanServerConnection.getAttribute(wldfRuntime,
         "WLDFAccessRuntime");
      ObjectName wldfDataAccessRuntime =
        (ObjectName) mbeanServerConnection.invoke(wldfAccessRuntime,
         "lookupWLDFDataAccessRuntime", new Object[] {logicalName},
          new String[] {"java.lang.String"});
      String cursor =
         (String) mbeanServerConnection.invoke(wldfDataAccessRuntime,
          "openCursor", new Object[] {query},
          new String[] {"java.lang.String"});
      int fetchedCount = 0;
      do {
        Object[] rows =
         (Object[]) mbeanServerConnection.invoke(wldfDataAccessRuntime,
          "fetch", new Object[] {cursor},
          new String[] {"java.lang.String"});
        fetchedCount = rows.length;
        for (int i=0; i<rows.length; i++) {
         StringBuffer sb = new StringBuffer();
          Object[] cols = (Object[]) rows[i];
          for (int j=0; j<cols.length; j++) {
            sb.append("Index " + j + "=" + cols[j].toString() + " ");
          }
          System.out.println("Found row = " + sb.toString());
        }
      } while (fetchedCount > 0);
      mbeanServerConnection.invoke(wldfDataAccessRuntime,
          "closeCursor", new Object[] {cursor},
          new String[] {"java.lang.String"});
      } catch(Throwable th) {
      th.printStackTrace();
      System.exit(1);
    }
  }
  private static MBeanServerConnection lookupMBeanServerConnection ()
          throws Exception {
    // construct JMX service URL
    JMXServiceURL serviceURL;
    serviceURL = new JMXServiceURL("iiop", "localhost", 7001,
        JNDI + "weblogic.management.mbeanservers.runtime");
    // Specify the user, password, and WebLogic provider package
    Hashtable h = new Hashtable();
    h.put(Context.SECURITY_PRINCIPAL,"weblogic");
    h.put(Context.SECURITY_CREDENTIALS,"password");
    h.put(JMXConnectorFactory.PROTOCOL_PROVIDER_PACKAGES,
          "weblogic.management.remote");
    // Get jmx connector
    JMXConnector connector = JMXConnectorFactory.connect(serviceURL,h);
    // return MBean server connection class
    return connector.getMBeanServerConnection();
  } // End - lookupMBeanServerConnection
}
```

17

Using Debug Patches

The WebLogic Diagnostics Framework (WLDF) supports the ability for you to apply debug patches dynamically, allowing you to capture diagnostic information using a patch that you can activate and deactivate without the need of a server restart.

Dynamic Application of Debug Patches

Dynamic application of debug patches allows you to avoid the server restarts while applying instrumented debug patches to gather additional information about an error.

Debug patches, packaged as JAR files, are generated through My Oracle Support (`https://support.oracle.com/`) and used to gather additional information about an error when it occurs in a production environment. Typically, the debug patch JAR files are added to the classpath and all server instances must be restarted for the JAR files to take effect. This can present problems, as it might not be possible to restart the server instances in a production environment due to scheduling and other constraints. Additionally, after the server instances are restarted, in-memory states are lost and the problem may disappear or take awhile to reappear. Also, when these debug patches are no longer needed, they can be deactivated without server restarts.

When dynamically applying debug patches, WebLogic Server uses Java HotSwap to replace the loaded classes with the versions provided in the debug patch JAR files. See Enabling Java HotSwap.

Specifying the Debug Patch Directory

Debug patch JAR files are picked up from a specific directory called the debug patch directory.

This directory is specified domain-wide using the `DebugPatchDirectory` attribute of the `DebugPatchesMBean`. By default, the `debug_patches` directory under the *`DOMAIN_HOME`* directory is used as the debug patch directory.

This feature is available to users with administrative privileges in the domain. Only authorized users are able to post debug patch JAR files in the debug patch directory. This directory must be properly protected with file system permissions.

Configuring the WLDF Debug Patch Agent

To apply debug patches dynamically, the target WebLogic Server instances must be started on the command line with the WLDF debug patch agent.

The WLDF debug patch agent handles the following:

- Replaces the loaded classes with the instrumented classes from the debug patch JAR.
- Makes sure that the replacement classes in the debug patch JAR have the same shape as the original classes. If any of the classes do not meet this requirement, none of the classes in the debug patch JAR are swapped in and an error message is logged.
- Logs informational messages to indicate the start and completion of debug patch activation or deactivation.
- Allows only properly authenticated users with administrative privileges to apply a debug patch.

To specify the WLDF debug patch agent on the command line, update your startup script to include the following:

```
-javaagent:$WL_HOME/server/lib/debugpatch-agent.jar
```

> **Note:**
>
> New startup scripts will automatically include the `debug-agent.jar` on the command line unless the `disableDebugPatches` option is specified on the startup script command line.

WLST Commands for Debug Patches

WLDF provides a set of WLST commands you can use to list, activate, and deactivate dynamic debug patches.

Table 17-1 summarizes the list of WLST commands used with debug patches.

Table 17-1 WLST Commands Used With Debug Patches

Command	Summary
`activateDebugPatch`	Activates a debug patch on the specified targets.
`deactivateAllDebugPatches`	Deactivates all debug patches on the specified targets.
`deactivateDebugPatches`	Deactivates a debug patch on the specified targets.
`listDebugPatches`	Lists the active and available debug patches on the specified targets.
`listDebugPatchTasks`	Lists the debug patch (activated or deactivated) tasks from the specified targets.
`purgeDebugPatchTasks`	Purges the debug patch (activated or deactivated) tasks on the specified targets.
`showDebugPatchInfo`	Displays details about a debug patch on the specified targets.

Dynamically Activating a Debug Patch

Example 17-1, Example 17-2, and Example 17-3 demonstrate how to use the `activateDebugPatch` command to activate a debug patch on the desired targets. Note that if a specified debug patch is not available in the debug patch directory on a target, a warning is issued and WebLogic Server will attempt to proceed and activate the debug patch on the remaining targets. If one of the classes in the debug patch fails to replace the original class on a target, the entire debug patch JAR file is rejected on that target and WebLogic Server will attempt to activate the debug patch on the remaining targets. Additionally, several debug patches may be activated over time and each debug patch will overlay the original classes and previously activated debug patches. If a class is contained in multiple activated debug patches, the class in the debug patch that was last activated has precedence. The `activateDebugPatch` command returns an array of tasks, each element corresponding to the activation activity on an affected target server instance.

Example 17-1 Activating a Debug Patch on Two Managed Servers

```
# Connected to admin server: Activate debug-patch-01.jar on managed servers
# MS1 and MS2
tasks=activateDebugPatch(Patch='debug-patch-01.jar', Target='MS1,MS2')
```

Example 17-2 Activating a Debug Patch on a Server Instance and a Cluster

```
# Connected to admin server: Activate debug-patch-01.jar on myserver and all
# members of cluster Cluster-0
tasks=activateDebugPatch(Patch='debug-patch-01.jar', Target='myserver,Cluster-0')
```

Example 17-3 Activating a Debug Patch on an Application Targeted to a Cluster

```
# Connected to admin server: Activate debug-patch-03.jar on application 'medrec'
# targeted to cluster Cluster-1
tasks=activateDebugPatch(Patch='debug-patch-03.jar', Target='Cluster-1',
     Application='medrec')
```

Dynamically Deactivating Debug Patches

Example 17-4, Example 17-5, and Example 17-6 demonstrate how to use the `deactivateDebugPatches` command to deactivate debug patches. To specify more than one debug patch, use a comma-separated list. If a specified debug patch is not active on a target, a warning is issued and the command continues. If no debug patches are specified, all active patches are deactivated on the specified targets and the original classes are activated. After successful deactivation, all targets are left in the same state they were in prior to running this command. The `deactivateDebugPatches` command returns an array of tasks.

Example 17-4 Deactivating Debug Patches on a Managed Server

```
# Connected to MS1: deactivate debug-patch-01.jar
tasks=deactivateDebugPatches(Patches='debug-patch-01.jar')
```

Example 17-5 Deactivating Debug Patches on All Members of a Cluster

```
# Connected to admin server: de-activate debug-patch-01.jar
# and debug-patch-02.jar on all members of cluster Cluster-0
tasks=deactivateDebugPatches(Patches='debug-patch-01.jar,debug-patch-02.jar',
     Target='Cluster-0')
```

Example 17-6 Deactivating Debug Patches on an Application Targeted to a Cluster

```
# Connected to admin server: de-activate debug-patch-03.jar on application
# 'medrec' targeted to cluster Cluster-1
tasks=deactivateDebugPatches(Patches='debug-patch-03.jar', Target='Cluster-1',
     Application='medrec')
```

A

Smart Rule Reference

Smart rules are prepackaged functions provided by the WebLogic Diagnostics Framework (WLDF) that simplify the creation of policy expressions.When used in scheduled policy expressions, as described in Configuring Smart Rule Based Policies, smart rules can execute elastic actions on dynamic clusters, as well as be used in conjunction with any WLDF action. For example, a smart rule that monitors stuck threads in a cluster can be used to execute an SMTP action that sends an email to the system administrator.
The smart rules are organized into Cluster Scope Smart Rules and Server Scope Smart Rules.

About the Parameters You Specify for Smart Rules

All smart rules involve the collection of metric values, which is the process of gathering data needed for monitoring system state and performance.Metrics are exposed to WLDF as attributes on qualified MBeans. Smart rules cause WLDF to gather values from selected MBean attributes at a specified sampling rate and retain those values for a specified duration of time. This allows you to track trends in metric changes in a server or cluster over time.
When you configure a smart rule, you always specify the following parameters:

- sampling rate
- retention window
- threshold value

> **Note:**
>
> Sampling rates and retention windows are completely independent of policy schedules. A policy schedule determines only when a smart rule is evaluated; the policy schedule does not determine the sampling rate or retention window.

sampling rate

The sampling rate is the frequency with which a metric value is collected. For example, a sampling rate of 30 seconds means that the value of an MBean attribute is collected every 30 seconds.

Each smart rule has a default sampling rate. When you are configuring a smart rule using either the WebLogic Remote Console or Fusion Middleware Control, you can accept the default sampling rate that is provided in the configuration assistant. However, when you configure a smart rule using WLST, REST, or JMX, you need to explicitly specify the sampling rate.

The sampling rate is a `String` value that can be specified using the following syntax:

amount[*unit*]

In the preceding syntax:

- *amount* represents an integer.
- *unit*] represents `seconds`, `minutes`, or `hours`. Each can be abbreviated to the first letter. For example: `seconds` can be abbreviated to `s`.

  The default sampling rate time unit is seconds.
- You may include a space character between *amount* and *unit*.

For example, any of the following can be used to specify 30 seconds:

- `"30"`
- `"30 seconds"`
- `"30snds"`
- `"30s"`

retention window

The retention window is the period of time during which collected samples are retained in an internal buffer for evaluation. For example, a retention window of 5 minutes causes the samples collected during the previous 5 minutes to be retained. As each new sample is collected, the oldest sample is removed.

Smart rules function by calculating the average value of a particular metric that has been collected over the period of time corresponding to the retention window. Obtaining average values allows you to obtain a more representative view of changes, and trends in those changes, that are occurring in a server, cluster, or operational environment of WebLogic Server.

The retention window you specify is a `String` value that uses the same syntax as the sampling rate:

amount[*unit*]

The time unit can be `seconds`, `minutes`, or `hours`, and each can be abbreviated. The default time unit in smart rule retention windows is `minutes`, which can be abbreviated to `m`. For example, any of the following can be used to specify 10 minutes:

- `"10"`
- `"10 minutes"`
- `"10mts"`
- `"10m"`

threshold value

The threshold value is an arbitrary value against which the average value of all metrics collected during a retention window is compared. If the average value meets the smart rule's comparison criteria for the threshold value, the smart rule can be evaluated to `true`, assuming all other conditions set in the smart rule are met.

For example, if you want a smart rule to be evaluated as `true` if the average number of idle threads in a cluster is greater than or equal to a specific number, you can enter that number as the threshold value in the ClusterHighIdleThreads smart rule, which monitors a cluster for a high idle thread count. In this context, the threshold value you specify for this smart rule is

referred to as the **high threshold value** because the cluster is monitored to measure whether the average number of idle threads *is greater than or equal to* that threshold.

By contrast, if you want a smart rule to be evaluated as `true` if the average free heap in a cluster falls below a certain amount, you enter that amount as the threshold value in the ClusterLowHeapFreePercent smart rule, which monitors a cluster for a low free heap. In this context, this threshold value yo specify for this smart rule is referred to as the **low threshold value** because the cluster is monitored to measure whether the average free heap amount *is less than* that threshold.

Note that smart rules vary with regard to how the average collected metric value must compare to the threshold value. Some smart rules require that the average collected value must be greater than or equal to the threshold; some require that the average must be greater than the threshold; some require the average to be less than or equal to the threshold; and so on.

Cluster Scope Smart Rules

A cluster scope smart rule is one that is applied to all active nodes in a cluster, and that must be executed from a policy on the Administration Server.The set of cluster scope smart rules provided by WLDF are listed and summarized in Table A-2. For each smart rule, Table A-2 identifies the following:

- The specific metric, typically an MBean attribute, that is sampled
- The condition that causes the smart rule to be evaluated to `true` if, over the course of the retention window, the number of servers with an average metric value that meets specific comparison criteria against the threshold value is greater than or equal to a specified percentage of all servers in the cluster.

Table A-1 Summary or Administration Server Scope Smart Rules

Smart Rule	Metric	Condition Required for Evaluation to `true`
ClusterLowThroughput	`Throughput` metric of the `ThreadPoolRuntimeMBean`	The average `Throughput` value is less than the low threshold value.
ClusterHighProcessCpuLoadAverage	`ProcessCpuLoad` value of the `java.lang:type=OperatingSystem` MXBean	The average `ProcessCpuLoad` value is greater than or equal to the high threshold value.
ClusterHighThroughput	`Throughput` metric of the `ThreadPoolRuntimeMBean`	The average `Throughput` value is greater than or equal to the high threshold value.
ClusterLowPendingUserRequests	`PendingUserRequestCount` value of the `ThreadPoolRuntimeMBean`	The average `PendingUserRequestCount` value is less than the low threshold value.
ClusterHighStuckThreads	`StuckThreadCount` value of the `ThreadPoolRuntimeMBean`	The average `StuckThreadCount` value is greater than or equal to the high threshold value.
ClusterLowQueueLength	`QueueLength` value of the `ThreadPoolRuntimeMBean`	The average `QueueLength` value is less than the low threshold value.
ClusterHighPendingUserRequests	`PendingUserRequestCount` value of the `ThreadPoolRuntimeMBean`	The average `PendingUserRequestCount` value is greater than or equal to the high threshold value.
ClusterLowProcessCpuLoadAverage	`ProcessCpuLoad` value of the `java.lang:type=OperatingSystem` MXBean	The average `ProcessCpuLoad` value is less than the low threshold value.
ClusterHighIdleThreads	`ExecuteThreadIdleCount` value of the `ThreadPoolRuntimeMBean`	The average `ExecuteThreadIdleCount` value is greater than or equal to the high threshold value.

Table A-1 (Cont.) Summary or Administration Server Scope Smart Rules

Smart Rule	Metric	Condition Required for Evaluation to `true`
ClusterLowSystemLoadAverage	`SystemLoadAverage` value of the `java.lang:type=OperatingSystem` MXBean	The average `SystemLoadAverage` value is less than the low threshold value.
ClusterHighQueueLength	`QueueLength` value of the `ThreadPoolRuntimeMBean`	The average `QueueLength` value is greater than or equal to the high threshold value.
ClusterLowHeapFreePercent	`HeapFreePercent` value of the `JVMRuntimeMBean`	The average `HeapFreePercent` value is less than the low threshold value.
ClusterHighSystemLoadAverage	`SystemLoadAverage` value of the `java.lang:type=OperatingSystem` MXBean	The average `SystemLoadAverage` value is greater than or equal to the high threshold value.
ClusterHighHeapFreePercent	`HeapFreePercent` value of the `JVMRuntimeMBean`	The average `HeapFreePercent` value is greater than or equal to the high threshold value.
ClusterLowSystemCpuLoadAverage	`SystemCpuLoad` value of the `java.lang:type=OperatingSystem` MXBean	The average `SystemCpuLoad` value is less than the low threshold value.
ClusterLowIdleThreads	`ExecuteThreadIdleCount` value of the `ThreadPoolRuntimeMBean`	The average `ExecuteThreadIdleCount` value is less than the low threshold value.
ClusterGenericMetricRule	Specified MBean attribute value	Any metric visible through JMX satisfies the specified comparison criteria with the threshold value. (This smart rule is a general form of cluster scope rule.)
ClusterHighSystemCpuLoadAverage	`SystemCpuLoad` value of the `java.lang:type=OperatingSystem` MXBean	The average `SystemCpuLoad` value is greater than or equal to the high threshold value.

- ClusterLowThroughput
- ClusterHighProcessCpuLoadAverage
- ClusterHighThroughput
- ClusterLowPendingUserRequests
- ClusterHighStuckThreads
- ClusterLowQueueLength
- ClusterHighPendingUserRequests
- ClusterLowProcessCpuLoadAverage
- ClusterHighIdleThreads
- ClusterLowSystemLoadAverage
- ClusterHighQueueLength
- ClusterLowHeapFreePercent
- ClusterHighSystemLoadAverage
- ClusterHighHeapFreePercent
- ClusterLowSystemCpuLoadAverage
- ClusterLowIdleThreads

- ClusterGenericMetricRule
  The `ClusterGenericMetricRule` smart rule is typically used to observe trends in JMX metrics that are published through the Server Runtime MBean Server and that are not provided through the other cluster scope smart rules.
- ClusterHighSystemCpuLoadAverage

ClusterLowThroughput

The `ClusterLowThrougput` smart rule measures whether the average throughput in a cluster is decreasing, as indicated by the average value of the `ThreadPoolRuntimeMBean.Throughput` attribute in each Managed Server.You can use this rule to determine whether cluster capacity can be safely reduced; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.Throughput` value that satisfies the low threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.Throughput` attribute
- Low `Throughput` threshold value
- Percentage of servers in the cluster with an average `Throughput` value that must be less than the low `Throughput` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterLowThroughput("clusterName", "period", "duration", throughputLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `Throughput` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Retention window during which collected samples are retained, expressed as a `String`. • The default time unit is minutes. • The default value is `10m`. See retention window for more information about specifying this parameter.
throughputLimit	Value established as the low threshold value of the `ThreadPoolRuntimeMBean.Throughput` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `Throughput` value that must be less than the value of the *throughputLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	myCluster
period	30
duration	15
throughputLimit	5
percentServersLimit	75

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowThroughput("myCluster","30 seconds","15 minutes",5,75)
```

If configured with a scale down action, this example smart rule does the following:

1. Samples the value of the `Throughput` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

   The average `Throughput` value, over the last 15 minutes, is less than 5 on at least 75 per cent of the Managed Servers in the cluster.

ClusterHighProcessCpuLoadAverage

The `ClusterHighProcessCpuLoadAverage` smart rule measures an increase in system load across the cluster, as indicated by the average value of the `ProcessCpuLoad` attribute in each Managed Server. You can use this rule to determine whether cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ProcessCpuLoad` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the operating system's `ProcessCpuLoad` value
- High `ProcessCpuLoad` threshold value
- Percentage of servers in the cluster with an average `ProcessCpuLoad` value that must be greater than or equal to the high `ProcessCpuLoad` threshold value in order for the rule to evaluate to `true`

> **Note:**
>
> The value of the `ProcessCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getProcessCpuLoad--.

Syntax

```
wls:ClusterHighProcessCpuLoadAverage("clusterName", "period", "duration",
procCpuLoadLimit, percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `ProcessCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Retention window during which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
procCpuLoadLimit	Value established as the high threshold value of the `ProcessCpuLoad` metric.
percentServersLimit	Percentage of servers in the cluster with an average `ProcessCpuLoad` value that must be greater than or equal to the value of the *procCpuLoadLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`10`
procCpuLoadLimit	`0.8`
percentServersLimit	`60`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighProcessCpuLoadAverage("myCluster","30 seconds","10 minutes",0.8,60)
```

If configured with a scale up action, this smart rule does the following:

1. Samples the value of the `ProcessCpuLoad` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `ProcessCpuLoad` value, over the last 10 minutes, is greater than or equal to 0.8 on at least 60 per cent of the Managed Servers in the cluster.

ClusterHighThroughput

The `ClusterHighThroughput` smart rule measures an increase in system throughput across the cluster, as indicated by the average value of the `ThreadPoolRuntimeMBean.Throughput` attribute in each Managed Server.You can use this rule to determine whether cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.Throughput` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.Throughput` metric
- High `Throughput` threshold value
- Percentage of servers in the cluster whose average `Throughput` value during the sampling period must be greater than or equal to the high `Throughput` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterHighThroughput("clusterName", "period", "duration", throughputLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `Throughput` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
throughputLimit	Value established as the high threshold value of the `Throughput` attribute.

Parameter	Description
percentServersLimit	Percentage of servers in the cluster with an average `Throughput` value that must be greater than or equal to the value of the *throughputLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`10`
throughputLimit	`100`
percentServersLimit	`60`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighThroughput("myCluster","30 seconds","10 minutes",100,60)
```

When configured with a scale up action, this smart rule does the following:

1. Samples the value of the `Throughput` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `Throughput` value, over the last 10 minutes, is greater than or equal to 100 on at least 60 per cent of the Managed Servers in the cluster.

ClusterLowPendingUserRequests

The `ClusterLowPendingUserRequests` smart rule measures a reduction in pending requests across the cluster as indicated by the average value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute in each Managed Server.You can use this rule to determine whether cluster capacity can be reduced; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.PendingUserRequestCount` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.PendingUserRequestCount` metric
- Low `PendingUserRequestCount` threshold value

- Percentage of servers in the cluster with an average `PendingUserRequestCount` value that must be less than the low `PendingUserRequestCount` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterLowPendingUserRequests("clusterName", "period", "duration",
pendingRequestsLimit, percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `PendingUserRequestCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
pendingRequestsLimit	Value established as the low threshold value of the `PendingUserRequestCount` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `PendingUserRequestCount` value that must be less than the value of the *pendingRequestsLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`10`
pendingRequestsLimit	`5`
percentServersLimit	`75`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowPendingUserRequests("myCluster","30 seconds","10 minutes",5,75)
```

When configured with a scale down action, this smart rule does the following:

1. Samples the value of the `PendingUserRequestCount` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

The average `PendingUserRequestCount` value, over the last 10 minutes, is less than 5 on at least 75 per cent of the Managed Servers in the cluster.

ClusterHighStuckThreads

The `ClusterHighStuckThreads` smart rule measures whether the number of stuck threads is rising and may soon become deadlocked, as indicated by the average value of the `ThreadPoolRuntimeMBean.StuckThreadCount` attribute in each Managed Server.You can use this rule to determine whether cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.StuckThreadCount` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.StuckThreadCount` attribute
- High `StuckThreadCount` threshold value
- Percentage of servers in the cluster with an average `ThreadPoolRuntimeMBean.StuckThreadCount` value that must be greater than or equal to the high `StuckThreadCount` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterHighStuckThreads("clusterName", "period", "duration", stuckThreadsLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `StuckThreadCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
stuckThreadsLimit	Value established as the high threshold value of the `StuckThreadCount` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `StuckThreadCount` value that must be greater than or equal to the value of the *stuckThreadsLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	myCluster
period	30
duration	10
stuckThreadsLimit	5
percentServersLimit	60

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighStuckThreads("myCluster","30 seconds","10 minutes",5,60)
```

When configured with a scale up action, this smart rule does the following:

1. Samples the value of the `StuckThreadCount` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `StuckThreadCount` value, over the last 10 minutes, is greater than or equal to 5 on at least 60 per cent of the Managed Servers in the cluster.

ClusterLowQueueLength

The `ClusterLowQueueLength` smart rule measures a decrease in system load across the cluster, as indicated by the average value of the `ThreadPoolRuntimeMBean.QueueLength` attribute in each Managed Server.You can use this rule to determine whether cluster capacity can be safely reduced; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.QueueLength` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.QueueLength` metric
- Low `QueueLength` threshold value
- Percentage of servers in the cluster with an average `QueueLength` value that must be less than the low `QueueLength` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterLowQueueLength("clusterName", "period", "duration", queueLengthLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `QueueLength` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
queueLengthLimit	Value established as the low threshold value of the `QueueLength` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `QueueLength` value that must be less than the value of the *queueLengthLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`15`
queueLengthLimit	`5`
percentServersLimit	`75`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowQueueLength("myCluster","30 seconds","15 minutes",5,75)
```

When configured with a scale down action, this smart rule does the following:

1. Samples the value of the `QueueLength` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

   The average `QueueLength` value, over the last 15 minutes, is less than 5 on at least 75 per cent of the Managed Servers in the cluster.

ClusterHighPendingUserRequests

The `ClusterHighPendingUserRequests` smart rule measures an increase in system load across the cluster, as indicated by the average value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute in each Managed Server.You

can use this rule to determine whether cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.PendingUserRequestCount` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.PendingUserRequestCount` metric
- High `PendingUserRequestCount` threshold value
- Percentage of servers in the cluster with an average `PendingUserRequestCount` value that must be greater than or equal to the high `PendingUserRequestCount` threshold value in order for the rule to evaluate to `true`

Syntax

`wls:ClusterHighPendingUserRequests("`*`clusterName`*`", "`*`period`*`", "`*`duration`*`", `*`pendingRequestsLimit`*`, `*`percentServersLimit`*`)`

Parameter	Description
`clusterName`	Name of target dynamic cluster, expressed as a `String`.
`period`	Sampling rate for `PendingUserRequestCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
`duration`	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
`pendingRequestsLimit`	Value established as the high threshold value of the `PendingUserRequestCount` attribute.
`percentServersLimit`	Percentage of servers in the cluster with an average `PendingUserRequestCount` value that must be greater than or equal to the value of the *`pendingRequestsLimit`* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	myCluster
period	30
duration	10
pendingRequestsLimit	100
percentServersLimit	60

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighPendingUserRequests("myCluster","30 seconds","10 minutes",100,60)
```

When configured with a scale up action, this smart rule does the following:

1. Samples the value of the `PendingUserRequestCount` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `PendingUserRequestCount` value, over the last 10 minutes, is greater than or equal to 100 on at least 60 per cent of the Managed Servers in the cluster.

ClusterLowProcessCpuLoadAverage

The `ClusterLowProcessCpuLoadAverage` smart rule measures a reduction of system CPU load across a cluster, as indicated by the average value of the `ProcessCpuLoad` attribute in each Managed Server.You can use this rule to determine whether cluster capacity needs to be decreased; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ProcessCpuLoad` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

Note that the value of `ProcessCpuLoad` is platform specific and is not available on all platforms.

To use this smart rule, specify:

- The sampling rate and retention window for the `java.lang:type=OperatingSystem ProcessCpuLoad` metric
- Low `ProcessCpuLoad` threshold value
- Percentage of servers in the cluster with an average `ProcessCpuLoad` value that must be less than the low `ProcessCpuLoad` threshold value in order for the rule to evaluate to `true`

> **Note:**
>
> The value of the `ProcessCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getProcessCpuLoad.

Syntax

```
wls:ClusterLowProcessCpuLoadAverage("clusterName", "period", "duration",
procCpuLoadLimit, percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `ProcessCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
procCpuLoadLimit	Value established as the low threshold value of the `ProcessCpuLoad` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `ProcessCpuLoad` value that must be less than the value of the *procCpuLoadLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`15`
procCpuLoadLimit	`0.2`
percentServersLimit	`75`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowProcessCpuLoadAverage("myCluster","30 seconds","10 minutes",0.2,75)
```

When configured with a scale down action, this smart rule does the following:

1. Samples the value of the `ProcessCpuLoad` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

   The average `ProcessCpuLoad` value, over the last 15 minutes, is less than 0.2 on at least 75 per cent of the Managed Servers in the cluster.

ClusterHighIdleThreads

The `ClusterHighIdleThreads` smart rule measures an increase in the number of idle threads in a cluster, as indicated by the average value of the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute in each Managed Server.You can use this rule to determine whether cluster capacity can be safely reduced; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` metric
- High `ExecuteThreadIdleCount` threshold value
- Percentage of Managed Servers in the cluster with an average `ExecuteThreadIdleCount` value that must be greater than or equal to the high `ExecuteThreadIdleCount` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterHighIdleThreads("clusterName", "period", "duration", idleThreadsLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `ExecuteThreadIdleCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.

Parameter	Description
idleThreadsLimit	Value established as the high threshold value of the `ExecuteThreadIdleCount` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `ExecuteThreadIdleCount` value that must be greater than or equal to the value of the *idleThreadsLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`10`
idleThreadsLimit	`20`
percentServersLimit	`75`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighIdleThreads("myCluster","30 seconds","10 minutes",20,75)
```

When configured with a scale down action, this smart rule does the following:

1. Samples the value of the `ExecuteThreadIdleCount` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

   The average `ExecuteThreadIdleCount` value, over the last 10 minutes, is greater than or equal to 20 on at least 75 per cent of the Managed Servers in the cluster.

ClusterLowSystemLoadAverage

The `ClusterLowSystemLoadAverage` smart rule measures a decrease in system load across a cluster, as indicated by the average value of the `SystemLoadAverage` attribute in each Managed Server.You can use this rule to determine whether cluster capacity needs to be decreased; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `SystemLoadAverage` value that satisfies the threshold comparison criteria is equal to or greater than the specified percentage of all servers in the cluster.

Note that the value of `SystemLoadAverage` is system dependent.

To use this smart rule, specify:

- The sampling rate and retention window for the `java.lang:type=OperatingSystem SystemLoadAverage` metric
- Low `SystemLoadAverage` threshold value
- Percentage of Managed Servers in the cluster with an average `SystemLoadAverage` value that must be less than the low `SystemLoadAverage` threshold value in order for the rule to evaluate to `true`

> **Note:**
>
> The value of the `SystemLoadAverage` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `http://docs.oracle.com/javase/8/docs/api/java/lang/management/OperatingSystemMXBean.html#getSystemLoadAverage--`.

Syntax

`wls:ClusterLowSystemLoadAverage("clusterName", "period", "duration", loadLimit, percentServersLimit)`

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `SystemLoadAverage` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
loadLimit	Value established as the low threshold value of the `SystemLoadAverage` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `SystemLoadAverage` value that must be less than the value of the *loadLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`15`

Parameter	Value
loadLimit	0.2
percentServersLimit	75

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowSystemLoadAverage("myCluster","30 seconds","15 minutes",0.2,75)
```

When configured with a scale down action, this smart rule does the following:

1. Samples the value of the `SystemLoadAverage` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

   The average `SystemLoadAverage` value, over the last 15 minutes, is less than 0.2 on at least 75 per cent of the Managed Servers in the cluster.

ClusterHighQueueLength

The `ClusterHighQueueLength` smart rule measures an increase in system load across the cluster, as indicated by the average value of the `ThreadPoolRuntimeMBean.QueueLength` attribute in each Managed Server.You can use this rule to determine whether the cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.QueueLength` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.QueueLength` metric
- High `QueueLength` threshold value
- Percentage of Managed Servers in the cluster with an average `QueueLength` value that must be greater than or equal to the high `QueueLength` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterHighQueueLength("clusterName", "period", "duration", queueLengthLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.

Parameter	Description
period	Sampling rate for `QueueLength` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
queueLengthLimit	Value established as the high threshold value of the `QueueLength` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `QueueLength` value that must be greater than or equal to the value of the *queueLengthLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`10`
queueLengthLimit	`100`
percentServersLimit	`60`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighQueueLength("myCluster","30 seconds","10 minutes",100,60)
```

When configured with a scale up action, this smart rule does the following:

1. Samples the value of the `QueueLength` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `QueueLength` value, over the last 10 minutes, is greater than or equal to 100 on at least 60 per cent of the Managed Servers in the cluster.

ClusterLowHeapFreePercent

The `ClusterLowHeapFreePercent` smart rule measures an increase in heap stress across a cluster, as indicated by the average value of the `JVMRuntimeMBean.HeapFreePercent` attribute

in each Managed Server.You can use this rule to determine whether the cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `JVMRuntimeMBean.HeapFreePercent` value that satisfies the threshold comparison criteria is greater than or equal to a specific percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `JVMRuntimeMBean.HeapFreePercent` metric
- Low `HeapFreePercent` threshold value
- Percentage of Managed Servers in the cluster with an average `HeapFreePercent` value during the sampling period that must be less than the low `HeapFreePercent` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterLowHeapFreePercent("clusterName", "period", "duration", percentFreeLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `HeapFreePercent` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
percentFreeLimit	Value established as the low threshold value of the `HeapFreePercent` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `HeapFreePercent` value that must be less than the value of the *percentFreeLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`10`

Parameter	Value
percentFreeLimit	20
percentServersLimit	60

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowHeapFreePercent("myCluster","30 seconds","10 minutes",20,60)
```

When configured with a scale up action, this smart rule does the following:

1. Samples the value of the `HeapFreePercent` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `HeapFreePercent` value, over the last 10 minutes, is less than 20 on at least 60 per cent of the Managed Servers in the cluster.

ClusterHighSystemLoadAverage

The `ClusterHighSystemLoadAverage` smart rule measures an increase on system load across a cluster, as indicated by the average value of the `SystemLoadAverage` attribute in each Managed Server.You can use this rule to determine if cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `java.lang:type=OperatingSystem SystemLoadAverage` value that satisfies the threshold comparison criteria is greater than or equal to the specified percentage of all servers in the cluster.

Note that the value of the `SystemLoadAverage` is system dependent.

To use this smart rule, specify:

- The sampling rate and retention window for the `java.lang:type=OperatingSystem SystemLoadAverage` metric
- High `SystemLoadAverage` threshold value
- Percentage of Managed Servers in the cluster with an average `SystemLoadAverage` value that must be greater than or equal to the high `SystemLoadAverage` threshold value in order for the rule to evaluate to `true`

> **Note:**
>
> The value of the `SystemLoadAverage` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `http://docs.oracle.com/javase/8/docs/api/java/lang/management/OperatingSystemMXBean.html#getSystemLoadAverage--`.

Syntax

```
wls:ClusterHighSystemLoadAverage("clusterName", "period", "duration", loadLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `SystemLoadAverage` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
loadLimit	Value established as the high threshold value of the `SystemLoadAverage` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `SystemLoadAverage` value that must be greater than or equal to the value of the *loadLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`5`
loadLimit	`0.8`
percentServersLimit	`60`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighSystemLoadAverage("myCluster","30 seconds","5 minutes",0.8,60)
```

When configured with a scale up action, this smart rule does the following:

1. Samples the value of the `SystemLoadAverage` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 5 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `SystemLoadAverage` value, over the last 5 minutes, is greater than or equal to 0.8 on at least 60 per cent of the Managed Servers in the cluster.

ClusterHighHeapFreePercent

The `ClusterHighHeapFreePercent` smart rule measures a reduction in heap stress across a dynamic cluster, as indicated by the average value of the `JVMRuntimeMBean.HeapFreePercent` attribute in each Managed Server.You can use this rule to determine if cluster capacity can be reduced; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average JVM free heap percentage value that satisfies the threshold comparison criteria is greater than or equal to a specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the JVM free heap percentage metric
- High JVM free heap threshold value
- Percentage of Managed Servers in the cluster with an average JVM free heap value that must be greater than or equal to the high JVM free heap threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterHighHeapFreePercent("clusterName", "period", "duration", percentFreeLimit,
percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for JVM free heap percentage values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
percentFreeLimit	Value established as the high threshold value of the JVM free heap percentage.
percentServersLimit	Percentage of servers in the cluster with an average JVM free heap percentage that must be greater than or equal to the *percentFreeLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	myCluster
period	30
duration	5
percentFreeLimit	60
percentServersLimit	75

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighHeapFreePercent("myCluster","30 seconds","5 minutes",60,75)
```

When configured with a scale down action, this smart rule does the following:

1. Samples the value of the JVM free heap percentage metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 5 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

   The average JVM free heap percentage value, over the last 5 minutes, is greater than or equal to 60 on at least 75 per cent of the Managed Servers in the cluster.

ClusterLowSystemCpuLoadAverage

The `ClusterLowSystemCpuLoadAverage` smart rule measures a reduction of the system CPU load average across a cluster, as indicated by the average value of the `SystemCpuLoad` attribute in each Managed Server.You can use this rule to determine whether cluster capacity needs to be decreased; for example, by executing a scale down action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `java.lang:type=OperatingSystem SystemCpuLoad` value satisfies the threshold comparison criteria is greater than or equal to a specified percentage of all servers in the cluster.

Note that the value of the `SystemCpuLoad` metric is platform-specific and is not available on all platforms.

To use this smart rule, specify:

- The sampling rate and retention window for the `java.lang:type=OperatingSystem SystemCpuLoad` metric
- Low `SystemCpuLoad` threshold value
- Percentage of Managed Servers in the cluster with an average `SystemCpuLoad` value that must be below the low `SystemCpuLoad` threshold value in order for the rule to evaluate to `true`

> **Note:**
>
> The value of the `SystemCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getSystemCpuLoad--.

Syntax

```
wls:ClusterLowSystemCpuLoadAverage("clusterName", "period", "duration",
systemCpuLoadLimit, percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `SystemCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
systemCpuLoadLimit	Value established as the low threshold value of the `SystemCpuLoad` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `SystemCpuLoad` value that must be less than the value of the *systemCpuLoadLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`15`
systemCpuLoadLimit	`0.2`
percentServersLimit	`75`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowSystemCpuLoadAverage("myCluster","30 seconds","15 minutes",0.2,75)
```

When configured with a scale down action, this smart rule does the following:

1. Samples the value of the `SystemCpuLoad` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires a scale down action if the following condition evaluates to `true`:

   The average `SystemCpuLoad` value, over the last 15 minutes, is less than 0.2 on at least 75 per cent of the Managed Servers in the cluster.

ClusterLowIdleThreads

The `ClusterLowIdleThreads` smart rule measures an increase in load stress across the cluster, as indicated by the average value of the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute in each Managed Server.You can use this rule to determine whether cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` value that satisfies the threshold comparison criteria is greater than or equal to a specified percentage of all servers in the cluster.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` metric
- Low `ExecuteThreadIdleCount` threshold value
- Percentage of Managed Servers in the cluster whose average `ExecuteThreadIdleCount` value is less than the low `ExecuteThreadIdleCount` threshold value in order for the rule to evaluate to `true`

Syntax

```
wls:ClusterLowIdleThreads("clusterName", "period", "duration", idleThreadsLimit",
percentServerLimit")
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `ExecuteThreadIdleCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is minutes. • The default value is `10m`. See retention window for more information about specifying this parameter.

Parameter	Description
idleThreadsLimit	Value established as the low `ExecuteThreadIdleCount` threshold value.
percentServersLimit	Percentage of servers in the cluster with an average `ExecuteThreadIdleCount` value that must be less than the value of the `idleThreadsLimit` parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float`.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
period	`30`
duration	`10`
idleThreadsLimit	`5`
percentServersLimit	`60`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterLowIdleThreads("myCluster","30 seconds","10 minutes",5,60)
```

When configured with a scale up action, this example smart rule:

1. Samples the value of the `ExecuteThreadIdleCount` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `ExecuteThreadIdleCount` value, over the last 10 minutes, is less than 5 on at least 60 per cent of the Managed Servers in the cluster.

ClusterGenericMetricRule

The `ClusterGenericMetricRule` smart rule is typically used to observe trends in JMX metrics that are published through the Server Runtime MBean Server and that are not provided through the other cluster scope smart rules.

Target: Administration Server

Description

This smart rule allows you to view the average value of any metric obtained through JMX within a specific time interval, and compare that average value to a specified threshold value by using a specified comparison operator for each Managed Server in the cluster. If the percentage of servers matching the comparison criteria meets or exceeds the specified limit, the overall condition of the rule is satisfied and this rule returns `true`.

To use this smart rule, specify:

- Dynamic cluster name

- A valid JMX `ObjectName` or `ObjectName` pattern
- An attribute name, or attribute expression (as an EL expression), where the expression is an attribute expression relative to each MBean.

  For example, if the MBean is the `ServerRuntimeMBean`, `'OpenSocketsCurrentCount'` obtains the value of the `ServerRuntimeMBean.OpenSocketsCurrentCount` attribute. In contrast, `'HealthState.State'` accesses the `State` value of the `HealthState` child object.
- A valid boolean comparison operator
- A threshold value against which the selected attribute is compared
- Percentage of Managed Servers in the cluster whose average attribute value during the sampling period must meet the threshold value in order for the rule to evaluate to `true`
- The sampling rate and retention window for the metric on each Managed Server instance in the cluster
- Period of time during which samples are collected

Syntax

```
wls:ClusterGenericMetricRule("clusterName", "instancePattern", "attribute", "operation",
thresholdValue, percentServersLimit, "period", "duration")
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
instancePattern	A valid JMX `ObjectName` or `ObjectName` pattern
attribute	A Java EL expression that retrieves a value on each MBean instance that matches *instancePattern*, where the expression is an attribute expression relative to each MBean. For example, if the MBean is the `ServerRuntimeMBean`, the expression `'OpenSocketsCurrentCount'` obtains the value of the `OpenSocketsCurrentCount` attribute of the `ServerRuntimeMBean`. By contrast, the expression `'HealthState.State'` obtains the `State` value of the `HealthState` child object of that MBean.
operation	A boolean comparison operator: <, <=, ==, >=, or >.
thresholdValue	Threshold value against which the value of the *attribute* parameter is compared.
percentServersLimit	Percentage of servers in the cluster with an average attribute value that must satisfy the comparison criteria with the value of the *thresholdValue* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0
period	Sampling rate for metric values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.

Parameter	Description
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	`myCluster`
instancePattern	`java.lang:type=OperatingSystem`
attribute	`ProcessCpuLoad`
operation	`>=`
thresholdValue	`0.9`
percentServersLimit	`75`
period	`30`
duration	`10`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterGenericMetricRule("myCluster","java.lang:type=OperatingSystem","ProcessCpuLoad
","=",0.9,75,"30 seconds","10 minutes")
```

This example smart rule:

1. Samples the value of the `ProcessCpuLoad` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, this smart rule evaluates to `true` in the following condition:

   The average value of `ProcessCpuLoad` on the `OperatingSystemMXBean`, over the last 10 minutes, is greater than or equal to 0.9 on at least 75 per cent of the Managed Servers in the cluster.

ClusterHighSystemCpuLoadAverage

The `ClusterHighSystemCpuLoadAverage` smart rule measures an increase on system load across the cluster, as indicated by the average value of the operating system `SystemCpuLoad` attribute in each Managed Server.You use this rule to determine whether cluster capacity needs to be increased; for example, by executing a scale up action.
Target: Administration Server

Description

This smart rule evaluates to `true` if the number of Managed Servers with an average `java.lang:type=OperatingSystem SystemCpuLoad` value that satisfies the threshold comparison criteria is greater than or equal to a specified percentage of all servers in the cluster.

Note that the value of `SystemCpuLoad` is platform-specific and is not available on all platforms.

To use this smart rule, specify:

- The sampling rate and retention window for the `java.lang:type=OperatingSystem SystemCpuLoad` metric
- High `SystemCpuLoad` threshold value
- Percentage of Managed Servers in the cluster with an average `SystemCpuLoad` value that is greater than or equal to the high `SystemCpuLoad` threshold value in order for the rule to evaluate to `true`

> **Note:**
>
> The value of the `SystemCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getSystemCpuLoad--`.

Syntax

```
wls:ClusterHighSystemCpuLoadAverage("clusterName", "period", "duration",
systemCpuLoadLimit, percentServersLimit)
```

Parameter	Description
clusterName	Name of target dynamic cluster, expressed as a `String`.
period	Sampling rate for `SystemCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
systemCpuLoadLimit	Value established as the high threshold value of the `SystemCpuLoad` attribute.
percentServersLimit	Percentage of servers in the cluster with an average `SystemCpuLoad` value that must be greater than or equal to the value of the *systemCpuLoadLimit* parameter in order for the smart rule to be evaluated as `true`. This parameter is expressed as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
clusterName	myCluster
period	30
duration	5
systemCpuLoadLimit	0.8
percentServersLimit	60

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ClusterHighSystemCpuLoadAverage("myCluster","30 seconds","5 minutes",0.8,60)
```

When configured with a scale up action, this example smart rule:

1. Samples the value of the `SystemCpuLoad` metric from each Managed Server instance in `myCluster` every 30 seconds over a retention window of 5 minutes.
2. At the end of the retention window, fires a scale up action if the following condition evaluates to `true`:

   The average `SystemCpuLoad` value, over the last 5 minutes, is greater than or equal to 0.8 on at least 60 per cent of the Managed Servers in the cluster.

Server Scope Smart Rules

A server scope smart rule is one that is applied only to the local WebLogic Server instance on which the policies associated with that smart rule are run. You can execute policies containing server scope smart rules on the Administration Server or any individual Managed Server in the domain.The set of server scope smart rules packaged with the WebLogic Diagnostics Framework (WLDF) are listed and summarized in Table A-2.

Table A-2 Summary of Managed Server Scope Smart Rules

After the retention window, the following smart rule . . .	. . . returns true if . . .
ServerLowIdleThreads	The average `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` value on the local server is equal to or less than the low threshold value.
ServerHighThroughput	The average `ThreadPoolRuntimeMBean.Throughput` value on the local server is greater than or equal to the high threshold value.
ServerGenericMetricRule	The average value of a metric visible through JMX within the local JVM satisfies the comparison criteria with the threshold value.
ServerLowPendingUserRequests	The average `ThreadPoolRuntimeMBean.PendingUserRequestCount` value on the local server is less than the low threshold value.
ServerLowProcessCpuLoadAverage	The average value of the `ProcessCpuLoad` metric of the `java.lang:type=OperatingSystem` MXBean on the local server is less than the low threshold value.

Table A-2 (Cont.) Summary of Managed Server Scope Smart Rules

After the retention window, the following smart rule . . .	. . . returns true if . . .
ServerHighSystemLoadAverage	The average value of the `SystemLoadAverage` metric from the `java.lang:type=OperatingSystem` MXBean on the local server is greater than or equal to the high threshold value.
ServerLowQueueLength	The average `ThreadPoolRuntimeMBean.QueueLength` value on the local server is less than the low threshold value.
ServerLowThroughput	The average `ThreadPoolRuntimeMBean.Throughput` value on the local server is less than the low threshold value.
ServerHighQueueLength	The average `ThreadPoolRuntimeMBean.QueueLength` value on the local server is greater than or equal to the high threshold value.
ServerHighSystemCpuLoadAverage	The average `SystemCpuLoad` attribute of the `java.lang:type=OperatingSystem` MXBean on the local server is greater than or equal to the high threshold value.
ServerHighPendingUserRequests	The average `ThreadPoolRuntimeMBean.PendingUserRequestCount` value on the local server is greater than or equal to the high threshold value.
ServerLowSystemCpuLoadAverage	The average `SystemCpuLoad` attribute of the `java.lang:type=OperatingSystem` MXBean on the local server is less than the low threshold value.
ServerHighHeapFreePercent	The average percentage of free heap on the local server is greater than or equal to the high threshold value.
ServerHighStuckThreads	The average `ThreadPoolRuntimeMBean.StuckThreadCount` value on the local server is greater than or equal to high threshold value.
ServerHighProcessCpuLoadAverage	The average `ProcessCpuLoad` value of the `java.lang:type=OperatingSystem` MXBean on the local server is greater than or equal to the high threshold value.
ServerLowSystemLoadAverage	The average `SystemLoadAverage` value of the `java.lang:type=OperatingSystem` MXBean on the local server is less than the low threshold value.
ServerLowHeapFreePercent	The average percentage of free heap on the local server is less than the low threshold value.
ServerHighIdleThreads	The average `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` value on the local server is greater than or equal to the high threshold value.

- ServerLowIdleThreads
  The `ServerLowIdleThreads` smart rule detects if the average number of idle threads is below the specified threshold within the local server in which the rule is running, as

indicated by the average value of the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute.

- ServerHighThroughput
  The `ServerHighThroughput` smart rule determines whether an increase in throughput exists within the local server in which the rule is running.
- ServerGenericMetricRule
- ServerLowPendingUserRequests
  The `ServerLowPendingUserRequests` smart rule determines whether the average number of pending user requests within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute.
- ServerLowProcessCpuLoadAverage
  The `ServerLowProcessCpuLoadAverage` smart rule determines whether a reduction exists in the average system load within the local server instance in which the rule is running.
- ServerHighSystemLoadAverage
  The `ServerHighSystemLoadAverage` smart rule determines whether a reduction exists on the average system load within the local server in which the rule is running.
- ServerLowQueueLength
  The `ServerLowQueueLength` smart rule determines whether a reduction exists in the average thread pool queue length within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.QueueLength` metric.
- ServerLowThroughput
  The `ServerLowThroughput` smart rule determines whether a decrease exists in the average throughput within the local server in which the rule is running.
- ServerHighQueueLength
  The `ServerHighQueueLength` smart rule determines whether an increase exists in the average thread pool queue length within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.QueueLength` attribute.
- ServerHighSystemCpuLoadAverage
  The `ServerHighSystemCpuLoadAverage` smart rule determines whether an increase exists in the average system CPU load within the local server in which the rule is running.
- ServerHighPendingUserRequests
  The `ServerHighPendingUserRequests` smart rule determines whether an increase exists in the number of pending user requests within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute.
- ServerLowSystemCpuLoadAverage
- ServerHighHeapFreePercent
  The `ServerHighHeapFreePercent` smart rule determines whether an increase in heap stress exists within the local server in which the rule is running.
- ServerHighStuckThreads
- ServerHighProcessCpuLoadAverage
  The `ServerHighProcessCpuLoadAverage` smart rule determines whether an decrease exists in the average system load within the local server in which the rule is running.
- ServerLowSystemLoadAverage
  The `ServerLowSystemLoadAverage` smart rule determines whether a reduction exists in the average system load within the local server in which the rule is running.

- ServerLowHeapFreePercent
  The `ServerLowHeapFreePercent` smart rule determines whether an increase exists in heap stress within the local server in which the rule is running.
- ServerHighIdleThreads
  The `ServerHighIdleThreads` smart rule determines whether a reduction in average system load exists within the local server in which the rule is running, by measuring an increase in idle threads as indicated by the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute.

ServerLowIdleThreads

The `ServerLowIdleThreads` smart rule detects if the average number of idle threads is below the specified threshold within the local server in which the rule is running, as indicated by the average value of the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This smart rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute is equal to or less than the specified threshold value.

To use this smart rule, specify:

- The sampling rate and retention window for the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` metric
- Low `ExecuteThreadIdleCount` threshold value

Syntax

```
wls:ServerLowIdleThreads("period", "duration", idleThreadsLimit)
```

Parameter	Description
period	Sampling rate for `ExecuteThreadIdleCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
idleThreadsLimit	Value established as the low threshold value of the `ExecuteThreadIdleCount` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	5
idleThreadsLimit	0.8

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowIdleThreads("30 seconds","10 minutes",5)
```

This example smart rule:

1. Samples the value of the `ExecuteThreadIdleCount` metric from the local server instance every 30 seconds over a retention window of 5 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `ExecuteThreadIdleCount` value, over the last 5 minutes, is less than or equal to 0.8 on this server instance.

ServerHighThroughput

The `ServerHighThroughput` smart rule determines whether an increase in throughput exists within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This smart rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.Throughput` attribute over the specified retention window is greater than or equal to the high threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.Throughput` attribute.
- High `Throughput` threshold value

Syntax

```
wls:ServerHighThroughput("period", "duration", throughputLimit)
```

Parameter	Description
period	Sampling rate for `Throughput` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.

Parameter	Description
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
throughputLimit	Value established as the high threshold value of the `Throughput` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	10
throughputLimit	100

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighThroughput("30 seconds","10 minutes",100)
```

This example smart rule:

1. Samples the value of the `Throughput` metric from the local server instance every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `Throughput` value, over the last 10 minutes, is greater than or equal to 100 on this server instance.

ServerGenericMetricRule

The `ServerGenericMetricRule` smart rule is a general server scope smart rule that you can use to observe trends of any JMX metric that is published through the Server Runtime MBean Server and that is not provided by the other server scope smart rules.This smart rule allows you to collect the average value of the metric across a recent time interval and compare it to a threshold value using a specified comparison operator.
You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This smart rule returns `true` if the average value of the metric meets or exceeds the specified threshold value.

To use this smart rule, specify:

- A valid JMX `ObjectName` or `ObjectName` pattern

- A Java EL expression that retrieves a value on each matching MBean instance, where the expression is an attribute expression relative to each MBean.
- A boolean comparison operator using the specified comparison operator
- A threshold value against which the selected attribute is compared
- The sampling rate and retention window of the metric.

Syntax

```
wls:ServerGenericMetricRule("instancePattern", "attribute", "operation", thresholdValue,
"period", "duration")
```

Parameter	Description
instancePattern	A valid JMX `ObjectName` or `ObjectName` pattern
attribute	A Java EL expression that retrieves a value on each MBean instance that matches *instancePattern*, where the expression is an attribute expression relative to each MBean. For example, if the MBean is the `ServerRuntimeMBean`, the expression `'OpenSocketsCurrentCount'` obtains the value of the `OpenSocketsCurrentCount` attribute of the `ServerRuntimeMBean`. By contrast, the expression `'HealthState.State'` obtains the `State` value of the `HealthState` child object of that MBean.
operation	A boolean comparison operator: <, <=, ==, >=, or >.
thresholdValue	A threshold value with which to compare the selected attribute using the specified comparison operator.
period	Sampling rate for metric values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
instancePattern	`java.lang:type=OperatingSystem`
attribute	`ProcessCpuLoad`
operation	`>=`
thresholdValue	`0.9`
period	`30`
duration	`10`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerGenericMetricRule("java.lang:type=OperatingSystem","ProcessCpuLoad",">=",0.9,"3
0 seconds","10 minutes")
```

The smart rule:

1. Samples the value of the `ProcessCpuLoad` metric on the targeted server instance every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, this smart rule evaluates to `true` in the following condition:

   The average value of `ProcessCpuLoad` on the `OperatingSystemMXBean`, over the last 10 minutes, is greater than or equal to 0.9 on this server instance.

ServerLowPendingUserRequests

The `ServerLowPendingUserRequests` smart rule determines whether the average number of pending user requests within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This smart rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute over the specified retention window is less than the low threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute.
- Low `PendingUserRequestCount` threshold value

Syntax

```
wls:ServerLowPendingUserRequests("period", "duration", pendingRequestsLimit)
```

Parameter	Description
period	Sampling rate for `PendingUserRequestCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
pendingRequestsLimit	Value established as the low threshold value of the `PendingUserRequestCount` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	15
pendingRequestsLimit	5

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowPendingUserRequests("30 seconds","15 minutes",5)
```

This example smart rule:

1. Samples the value of the `PendingUserRequestCount` metric from the local server instance every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, evaluates to `true` if the following condition exists:

   The average `PendingUserRequestCount` value, over the last 15 minutes, is less than 5 on this server instance.

ServerLowProcessCpuLoadAverage

The `ServerLowProcessCpuLoadAverage` smart rule determines whether a reduction exists in the average system load within the local server instance in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `ProcessCpuLoad` metric of the `java.lang:type=OperatingSystem` MXBean over the specified time interval is less than a specified threshold value.

> **Note:**
>
> The value of the `ProcessCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getProcessCpuLoad--`.

To use this smart rule, specify:

- The sampling rate and retention window of the `ProcessCpuLoad` attribute.
- Low `ProcessCpuLoad` threshold value

Syntax

```
wls:ServerLowProcessCpuLoadAverage("period", "duration", processCpuLoadLimit)
```

Parameter	Description
period	Sampling rate for `ProcessCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
processCpuLoadLimit	Value established as the low threshold value of the `ProcessCpuLoad` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	`30`
duration	`15`
processCpuLoadLimit	`0.2`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowProcessCpuLoadAverage("30 seconds","15 minutes",0.2)
```

This example smart rule:

1. Samples the value of the `ProcessCpuLoad` metric from the local server instance every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `ProcessCpuLoad` value, over the last 15 minutes, is less than 0.2 on this server instance.

ServerHighSystemLoadAverage

The `ServerHighSystemLoadAverage` smart rule determines whether a reduction exists on the average system load within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `SystemLoadAverage` metric from the `java.lang:type=OperatingSystem` MXBean on the local server instance over specified interval is greater than or equal to a specific high threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `SystemLoadAverage` attribute.
- High `SystemLoadAverage` threshold value

> **Note:**
>
> The value of the `SystemLoadAverage` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `http://docs.oracle.com/javase/8/docs/api/java/lang/management/OperatingSystemMXBean.html#getSystemLoadAverage--`.

Syntax

```
wls:ServerHighSystemLoadAverage("period", "duration", loadLimit)
```

Parameter	Description
period	Sampling rate for `SystemLoadAverage` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
loadLimit	Value established as the high threshold value of the `SystemLoadAverage` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	5
loadLimit	0.8

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighSystemLoadAverage("30 seconds","5 minutes",0.8)
```

This example smart rule:

1. Samples the value of the `SystemLoadAverage` metric on the local server instance every 30 seconds over a retention window of 5 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `SystemLoadAverage` value, over the last 5 minutes, is greater than or equal to 0.8 collected on this server instance.

ServerLowQueueLength

The `ServerLowQueueLength` smart rule determines whether a reduction exists in the average thread pool queue length within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.QueueLength` metric.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.QueueLength` attribute on the local server instance over specified interval is less than a specific low threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.QueueLength` attribute.
- Low `QueueLength` threshold value

Syntax

```
wls:ServerLowQueueLength("period", "duration", queueLengthLimit)
```

Parameter	Description
period	Sampling rate for `QueueLength` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
queueLengthLimit	Value established as the low threshold value of the `QueueLength` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	15
queueLengthLimit	5

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowQueueLength("30 seconds","15 minutes",5)
```

This example smart rule:

1. Samples the value of the `QueueLength` metric from the local server instance every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `QueueLength` value, over the last 15 minutes, is less than 5 on this server instance.

ServerLowThroughput

The `ServerLowThroughput` smart rule determines whether a decrease exists in the average throughput within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.Throughput` attribute on the local server over the specified interval is less than the specified low threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.Throughput` attribute.
- Low `Throughput` threshold value

Syntax

```
wls:ServerLowThroughput("period", "duration", throughputLimit)
```

Parameter	Description
period	Sampling rate for `Throughput` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.

Parameter	Description
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
throughputLimit	Value established as the low threshold value of the `Throughput` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	`30`
duration	`15`
idleThreadsLimit	`5`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowThroughput("30 seconds","15 minutes",5)
```

This example smart rule:

1. Samples the value of the `Throughput` metric from the local server instance every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `Throughput` value, over the last 15 minutes, is less than 5 on this server instance.

ServerHighQueueLength

The `ServerHighQueueLength` smart rule determines whether an increase exists in the average thread pool queue length within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.QueueLength` attribute.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.QueueLength` attribute over a specific time interval is greater than or equal to a specific high threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.QueueLength` attribute.
- High `QueueLength` threshold value

Syntax

```
wls:ServerHighQueueLength("period", "duration", queueLengthLimit)
```

Parameter	Description
period	Sampling rate for `QueueLength` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
queueLengthLimit	Value established as the high threshold value of the `QueueLength` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	`30`
duration	`10`
queueLengthLimit	`100`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighQueueLength("30 seconds","10 minutes",100)
```

This example smart rule:

1. Samples the value of the `QueueLength` metric from the local server instance every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `QueueLength` value, over the last 10 minutes, is greater than or equal to 100 on this server instance.

ServerHighSystemCpuLoadAverage

The `ServerHighSystemCpuLoadAverage` smart rule determines whether an increase exists in the average system CPU load within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `SystemCpuLoad` attribute of the `java.lang:type=OperatingSystem` MXBean over a specific time interval is greater than or equal to a specific high threshold.

> **Note:**
>
> The value of the `SystemCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getSystemCpuLoad--`.

To use this smart rule, specify:

- The sampling rate and retention window of the `SystemCpuLoad` attribute.
- High `SystemCpuLoad` threshold value

Syntax

```
wls:ServerHighSystemCpuLoadAverage("period", "duration", systemCpuLoadLimit)
```

Parameter	Description
period	Sampling rate for `SystemCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
systemCpuLoadLimit	Value established as the high threshold value of the `SystemCpuLoad` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	`30`
duration	`10`
systemCpuLoadLimit	`0.8`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighSystemCpuLoadAverage("30 seconds","10 minutes",0.8)
```

This example smart rule:

1. Samples the value of the `SystemCpuLoad` metric from the local server instance every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `SystemCpuLoad` value, over the last 10 minutes, is greater than or equal to 0.8 on this server instance.

ServerHighPendingUserRequests

The `ServerHighPendingUserRequests` smart rule determines whether an increase exists in the number of pending user requests within the local server in which the rule is running, as indicated by the value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute over a specific interval is greater than or equal to a specific threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.PendingUserRequestCount` attribute.
- High `PendingUserRequestCount` threshold value

Syntax

```
wls:ServerHighPendingUserRequests("period", "duration", pendingRequestsLimit)
```

Parameter	Description
period	Sampling rate for `PendingUserRequestCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
pendingRequestsLimit	Value established as the high threshold value of the `PendingUserRequestCount` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	10
pendingRequestsLimit	100

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighPendingUserRequests("30 seconds","10 minutes",100)
```

This example smart rule:

1. Samples the value of the `PendingUserRequestCount` metric from the local server instance every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `PendingUserRequestCount` value, over the last 10 minutes, is greater than or equal to 100 on this server instance.

ServerLowSystemCpuLoadAverage

The `ServerLowSystemCpuLoadAverage` smart rule determines whether a reduction exists in the average system CPU load within the local server in which the rule is running.
You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `SystemCpuLoad` metric of the `java.lang:type=OperatingSystem` MXBean over a specific interval is less than the specified low threshold value.

> **Note:**
>
> The value of the `SystemCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getSystemCpuLoad--`.

To use this smart rule, specify:

- The sampling rate and retention window of the `SystemCpuLoad` attribute.
- Low `SystemCpuLoad` threshold value

Syntax

```
wls:ServerLowSystemCpuLoadAverage("period", "duration", systemCpuLoadLimit)
```

Parameter	Description
period	Sampling rate for `SystemCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
systemCpuLoadLimit	Value established as the low threshold value of the `SystemCpuLoad` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	`30`
duration	`15`
systemCpuLoadLimit	`0.8`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowSystemCpuLoadAverage("30 seconds","15 minutes",0.8)
```

This example smart rule:

1. Samples the value of the `SystemCpuLoad` metric from the local server instance every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `SystemCpuLoad` value, over the last 15 minutes, is less than 0.8 on this server instance.

ServerHighHeapFreePercent

The `ServerHighHeapFreePercent` smart rule determines whether an increase in heap stress exists within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average `JVMRuntimeMBean.HeapFreePercent` value over the specific time interval is greater than or equal to the specified high threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `JVMRuntimeMBean.HeapFreePercent` attribute.
- High JVM free heap percentage threshold value

Syntax

```
wls:ServerHighHeapFreePercent("period", "duration", percentFreeLimit)
```

Parameter	Description
period	Sampling rate for JVM free heap percentage values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
percentFreeLimit	Value established as the high threshold of the JVM free heap percentage, specified as a `float` value between 0.0 and 100.0

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	`30`
duration	`10`
percentFreeLimit	`60`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighHeapFreePercent("30 seconds","10 minutes",60)
```

This example smart rule:

1. Samples the value of the JVM free heap percentage from the local server instance every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average JVM free heap value, over the last 10 minutes, is greater than or equal to 60 per cent on this server instance.

ServerHighStuckThreads

The `ServerHighStuckThreads` smart rule determines whether an increase exists on server stress based on the average number of stuck threads within the local server in which the rule is

running, as indicated by the value of the `ThreadPoolRuntimeMBean.StuckThreadCount` attribute.
You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.StuckThreadCount` attribute over a specific time interval is greater than or equal to the specified threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.StuckThreadCount` attribute.
- High `StuckThreadCount` threshold value

Syntax

```
wls:ServerHighStuckThreads("period", "duration", stuckThreadsLimit)
```

Parameter	Description
period	Sampling rate for `StuckThreadCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
stuckThreadsLimit	Value established as the high threshold value of the `StuckThreadCount` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	10
stuckThreadsLimit	5

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighStuckThreads("30 seconds","10 minutes",5)
```

This example smart rule:

1. Samples the value of the `StuckThreadCount` metric from the local server instance every 30 seconds over a retention window of 10 minutes.

2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `StuckThreadCount` value, over the last 10 minutes, is greater than or equal to 5 on this server instance.

ServerHighProcessCpuLoadAverage

The `ServerHighProcessCpuLoadAverage` smart rule determines whether an decrease exists in the average system load within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average `ProcessCpuLoad` value of the `java.lang:type=OperatingSystem` MXBean over the specified interval is greater than or equal to the specified threshold.

> **Note:**
>
> The value of the `ProcessCpuLoad` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `https://docs.oracle.com/javase/8/docs/jre/api/management/extension/com/sun/management/OperatingSystemMXBean.html#getProcessCpuLoad--`.

To use this smart rule, specify:

- The sampling rate and retention window of the `ProcessCpuLoad` attribute.
- High `ProcessCpuLoad` threshold value

Syntax

```
wls:ServerHighProcessCpuLoadAverage("period", "duration", processCpuLoadLimit)
```

Parameter	Description
period	Sampling rate for `ProcessCpuLoad` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
processCpuLoadLimit	Value established as the high threshold value of the `ProcessCpuLoad` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	5
processCpuLoadLimit	0.8

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighProcessCpuLoadAverage("30 seconds","5 minutes",0.8)
```

This example smart rule:

1. Samples the value of the `ProcessCpuLoad` metric from the local server instance every 30 seconds over a retention window of 5 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `ProcessCpuLoad` value, over the last 5 minutes, is greater than or equal to 0.8 on this server instance.

ServerLowSystemLoadAverage

The `ServerLowSystemLoadAverage` smart rule determines whether a reduction exists in the average system load within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the value of the `SystemLoadAverage` metric of the `java.lang:type=OperatingSystem` MXBean over a specified interval is less than the specified low threshold value.

> **Note:**
>
> The value of the `SystemLoadAverage` metric is platform-specific and is not available on all platforms. The MXBean attribute from which this metric originates is described at `http://docs.oracle.com/javase/8/docs/api/java/lang/management/OperatingSystemMXBean.html#getSystemLoadAverage--`.

To use this smart rule, specify:

- The sampling rate and retention window of the `SystemLoadAverage` attribute.
- Low `SystemLoadAverage` threshold value

Syntax

```
wls:ServerLowSystemLoadAverage("period", "duration", loadLimit)
```

Parameter	Description
period	Sampling rate for `SystemLoadAverage` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
loadLimit	Value established as the low threshold value of the `SystemLoadAverage` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	`30`
duration	`15`
loadLimit	`0.2`

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowSystemLoadAverage("30 seconds","15 minutes",0.2)
```

This example smart rule:

1. Samples the value of the `SystemLoadAverage` metric from the local server instance every 30 seconds over a retention window of 15 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `SystemLoadAverage` value, over the last 15 minutes, is less than 0.2 on this server instance.

ServerLowHeapFreePercent

The `ServerLowHeapFreePercent` smart rule determines whether an increase exists in heap stress within the local server in which the rule is running.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average `JVMRuntimeMBean.HeapFreePercent` value over the specified time interval is less than the specified low threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `JVMRuntimeMBean.HeapFreePercent` attribute.
- Low Java free heap percentage threshold value

Syntax

```
wls:ServerLowHeapFreePercent("period", "duration", percentFreeLimit)
```

Parameter	Description
period	Sampling rate for Java free heap percentage values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
percentFreeLimit	Value established as the low threshold value of the Java free heap percentage.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	5
percentFreeLimit	20

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerLowHeapFreePercent("30 seconds","5 minutes",20)
```

This example smart rule:

1. Samples the value of the Java free heap percentage from the local server instance every 30 seconds over a retention window of 5 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average Java free heap percentage value, over the last 5 minutes, is less than 20 per cent on this server instance.

ServerHighIdleThreads

The `ServerHighIdleThreads` smart rule determines whether a reduction in average system load exists within the local server in which the rule is running, by measuring an increase in idle threads as indicated by the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute.

You can target this smart rule on either a Managed Server or an Administration Server.

Group: Server

Description

This rule returns `true` if the average value of the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute over the specified retention window is greater than or equal to the specified threshold value.

To use this smart rule, specify:

- The sampling rate and retention window of the `ThreadPoolRuntimeMBean.ExecuteThreadIdleCount` attribute.
- High `ExecuteThreadIdleCount` threshold value

Syntax

```
wls:ServerHighIdleThreads("period", "duration", idleThreadsLimit)
```

Parameter	Description
period	Sampling rate for `ExecuteThreadIdleCount` values, expressed as a `String`. For example, `30s` specifies that this metric is sampled every 30 seconds. • The default time unit is seconds. • The default value is `30s`. See sampling rate for more information about specifying this parameter.
duration	Period of time for which collected samples are retained, expressed as a `String`. • The default time unit is seconds. • The default value is `10m`. See retention window for more information about specifying this parameter.
idleThreadsLimit	Value established as the high threshold value of the `ExecuteThreadIdleCount` attribute.

Example

The smart rule shown in this example uses the following input parameters:

Parameter	Value
period	30
duration	10
idleThreadsLimit	20

The smart rule that uses the preceding parameters is expressed as follows:

```
wls:ServerHighIdleThreads("30 seconds","10 minutes",20)
```

This example smart rule:

1. Samples the value of the `ExecuteThreadIdleCount` metric from the local server instance every 30 seconds over a retention window of 10 minutes.
2. At the end of the retention window, fires the associated action if the following condition evaluates to `true`:

   The average `ExecuteThreadIdleCount` value, over the last 10 minutes, is greater than or equal to 20 on this server instance.

B

WLDF Beans and Functions Reference

The WebLogic Diagnostics Framework (WLDF) provides a set of beans and functions that can be used in collected metrics policy expressions to obtain access to common WebLogic Server JMX data sources.

- WLDF Beans Reference
  WLDF includes several beans that can be used in collected metrics policy expressions to access statistics that provide information about active cluster objects, MBeans, instrument event fields, and more.
- Functions Reference
  WLDF includes a set of functions that can be used in policy expressions to simplify the extraction or querying of data.

WLDF Beans Reference

WLDF includes several beans that can be used in collected metrics policy expressions to access statistics that provide information about active cluster objects, MBeans, instrument event fields, and more.

- clusterRuntime
  The `clusterRuntime` bean provides cluster-wide access to statistics for active clusters in the domain.
- domainRuntime
  The `domainRuntime` bean provides access to MBeans registered in the Domain Runtime MBean Server.
- instrumentationEvent
  The `instrumentationEvent` bean provides access to instrumentation event fields in instrumentation policy expressions.
- log
  Used in log policy expressions, the `log` bean provides access to log message fields.
- platform
- resource
- runtime
  The `runtime` bean provides access to MBeans registered in the WebLogic Server Runtime MBean Server.

clusterRuntime

The `clusterRuntime` bean provides cluster-wide access to statistics for active clusters in the domain.

Attributes

Name	Description
`clusters`	Provides a map of beans that represent active cluster objects within the domain, keyed by cluster name. Type: `interface java.util.Map`
`name`	The name of the cluster. Type: `class java.lang.String`

Methods

Name	Description
`query`	Performs a query for a set of MBean attribute values based on an Object Name pattern and an attribute expression. **Parameters:** • `onPattern` A valid JMX Object Name, or Object Name pattern. • `attributePattern` A EL expression that is used to retrieve a value from each matching MBean instance, where the expression is an attribute expression relative to each MBean. For example, if the MBean is the `ServerRuntimeMBean`, the expression `'OpenSocketsCurrentCount'` obtains the value of the `OpenSocketsCurrentCount` attribute. By contrast, `'HealthState.State'` obtains the `State` value of the `HealthState` child object. **Return values:** Returns a set of values matching the specified ObjectName pattern and attribute expression. These results can be fed to the wls:extract function for maintaining an in-memory history of values.
`getClusters`	Provides a map of beans that represent active cluster objects within the domain.
`getAttribute`	Obtains a single attribute value from an MBean source. **Parameters:** • `objectNamePattern` A JMX ObjectName or ObjectName pattern that must resolve to a single MBean instance. • `attribute` The MBean attribute value to obtain. **Returns Values:** Returns the attribute value matching the specified JMX ObjectName.

domainRuntime

The `domainRuntime` bean provides access to MBeans registered in the Domain Runtime MBean Server.

Attributes

Name	Description
`domain`	The root `DomainRuntimeMBean` in the Domain Runtime MBean Server.
`name`	The bean name. Type: `class java.lang.String`
`serverRuntimes`	Returns the array of active `ServerRuntimeMBean` instances in the domain. Type: `class weblogic.management.runtime.ServerRuntimeMBean[]`

Methods

Name	Description
`query`	Performs a query for a set of MBean attribute values based on an Object Name pattern and an attribute expression. **Parameters:** • `onPattern` A valid JMX Object Name, or Object Name pattern) • `attributePattern` A EL expression that is used to retrieve a value from each matching MBean instance, where the expression is an attribute expression relative to each MBean. For example, if the MBean is the `ServerRuntimeMBean`, the expression `'OpenSocketsCurrentCount'` obtains the value of the `OpenSocketsCurrentCount` attribute. By contrast, `'HealthState.State'` obtains the `State` value of the `HealthState` child object. **Return values:** Returns a set of values matching the specified Object Name pattern and attribute expression. These results can be fed to the wls:extract function for maintaining an in-memory history of values.
`query`	Executes a JMX query against a set of targets within the Domain Runtime MBean Server. **Parameters:** • `targets` A list of server or cluster targets specified as a comma-delimited `String` • `onPattern` A valid JMX Object Name or Object Name pattern • `expression` A EL expression that is used to retrieve a value on each matching MBean instance **Return values:** Returns a set of values matching the specified Object Name pattern and attribute expression, across the specified target names. The target names can be a valid WebLogic Server instance or cluster in the domain. These results can be fed to the wls:extract function for maintaining an in-memory history of values.

Name	Description
`lookupServerRuntime`	Returns the `ServerRuntimeMBean` for the named server instance, or `null` if not specified. **Parameter:** • `serverName` The name of the `ServerRuntimeMBean` to look up **Return values:** Returns a value matching the specified Object Name pattern and attribute expression.
`getAttribute`	Obtains a single attribute value from an MBean source. **Parameters:** • `objectNamePattern` A JMX ObjectName or ObjectName pattern that must resolve to a single MBean instance. • `attribute` The MBean attribute value to obtain. **Returns Values:** Returns the attribute value matching the specified JMX ObjectName.

instrumentationEvent

The `instrumentationEvent` bean provides access to instrumentation event fields in instrumentation policy expressions.

Attributes

Name	Description
`timeStamp`	The timestamp value associated with the event creation. Type: `class java.lang.Long`
`contextId`	The diagnostic context ID associated with the instrumentation event. Type: `class java.lang.String`
`txId`	The JTA transaction ID associated with the instrumentation event. Type: `class java.lang.String`
`userId`	The user name associated with the request for which the instrumentation event is generated. Type: `class java.lang.String`
`eventType`	The instrumentation event type. Type: `class java.lang.String`
`domain`	The name of the current domain. Type: `class java.lang.String`
`server`	The name of the server on which the instrumentation event occurred. Type: `class java.lang.String`
`scope`	The instrumentation scope for this event. Type: `class java.lang.String`
`module`	The name of the module in which the instrumentation event rule is defined. Type: `class java.lang.String`

Name	Description
monitor	The instrumentation monitor that generated the instrumentation event. Type: class java.lang.String
fileName	The source file name containing the code that generated the instrumentation event. Type: class java.lang.String
lineNumber	The line number in the source file where the instrumentation event originated. Type: class java.lang.Integer
className	The class name where the instrumentation event originated. Type: class java.lang.String
methodName	The method name where the instrumentation event originated. Type: class java.lang.String
methodDesc	The description of the method that generated the instrumentation event. Type: class java.lang.String
arguments	The arguments passed into the method that generated the instrumentation event. Type: class java.lang.String
returnValue	The return value for the method that generated the instrumentation event. Type: class java.lang.String
payload	The payload associated with the instrumentation event. Type class java.lang.Object
contextPayload	The context payload associated with the instrumentation event. Type: class java.lang.String
dyeVector	The dye vector associated with the instrumentation event. Type: class java.lang.Long
threadName	The name of the thread that generated the instrumentation event. Type: class java.lang.String

Example

The following are examples of using the `instrumentationEvent` bean in an EL policy expression to access instrumentation event fields:

```
instrumentationEvent.monitor == 'Servlet_Around_Service'

instrumentationEvent.getMonitor() == 'Servlet_Around_Service'

instrumentationEvent.monitor.contains('Servlet_')
```

log

Used in log policy expressions, the `log` bean provides access to log message fields.

Attributes

Name	Description
timestamp	The timestamp indicating when the log message was created. Type: class java.lang.Long

Name	Description
formattedDate	The formatted date string. Type: class java.lang.String
messageId	The message ID of the log entry. Type: class java.lang.String
machineName	The machine name on which the log entry was created. Type: class java.lang.String
serverName	The server name on which the log entry was created. Type: class java.lang.String
threadName	The thread name in which the logged event was created. Type: class java.lang.String
userId	The ID of the user who generated the logged event. Type: class java.lang.String
transactionId	The JTA transaction ID associated with the logged event. Type: class java.lang.String
severity	The severity level for the log message. Type: class java.lang.Integer
severityString	The severity string for the log message. Type: class java.lang.String
subsystem	The name of the subsystem that generated the log message. Type: class java.lang.String
logMessage	The message content of the log entry. Type: class java.lang.String
diagnosticContextId	The diagnostic context ID associated with the logged event. Type: class java.lang.String
supplementalAttributes	The name-value pairs of supplemental attributes that are included in the log entries. Type: class java.util.Properties

Example

The following are examples of using the `log` bean in an EL policy expression to access log message fields:

```
log.logMessage.contains("Part of a message")

log.getLogMessage().contains("Part of a message")

log.messageId == "BEA-000365"

log.messageId.endsWith('000365')
```

platform

The `platform` bean obtain values from MBeans that are exposed through the JVM's platform MBean server. (Note that WebLogic Server uses the JVM's platform MBean server to contain the WebLogic run-time MBeans by default. As such, the platform MBean server provides

access to platform MXBeans, WebLogic run-time MBeans, and WebLogic configuration MBeans that are on a single server instance.)

Attributes

Name	Description
`name`	The name of the platform bean ("`platform`")

Methods

Name	Description
`query`	Performs a query for a set of MBean attribute values based on an Object Name pattern and an attribute expression. **Parameters:** • `onPattern` A valid JMX Object Name, or Object Name pattern) • `attributePattern` A EL expression that is used to retrieve a value from each matching MBean instance, where the expression is an attribute expression relative to each MBean. For example, if the MBean is the `ServerRuntimeMBean`, the expression `'OpenSocketsCurrentCount'` obtains the value of the `OpenSocketsCurrentCount` attribute. By contrast, `'HealthState.State'` obtains the `State` value of the `HealthState` child object. **Return values:** A set of values matching the specified Object Name pattern and attribute expression. These results can be fed to the wls:extract function for maintaining an in-memory history of values.
`getAttribute`	Obtains a single attribute value from an MBean source. **Parameters:** • `objectNamePattern` A JMX ObjectName or ObjectName pattern that must resolve to a single MBean instance. • `attribute` The MBean attribute value to obtain. **Returns Values:** Returns the attribute value matching the specified JMX ObjectName.

resource

The `resource` bean provides access to beans and state information within a diagnostic system module deployment.Access is restricted to policies that are configured within the same diagnostic system module. That is, this bean cannot obtain access to beans and state

information from policies that are configured in other diagnostic system modules. This bean is used for policy-chaining.

Attributes

Name	Description
`watches`	A map of currently configured policies within the same diagnostic system module deployment. Type: `interface java.util.Map`

runtime

The `runtime` bean provides access to MBeans registered in the WebLogic Server Runtime MBean Server.

Attributes

Name	Description
`domain`	The root `DomainMBean` in the local WebLogic Server Runtime MBean Server. Type: `interface weblogic.management.configuration.DomainMBean`
`name`	The bean name. Type: `class java.lang.String`
`serverRuntime`	The root `ServerRuntimeMBean` in the local WebLogic Server Runtime MBean Server. Type: `interface weblogic.management.runtime.ServerRuntimeMBean`

Methods

Name	Description
`query`	Performs a query for a set of MBean attribute values based on an Object Name pattern and an attribute expression. **Parameters:** • `onPattern` A valid JMX Object Name, or Object Name pattern) • `attributePattern` A EL expression that is used to retrieve a value from each matching MBean instance, where the expression is an attribute expression relative to each MBean. For example, if the MBean is the `ServerRuntimeMBean`, the expression `'OpenSocketsCurrentCount'` obtains the value of the `OpenSocketsCurrentCount` attribute. By contrast, `'HealthState.State'` obtains the `State` value of the `HealthState` child object. **Return values:** A set of values matching the specified Object Name pattern and attribute expression. These results can be fed to the wls:extract function for maintaining an in-memory history of values.

Name	Description
`getAttribute`	Obtains a single attribute value from an MBean source. **Parameters:** • `objectNamePattern` A JMX ObjectName or ObjectName pattern that must resolve to a single MBean instance. • `attribute` The MBean attribute value to obtain. **Returns Values:** Returns the attribute value matching the specified JMX ObjectName.

Functions Reference

WLDF includes a set of functions that can be used in policy expressions to simplify the extraction or querying of data.

- wls:tableChanges
  The `wls:tableChanges` function takes a table of input values and generates an output table of difference vectors, one for each input vector.
- wls:tableAverages
- wls:extract
- wls:average
- wls:changes
- wls:aliveServersCount

wls:tableChanges

The `wls:tableChanges` function takes a table of input values and generates an output table of difference vectors, one for each input vector.

This function throws an `IllegalArgumentException` if the input either:

- Is not a two-dimensional table
- Contains non-numeric values

Parameters

Name	Description
`inputTable`	The input table of numeric values, where each row is typically a time series of values from the same metric instance.

wls:tableAverages

The `wls:tableAverages` function performs a matrix reduction on an input table of values, computing the average of each row in the table and producing a vector of averages, one for each row in the table. Typically each row in the table represents a time series of values from a particular metric instance.
This function throws an `IllegalArgumentException` if the input either:

- Is not a two-dimensional table
- Contains non-numeric values

Parameters

Name	Description
`valuesTable`	The input table of numeric values, where each row is typically a time series of values from the same metric instance.

wls:extract

The `wls:extract` function extracts a table of time series from a specified set of input sources, based on a specified sampling rate schedule and time window. The input source can be one of the following:

- The output from a `query()` operation from a JMX bean. For example:

  ```
  wls.runtime.query('com.bea:Type=ServletRuntime,*', 'ExecutionTimeAverage')
  ```

- An EL expression, as a `String`. For example:

  ```
  wls.runtime.JVMRuntime.heapFreePercent
  ```

Parameters

Name	Decription
`inputExpression`	The bean metric to be sampled.
`schedule`	The sampling rate of the metric, specified as a string, in hours, minutes, or seconds (the default).
`duration`	The required sampling window of the metric, specified as a string, in hours, minutes, or seconds (the default)

The *`schedule`* and *`duration`* parameters can be specified in seconds, minutes, or hours, and are specified as strings using the following syntax:

`amount``[`*`unit`*`]`

In the preceding syntax:

- *`amount`* represents an integer.
- [*`unit`*] represents `seconds`, `minutes`, or `hours`. Each can be abbreviated to the first letter. For example: `seconds` can be abbreviated to `s`.
- You may include a space character between *`amount`* and *`unit`*.

For example, any of the following can be used to specify five seconds:

- `5seconds`
- `5 sec`
- `5s`
- `5snds`

wls:average

The `wls:average` function computes an average value based on set of numeric input values. This function returns the scalar average of the input vector, or `Double.NaN` if the input is empty. If the input contains any non-numeric values, an `IllegalArgumentException` is thrown.

> **Note:**
>
> The `wls:average` function is different from the EL-provided `average()` operation.

Parameters

Name	Description
`inputValues`	A vector of numeric input values

wls:changes

The `wls:changes` method takes a vector of input values of size *n* and produces a vector of (at most) *n*-1 differences between successive values. For example, if the input vector is `{ 3, 2, 5, 3, 7 }`, the resulting vector is `{ 1, -1, 3, -2, 4 }`.
Note the following:

- It is possible for a sequence to contain `Double.NaN`, which are skipped in subsequent computations.
- If an input value is non-numeric, an `IllegalArgumentException` is thrown.

Parameters

Name	Description
`inputValues`	A input vector of numeric values

wls:aliveServersCount

The `wls:aliveServersCount` function is a helper function that counts the number of Managed Server instances that are in the `RUNNING` state in a given cluster.

Parameters

Name	Description
`clusterName`	The name of the cluster containing the running server instances to be counted.

C

WLDF Query Language

The WebLogic Diagnostics Framework (WLDF) includes a query language for constructing watch rule expressions, Data Accessor query expressions, and log filter expressions.The syntax is a small and simplified subset of SQL syntax.

- Components of a Query Expression
- Supported Operators
- Operator Precedence
  The WLDF query language has six levels of precedence among its operators.
- Numeric Relational Operations Supported on String Column Types
- Supported Numeric Constants and String Literals
  The WLDF query language has two sets of rules: one set for numeric constants, and another for string literals.
- About Variables in Expressions
- Creating Policy Expressions
- Creating Data Accessor Queries
- Creating Log Filter Expressions
- Building Complex Expressions

Components of a Query Expression

A query expression may include operators, literals, and variables.The supported variables differ for each type of expression.

- Supported Operators
- Supported Numeric Constants and String Literals
- About Variables in Expressions

The query language is case-sensitive.

Supported Operators

The WLDF query language supports a set of operators and, for each operator, corresponding operator and operand types.These operators, and corresponding types and operands, are listed and described in Table C-1.

Table C-1 WLDF Query Language Operators

Operator	Operator Type	Supported Operand Types	Definition
AND	Logical binary	Boolean	Evaluates to true when both expressions are true.

Table C-1 (Cont.) WLDF Query Language Operators

Operator	Operator Type	Supported Operand Types	Definition
OR	Logical binary	Boolean	Evaluates to true when either expression is true.
NOT	Logical unary	Boolean	Evaluates to true when the expression is not true.
&	Bitwise binary	Numeric, Dye flag	Performs the bitwise AND function on each parallel pair of bits in each operand. If *both* operand bits are 1, the & function sets the resulting bit to 1. Otherwise, the resulting bit is set to 0. Examples of both the & and the | operators are: 1010 & 0010 = 0010 1010 | 0001 = 1011 (1010 & (1100 | 1101)) = 1000
|	Bitwise binary	Numeric, Dye flag	Performs the bitwise OR function on each parallel pair of bits in each operand. If *either* operand bit is 1, the | function sets the resulting bit to 1. Otherwise, the resulting bit is set to 0. For examples, see the entry for the bitwise & operator, above.
=	Relational	Numeric, String	Equals
!=	Relational	Numeric	Not equals
<	Relational	Numeric	Less than
>	Relational	Numeric	Greater than
<=	Relational	Numeric	Less than or equals
>=	Relational	Numeric	Greater than or equals
LIKE	Match	String	Evaluates to true when a character string matches a specified pattern that can include wildcards. LIKE supports two wildcard characters: A percent sign (%) matches any string of zero or more characters A period (.) matches any single character
MATCHES	Match	String	Evaluates to true when a target string matches the regular expression pattern in the operand String.
IN	Search	String	Evaluates to true when the value of a variable exists in a predefined set, for example: SUBSYSTEM IN ('A','B')

Operator Precedence

The WLDF query language has six levels of precedence among its operators.

The following list shows the levels of precedence among operators, from the highest precedence to the lowest. Operators listed on the same line have equivalent precedence:

1. ( )
2. NOT
3. &, |
4. =, !=, <, >, <=, >=, LIKE, MATCHES,IN
5. AND
6. OR

Numeric Relational Operations Supported on String Column Types

Numeric relational operations can be performed on String column types when they hold numeric values.For example, if STATUS is a String type, while performing relational operations with a numeric operand, the column value is treated as a numeric value.
For instance, in the following comparisons, the query evaluator attempts to convert the string value to appropriate numeric value before comparison:

STATUS = 100

STATUS != 100

STATUS < 100

STATUS <= 100

STATUS > 100

STATUS >= 100

When the string value cannot be converted to a numeric value, the query fails.

Supported Numeric Constants and String Literals

The WLDF query language has two sets of rules: one set for numeric constants, and another for string literals.

The rules for numeric constants are as follows:

- Numeric literals can be integers or floating point numbers.
- Numeric literals are specified the same as in Java. Some examples of numeric literals are 2, 2.0, 12.856f, 2.1934E-4, 123456L and 2.0D.

The rules for string literals are as follows:

- String literals must be enclosed in single quotes.
- A percent character (%) can be used as a wildcard inside string literals.

- An underscore character (_) can be used as a wildcard to stand for any single character.
- A backslash character (\) can be used to escape special characters, such as a quote (') or a percent character (%).
- For watch rule expressions, you can use comparison operators to specify threshold values for String, Integer, Long, Double, Boolean literals.
- The relational operators do a lexical comparison for Strings. See the documentation for the java.lang.String.compareTo(String str) method.

About Variables in Expressions

Variables represent the dynamic portion of a query expression that is evaluated at run time.You must use variables that are appropriate for the type of expression you are constructing, as explained in the following sections:

- Creating Policy Expressions
- Creating Data Accessor Queries
- Creating Log Filter Expressions

> **Note:**
>
> When specifying a wildcard pattern in a variable for a policy expression that matches custom MBean ObjectName instances, make sure the pattern is sufficiently explicit. If you exclude an MBean type name and use an ambiguous instance pattern, the following may result:
>
> - Only WebLogic Server runtime MBean instances are matched to the pattern.
> - The desired custom MBean instances are ignored.
>
> For example, the following ObjectName pattern does not explicitly declare a type and uses an ambiguous ObjectName pattern that can match a WebLogic Server runtime MBean instance:
>
> ```
> ${ServerRuntime//com.b*:Type=Server*,*}
> ```
>
> The preceding pattern matches the WebLogic Server runtime MBean instances, and causes any custom MBeans matching the same pattern to be ignored.

Creating Policy Expressions

You can create policies based on log events, instrumentation events, and harvested attributes. For complete documentation about configuring and using WLDF policies, see:

- Configuring Policies and Actions
- Configuring Policies

The variables supported for creating the expressions are different for each type of policy, as described in the following sections:

- Creating Log Event Policy Expressions
- Creating Instrumentation Event Policy Expressions

Creating Log Event Policy Expressions

A *log event* policy expression is based upon the attributes of a log message from the server log.

Variable names for log message attributes are listed and explained in Table C-2:

Table C-2 Variable Names for Log Event Policy Expressions

Variable	Description	Data Type
CONTEXTID	The request ID propagated with the request.	String
DATE	Date when the message was created.	String
MACHINE	Name of machine that generated the log message.	String
MESSAGE	Message content of the log message.	String
MSGID	ID of the log message (usually starts with "BEA=").	String
RECORDID	The number of the record in the log.	Long
SERVER	Name of server that generated the log message.	String
SEVERITY	Severity of log message. Values are Info, Notice, Warning, Error, Critical, Alert, and Emergency.	String
SUBSYTEM	Name of subsystem emitting the log message.	String
THREAD	Name of thread that generated the log message.	String
TIMESTAMP	Timestamp when the log message was created.	Long
TXID	JTA transaction ID of thread that generated the log message.	String
USERID	ID of the user that generated the log message.	String

An example log event policy expression is:

```
(SEVERITY = 'Warning') AND (MSGID = 'BEA-320012')
```

Creating Instrumentation Event Policy Expressions

An *instrumentation event* policy expression is based upon attributes of a data record created by a diagnostic monitor action.

Variable names for instrumentation data record attributes are listed and explained in Table C-3:

Table C-3 Variable Names for Instrumentation Event Policy Expressions

Variable	Description	Data Type
ARGUMENTS	Arguments passed to the method that was invoked.	String
CLASSNAME	Class name of joinpoint.	String
CONTEXTID	Diagnostic context ID of instrumentation event.	String
CTXPAYLOAD	The context payload associated with this request.	String

Table C-3 (Cont.) Variable Names for Instrumentation Event Policy Expressions

Variable	Description	Data Type
DOMAIN	Name of domain.	String
DYES	Dyes associated with this request.	Long
FILENAME	Source file name.	String
LINENUM	Line number in source file.	Integer
METHODNAME	Method name of joinpoint.	String
METHODDSC	Method arguments of joinpoint.	String
MODULE	Name of the diagnostic module.	String
MONITOR	Name of the monitor.	String
PAYLOAD	Payload of instrumentation event.	String
RECORDID	The number of the record in the log.	Long
RETVAL	Return value of joinpoint.	String
SCOPE	Name of instrumentation scope.	String
SERVER	Name of server that created the instrumentation event.	String
TIMESTAMP	Timestamp when the instrumentation event was created.	Long
TXID	JTA transaction ID of thread that created the instrumentation event.	String
TYPE	Type of monitor.	String
USERID	ID of the user that created the instrumentation event.	String

An example instrumentation event data policy expression is:

```
(USERID = 'weblogic')
```

Creating Harvester Policy Expressions

A *Harvester* policy expression is based upon one or more harvestable MBean attributes. The expression can specify an MBean type, an instance, an attribute, or an instance and an attribute.

Instance-based and type-based expressions can contain an optional *namespace* component, which is the namespace of the metric being monitored by the policy. It can be set to either Server Runtime or DomainRuntime. If omitted, it defaults to ServerRuntime.

If the namespace component is included and set to DomainRuntime, you should limit the usage to monitoring only DomainRuntime-specific MBeans, such as the ServerLifeCycleRuntimeMBean. Monitoring remote Managed Server MBeans through the DomainRuntime MBeanServer is possible, but is discouraged for performance reasons. It is a best practice to use the resident policy in each Managed Server to monitor metrics related to that Managed Server instance.

You can also use wildcards in instance names in Harvester policy expressions, as well as specify complex attributes in Harvester policy expressions. See Using Wildcards in Expressions.

The syntax for constructing a Harvester policy expression is as follows:

- To specify an attribute of all instances of a type, use the following syntax:

```
${namespace//[type_name]//attribute_name}
```

- To specify an attribute of an instance of a WebLogic type, use the following syntax:

```
${com.bea:namespace//instance_name//attribute_name}
```

- To specify an attribute of an instance of a custom MBean type, use the following syntax:

```
${domain_name:instance_name//attribute_name}
```

> **Note:**
>
> The *domain_name* is not required for a WebLogic Server domain name.

The expression must include the complete MBean object name, as shown in the following example:

```
${com.bea:Name=HarvesterRuntime,Location=myserver,Type=HarvesterRuntime,
      ServerRuntime=myserver//TotalSamplingCycles} > 10
```

Creating Data Accessor Queries

Use the WLDF query language with the Data Accessor component to retrieve data from data stores, including server logs, HTTP logs, and harvested metrics.The variables used to build a Data Accessor query are based on the column names in the data store from which you want to extract data.
A Data Accessor query contains the following:

- The logical name of a data store, as described in Data Store Logical Names.
- Optionally, the name(s) of one or more columns from which to retrieve data, as described in Data Store Column Names.

When there is a match, all columns of matching rows are returned.

Data Store Logical Names

The logical name for a data store must be unique. It denotes a specific data store available on the server. The logical name consists of a log type keyword followed by zero or more identifiers separated by the forward-slash (/) delimiter. For example, the logical name of the server log data store is simply ServerLog. However, other log types may require additional identifiers, as shown in Table C-4.

Table C-4 Naming Conventions for Log Types

Log Type	Optional Identifiers	Example
ConnectorLog	The JNDI name of the connection factory	`ConnectorLog/eis/900eisaBlackBoxXATxConnectorJNDINAME` In this example, `eis/900eisaBlackBoxXATxConnectorJNDINAME` is the JNDI name of the connection factory specified in the `weblogic-ra.xml` deployment descriptor.
DataSourceLog	None	`DataSourceLog`
DomainLog	None	`DomainLog`
EventsDataArchive	None	`EventsDataArchive`
HarvestedDataArchive	None	`HarvestedDataArchive`
HTTPAccessLog	Virtual host name	`HTTPAccessLog` — For the default web server's access log. `HTTPAccessLog/MyVirtualHost` — For the Virtual host named MyVirtualHost deployed to the current server. **Note:** In the case of HTTPAccessLog logs with extended format, the number of columns are user-defined.
JMSMessageLog	The name of the JMS Server.	`JMSMessageLog/MyJMSServer`
JMSSAFMessageLog	The name of the SAF agent.	`JMSSAFMessageLog/MySAFAgent`
ServerLog	None	`ServerLog`
WebAppLog	Web server name + Root servlet context name	`WebAppLog/MyWebServer/MyRootServletContext`

Data Store Column Names

The column names included in a query are resolved for each row of data. A row is added to the result set only if it satisfies the query conditions for all specified columns. A query that omits column names returns all the entries in the log.

All column names from all WebLogic Server log types are listed in Table C-5.

Table C-5 Column Names for Log Types

Log Type	Column Names
ConnectorLog	LINE, RECORDID
DataSourceLog	RECORDID, DATASOURCE, PROFILETYPE, TIMESTAMP, USER, PROFILEINFORMATION, SUPP_ATTRS
DomainLog	CONTEXTID, DATE, MACHINE, MESSAGE, MSGID, RECORDID, SERVER, SEVERITY, SUBSYSTEM, THREAD, TIMESTAMP, TXID, USERID, SUPP_ATTRS, SEVERITY_VALUE

Table C-5 (Cont.) Column Names for Log Types

Log Type	Column Names
EventsDataArchive	ARGUMENTS, CLASSNAME, CONTEXTID, CTXPAYLOAD, DOMAIN, DYES, FILENAME, LINENUM, METHODNAME, METHODDSC, MODULE, MONITOR, PAYLOAD, RECORDID, RETVAL, SCOPE, SERVER, THREADNAME, TIMESTAMP, TXID, TYPE, USERID
HarvestedDataArchive	ATTRNAME, ATTRTYPE, ATTRVALUE, DOMAIN, NAME, RECORDID, SERVER, TIMESTAMP, TYPE, WLDFMODULE
HTTPAccessLog	AUTHUSER, BYTECOUNT, HOST, RECORDID, REMOTEUSER, REQUEST, STATUS, TIMESTAMP
JDBCLog	Same as DomainLog
JMSMessageLog	CONTEXTID, DATE, DESTINATION, EVENT, JMSCORRELATIONID, JMSMESSAGEID, MESSAGE, MESSAGECONSUMER, NANOTIMESTAMP, RECORDID, SELECTOR, TIMESTAMP, TXID, USERID
JMSSAFMessageLog	CONTEXTID, DATE, DESTINATION, EVENT, JMSCORRELATIONID, JMSMESSAGEID, MESSAGE, MESSAGECONSUMER, NANOTIMESTAMP, RECORDID, SELECTOR, TIMESTAMP, TXID, USERID
ServerLog	Same as DomainLog
WebAppLog	Same as DomainLog

An example of a Data Accessor query is:

```
(SUBSYSTEM = 'Deployer') AND (MESSAGE LIKE '%Failed%')
```

In this example, the Accessor retrieves all messages that include the string "Failed" from the Deployer subsystem.

The following example shows an API method invocation. It includes a query for harvested attributes of the JDBC connection pool named `MyPool`, within an interval between a `timeStampFrom` (inclusive) and a `timeStampTo` (exclusive):

```
WLDFDataAccessRuntimeMBean.retrieveDataRecords(timeStampFrom,
  timeStampTo, "TYPE='JDBCConnectionPoolRuntime' AND NAME='MyPool'")
```

For complete documentation about the WLDF Data Accessor, see Accessing Diagnostic Data With the Data Accessor.

Creating Log Filter Expressions

The query language can be used to filter what is written to the server log.The variables used to construct a log filter expression represent the columns in the log are:

- `CONTEXTID`
- `DATE`
- `MACHINE`
- `MESSAGE`
- `MSGID`
- `RECORDID`

- SEVERITY
- SUBSYSTEM
- SERVER
- THREAD
- TIMESTAMP
- TXID
- USERID

> **Note:**
>
> These are the same variables that you use to build a Data Accessor query for retrieving historical diagnostic data from existing server logs.

For complete documentation about the WebLogic Server logging services, see Filtering WebLogic Server Log Messages in *Configuring Log Files and Filtering Log Messages for Oracle WebLogic Server*.

Building Complex Expressions

You can build complex query expressions using subexpressions containing variables, binary comparisons, and other complex subexpressions.There is no limit on levels of nesting. The following rules apply:

- Nest queries by surrounding subexpressions within parentheses, for example:

  ```
  (SEVERITY = 'Warning') AND (MSGID = 'BEA-320012')
  ```

- Enclose a variable name within `${}` if it includes special characters, as in an MBean object name. For example:

  ```
  ${mydomain:Name=myserver,
        Type=ServerRuntime//SocketsOpenedTotalCount} >= 1
  ```

  Notice that the object name and the attribute name are separated by consecutive forward slashes (`//`) in the policy variable name.

D

WLDF Instrumentation Library

The WebLogic Diagnostics Framework (WLDF) instrumentation library contains diagnostic monitors and diagnostic actions.

For information about using items from the instrumentation library, see Configuring Instrumentation.

- Diagnostic Monitor Library
- Diagnostic Action Library

Diagnostic Monitor Library

Diagnostic monitors are broadly classified as server-scoped and application-scoped monitors.The former can be used to instrument WebLogic Server classes. You use the latter to instrument application classes. Except for the DyeInjection monitor, all monitors are delegating monitors; that is, they do not have a built-in diagnostic action. Instead, they delegate to actions attached to them to perform diagnostic activity.
All monitors are preconfigured with their respective pointcuts. However, the actual locations affected by them may vary depending on the classes they instrument. For example, the Servlet_Before_Service monitor adds diagnostic code at the entry of servlet or java server page (JSP) service methods at different locations in different servlet implementations.

For any delegating monitor, only compatible actions may be attached. The compatibility is determined by the nature of the monitor.

The following table lists and describes the diagnostic monitors that can be used within server scope; that is, in WebLogic Server classes. For the diagnostic actions that are compatible with each monitor, see the **Compatible Action Type** column in Table D-1.

Table D-1 Diagnostic Monitors for Use Within Server Scope

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
Connector_Before_Inbound	Before	Stateless	At entry of methods handling inbound connections.
Connector_After_Inbound	Server	Stateless	At exit of methods handling inbound connections.
Connector_Around_Inbound	Around	Around	At entry and exit of methods handling inbound connections.
Connector_Before_Outbound	Before	Stateless	At entry of methods handling outbound connections.
Connector_After_Outbound	After	Stateless	At exit of methods handling outbound connections.
Connector_Around_Outbound	Around	Around	At entry and exit of methods handling outbound connections.
Connector_Before_Tx	Before	Stateless	Entry of transaction register, unregister, start, rollback and commit methods.

Table D-1 (Cont.) Diagnostic Monitors for Use Within Server Scope

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
Connector_After_Tx	After	Stateless	At exit of transaction register, unregister, start, rollback and commit methods.
Connector_Around_Tx	Around	Around	At entry and exit of transaction register, unregister, start, rollback and commit methods.
Connector_Before_Work	Before	Stateless	At entry of methods related to scheduling, starting and executing connector work items.
Connector_After_Work	After	Stateless	At exit of methods related to scheduling, starting and executing connector work items.
Connector_Around_Work	Around	Around	At entry and exit of methods related to scheduling, starting and executing connector work items.
DyeInjection	Before	Built-in	At points where requests enter the server.
JDBC_Before_Commit_Internal	Before	Stateless	JDBC subsystem internal code
JDBC_After_Commit_Internal	After	Stateless	JDBC subsystem internal code
JDBC_Before_Connection_ Internal	Before	Stateless	Before calls to methods: Driver.connect DataSource.getConnection
JDBC_After_Connection_ Internal	Before	Stateless	JDBC subsystem internal code
JDBC_Before_Rollback_ Internal	Before	Stateless	JDBC subsystem internal code
JDBC_After_Rollback_Internal	After	Stateless	JDBC subsystem internal code
JDBC_Before_Start_Internal	Before	Stateless	JDBC subsystem internal code
JDBC_After_Start_Internal	After	Stateless	JDBC subsystem internal code
JDBC_Before_Statement_ Internal	Before	Stateless	JDBC subsystem internal code
JDBC_After_Statement_ Internal	After	Stateless	JDBC subsystem internal code
JDBC_After_Reserve_Connection_Internal	After	Stateless	After a JDBC connection is reserved from the connection pool.
JDBC_After_Release_Connection_Internal	After	Stateless	After a JDBC connection is released back to the connection pool.

Table D-2 lists the diagnostic monitors that can be used within application scopes; that is, in deployed applications. The **Compatible Action Type** column identifies the diagnostic action type that is compatible with each monitor.

Table D-2 Diagnostic Monitors for Use Within Application Scopes

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
EJB_After_EntityEjbBusiness Methods	After	Stateless	At exits of all EntityBean methods, which are not standard ejb methods.
EJB_Around_EntityEjbBusinessMethods	Around	Around	At entry and exits of all EntityBean methods that are not standard ejb methods.
EJB_After_EntityEjbMethods	After	Stateless	At exits of methods: EnitityBean.setEntityContext EnitityBean.unsetEntityContext EnitityBean.ejbRemove EnitityBean.ejbActivate EnitityBean.ejbPassivate EnitityBean.ejbLoad EnitityBean.ejbStore
EJB_Around_EntityEjbMethods	Around	Around	At exits of methods: EnitityBean.setEntityContext EnitityBean.unsetEntityContext EnitityBean.ejbRemove EnitityBean.ejbActivate EnitityBean.ejbPassivate EnitityBean.ejbLoad EnitityBean.ejbStore
EJB_After_EntityEjbSemantic Methods	After	Stateless	At exits of methods: EnitityBean.set* EnitityBean.get* EnitityBean.ejbFind* EnitityBean.ejbHome* EnitityBean.ejbSelect* EnitityBean.ejbCreate* EnitityBean.ejbPostCreate*
EJB_Around_EntityEjbSemanticMethods	Around	Around	At entry and exits of methods: EnitityBean.set* EnitityBean.get* EnitityBean.ejbFind* EnitityBean.ejbHome* EnitityBean.ejbSelect* EnitityBean.ejbCreate* EnitityBean.ejbPostCreate*
EJB_After_SessionEjbMethods	After	Stateless	At exits of methods: SessionBean.setSessionContext SessionBean.ejbRemove SessionBean.ejbActivate SessionBean.ejbPassivate

Table D-2 (Cont.) Diagnostic Monitors for Use Within Application Scopes

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
EJB_Around_SessionEjbMethods	Around	Around	At entry and exits of methods: SessionBean.setSessionContext SessionBean.ejbRemove SessionBean.ejbActivate SessionBean.ejbPassivate
EJB_After_SessionEjbBusinessMethods	After	Stateless	At exits of all SessionBean methods, which are not standard ejb methods.
EJB_Around_SessionEjb BusinessMethods	Around	Around	At entry and exits of all SessionBean methods, which are not standard ejb methods.
EJB_After_SessionEjbSemanticMethods	After	Stateless	At exits of methods: SessionBean.ejbCreateSessionBean.ejbPostCreate
EJB_Around_SessionEjb SemanticMethods	Around	Around	At entry and exits of methods: SessionBean.ejbCreate SessionBean.ejbPostCreate
EJB_Before_EntityEjbBusinessMethods	Before	Stateless	At entry of all EntityBean methods, which are not standard ejb methods.
EJB_Before_EntityEjbMethods	Before	Stateless	At entry of methods: EnitityBean.setEntityContext EnitityBean.unsetEntityContext EnitityBean.ejbRemove EnitityBean.ejbActivate EnitityBean.ejbPassivate EnitityBean.ejbLoad EnitityBean.ejbStore
EJB_Before_EntityEjbSemanticMethods	Before	Stateless	At entry of methods: EnitityBean.set* EnitityBean.get* EnitityBean.ejbFind* EnitityBean.ejbHome* EnitityBean.ejbSelect* EnitityBean.ejbCreate* EnitityBean.ejbPostCreate*
EJB_Before_SessionEjb BusinessMethods	Before	Stateless	At entry of all SessionBean methods, which are not standard ejb methods.
EJB_Before_SessionEjbMethods	Before	Stateless	At entry of methods: SessionBean.setSessionContext SessionBean.ejbRemove SessionBean.ejbActivate SessionBean.ejbPassivate

Table D-2 (Cont.) Diagnostic Monitors for Use Within Application Scopes

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
EJB_Before_SessionEjb SemanticMethods	Before	Stateless	At entry of methods: SessionBean.ejbCreate SessionBean.ejbPostCreate
HttpSessionDebug	Around	Built-in	getSession - Inspects returned HTTP session Before and after calls to methods: getAttribute setAttribute removeAttribute At inspection points, the approximate session size is computed and stored as the payload of a generated event. The size is computed by flattening the session to a byte-array. If an error is encountered while flattening the session, a negative size is reported.
JDBC_Before_CloseConnection	Before	Stateless	Before calls to methods: Connection.close
JDBC_After_CloseConnection	After	Stateless	After calls to methods: Connection.close
JDBC_Around_CloseConnection	Around	Around	Before and after calls to methods: Connection.close
JDBC_Before_CommitRollback	Before	Stateless	Before calls to methods: Connection.commit Connection.rollback
JDBC_After_CommitRollback	After	Stateless	After calls to methods: Connection.commit Connection.rollback
JDBC_Around_CommitRollback	Around	Around	Before and after calls to methods: Connection.commit Connection.rollback
JDBC_Before_Execute	Before	Stateless	Before calls to methods: Statement.execute* PreparedStatement.execute*
JDBC_After_Execute	After	Stateless	After calls to methods: Statement.execute* PreparedStatement.execute*
JDBC_Around_Execute	Around	Around	Before and after calls to methods: Statement.execute* PreparedStatement.execute*
JDBC_Before_GetConnection	Before	Stateless	Before calls to methods: Driver.connect DataSource.getConnection

Table D-2 (Cont.) Diagnostic Monitors for Use Within Application Scopes

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
JDBC_After_GetConnection	After	Stateless	After calls to methods: Driver.connect DataSource.getConnection
JDBC_Around_GetConnection	Around	Around	Before and after calls to methods: Driver.connect DataSource.getConnection
JDBC_Before_Statement	Before	Stateless	Before calls to methods: Connection.prepareStatement Connection.prepareCall Statement.addBatch RowSet.setCommand
JDBC_After_Statement	After	Stateless	After calls to methods: Connection.prepareStatement Connection.prepareCall Statement.addBatch RowSet.setCommand
JDBC_Around_Statement	Around	Around	Before and after calls to methods: Connection.prepareStatement Connection.prepareCall Statement.addBatch RowSet.setCommand
JMS_Before_AsyncMessage Received	Before	Stateless	At entry of methods: MessageListener.onMessage
JMS_After_AsyncMessage Received	After	Stateless	At exits of methods: MessageListener.onMessage
JMS_Around_AsyncMessage Received	Around	Around	At entry and exits of methods: MessageListener.onMessage
JMS_Before_MessageSent	Before	Stateless	Before call to methods: QueSender send
JMS_After_MessageSent	After	Stateless	After call to methods: QueSender send
JMS_Around_MessageSent	Around	Around	Before and after call to methods: QueSender send
JMS_Before_SyncMessage Received	Before	Stateless	Before calls to methods: MessageConsumer.receive*
JMS_After_SyncMessage Received	After	Stateless	After calls to methods: MessageConsumer.receive*
JMS_Around_SyncMessage Received	Around	Around	Before and after calls to methods: MessageConsumer.receive*
JMS_Before_TopicPublished	Before	Stateless	Before call to methods: TopicPublisher.publish

Table D-2 (Cont.) Diagnostic Monitors for Use Within Application Scopes

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
JMS_After_TopicPublished	After	Stateless	After call to methods: TopicPublisher.publish
JMS_Around_TopicPublished	Around	Around	Before and after call to methods: TopicPublisher.publish
JNDI_Before_Lookup	Before	Stateless	Before calls to javax.naming.Context lookup methods Context.lookup*
JNDI_After_Lookup	After	Stateless	After calls to javax.naming.Context lookup methods: Context.lookup*
JNDI_Around_Lookup	Around	Around	Before and after calls to javax.naming.Context lookup methods Context.lookup*
JTA_Before_Commit	Before	Stateless	At entry of methods: UserTransaction.commit
JTA_After_Commit	After	Stateless advice	At exits of methods: UserTransaction.commit
JTA_Around_Commit	Around	Around	At entry and exits of methods: UserTransaction.commit
JTA_Before_Rollback	Before	Stateless	At entry of methods: UserTransaction.rollback
JTA_After_Rollback	After	Stateless advice	At exits of methods: UserTransaction.rollback
JTA_Around_Rollback	Around	Around	At entry and exits of methods: UserTransaction.rollback
JTA_Before_Start	Before	Stateless	At entry of methods: UserTransaction.begin
JTA_After_Start	After	Stateless advice	At exits of methods: UserTransaction.begin
JTA_Around_Start	Around	Around	At entry and exits of methods: UserTransaction.begin
MDB_Before_MessageReceived	Before	Stateless	At entry of methods: MessageDrivenBean.onMessage
MDB_After_MessageReceived	After	Stateless	At exits of methods: MessageDrivenBean.onMessage
MDB_Around_MessageReceived	Around	Around	At entry and exits of methods: MessageDrivenBean.onMessage
MDB_Before_Remove	Before	Stateless	At entry of methods: MessageDrivenBean.ejbRemove
MDB_After_Remove	After	Stateless	At exits of methods: MessageDrivenBean.ejbRemove

Table D-2 (Cont.) Diagnostic Monitors for Use Within Application Scopes

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
MDB_Around_Remove	Around	Around	At entry and exits of methods: MessageDrivenBean.ejbRemove
MDB_Before_SetMessageDriven Context	Before	Stateless	At entry of methods: MessageDrivenBean.setMessage DrivenContext
MDB_After_SetMessageDriven Context	After	Stateless	At exits of methods: MessageDrivenBean.setMessageDrivenC ontext
MDB_Around_SetMessageDriven Context	Around	Around	At entry and exits of methods: MessageDrivenBean.setMessageDrivenC ontext
Servlet_Before_Service	Before	Stateless	At method entries of servlet/jsp methods: HttpJspPage._jspService Servlet.service HttpServlet.doGet HttpServlet.doPost Filter.doFilter
Servlet_After_Service	After	Stateless	At method exits of servlet/jsp methods: HttpJspPage._jspService Servlet.service HttpServlet.doGet HttpServlet.doPost Filter.doFilter
Servlet_Around_Service	Around	Around	At method entry and exits of servlet/jsp methods: HttpJspPage._jspService Servlet.service HttpServlet.doGet HttpServlet.doPost Filter.doFilter
Servlet_Before_Session	Before	Stateless	Before calls to servlet methods: HttpServletRequest.getSession HttpSession.setAttribute/ putValue HttpSession.getAttribute/ getValue HttpSession.removeAttribute/ removeValue HttpSession.invalidate

Table D-2 (Cont.) Diagnostic Monitors for Use Within Application Scopes

Monitor Name	Monitor Type	Compatible Action Type	Pointcuts
Servlet_Around_Session	Around	Around	Before and after calls to servlet methods: HttpServletRequest.getSession HttpSession.setAttribute/ putValue HttpSession.getAttribute/ getValue HttpSession.removeAttribute/ removeValue HttpSession.invalidate
Servlet_After_Session	After	Stateless	After calls to servlet methods: HttpServletRequest.getSession HttpSession.setAttribute/ putValue HttpSession.getAttribute/ getValue HttpSession.removeAttribute/ removeValue HttpSession.invalidate
Servlet_Before_Tags	Before	Stateless	Before calls to jsp methods: Tag.doStartTag Tag.doEndTag
Servlet_After_Tags	After	Stateless	After calls to jsp methods: Tag.doStartTag Tag.doEndTag
Servlet_Around_Tags	Around	Around	Before and after calls to jsp methods: Tag.doStartTag Tag.doEndTag

Diagnostic Action Library

WLDF includes a library of diagnostic actions that you can use with delegating monitors.You can also use these diagnostic actions with custom monitors that you can define and use within applications. Each diagnostic action can be used only with monitors with which they are compatible, as indicated by the Compatible Monitor Type column. Some actions (for example, TraceElapsedTimeAction) generate an event payload.
The diagnostic action library includes the following actions:

- TraceAction
- DisplayArgumentsAction
- TraceElapsedTimeAction
- TraceMemoryAllocationAction
- StackDumpAction

- ThreadDumpAction
- MethodInvocationStatisticsAction
- MemoryAllocationStatisticsAction

TraceAction

TraceAction is a stateless action that is compatible with Before and After monitor types.

TraceAction generates a trace event at the affected location in the program execution. The following information is generated:

- Timestamp
- Context identifier from the diagnostic context which uniquely identifies the request
- Transaction identifier, if available
- User identity
- Action type (that is, TraceAction)
- Domain
- Server name
- Instrumentation scope name (for example, application name)
- Diagnostic monitor name
- Module name
- Location in code from where the action was called. The location information includes:
  - Class name
  - Method name
  - Method signature
  - Line number
  - Thread name
- Payload carried by the diagnostic context, if any

DisplayArgumentsAction

DisplayArgumentsAction is a stateless action that is compatible with Before and After monitor types.

DisplayArgumentsAction generates an instrumentation event at the affected location in the program execution to capture method arguments or a return value.

When executed, this action causes an instrumentation event that is dispatched to the events archive. When attached to Before monitors, the instrumentation event captures input arguments to the joinpoint (for example, method arguments). When attached to After monitors, the instrumentation event captures the return value from the joinpoint. The event carries the following information:

- Timestamp
- Context identifier from the diagnostic context that uniquely identifies the request
- Transaction identifier, if available

- User identity
- Action type (that is, DisplayArgumentsAction)
- Domain
- Server name
- Instrumentation scope name (for example, application name)
- Diagnostic monitor name
- Module name
- Location in code from where the action was called. The location information includes:
  - Class name
  - Method name
  - Method signature
  - Line number
  - Thread name
- Payload carried by the diagnostic context, if any
- Input arguments, if any, when attached to Before monitors
- Return value, if any, when attached to After monitors

TraceElapsedTimeAction

TraceElapsedTimeAction is an Around action that is compatible with Around monitor types.

TraceElapsedTimeAction generates two events: one before and one after the location in the program execution.

When executed, this action captures the timestamps before and after the execution of an associated joinpoint. It then computes the elapsed time by computing the difference. It generates an instrumentation event which is dispatched to the events archive. The elapsed time is stored as event payload. The event carries the following information:

- Timestamp
- Context identifier from the diagnostic context that uniquely identifies the request
- Transaction identifier, if available
- User identity
- Action type (that is TraceElapsedTimeAction)
- Domain
- Server name
- Instrumentation scope name (for example, application name)
- Diagnostic monitor name
- Module name
- Location in code from where the action was called. This location information consists of:
  - Class name
  - Method name
  - Method signature

  - Line number
  - Thread name
- Payload carried by the diagnostic context, if any
- Elapsed time processing the joinpoint, as event payload, in nanoseconds

TraceMemoryAllocationAction

TraceMemoryAllocationAction uses the HotSpot ThreadMXBean API to trace the number of bytes allocated by a thread during a method call. This action is very similar to TraceElapsedTimeAction, with the exception that the memory allocated within a method call is traced.

The TraceMemoryAllocationAction action:

- Creates an instrumentation event that is persisted.
- Can be used from delegating and custom monitors.

StackDumpAction

StackDumpAction is a stateless action that is compatible with Before and After monitor types.

StackDumpAction generates an instrumentation event at the affected location in the program execution to capture a stack dump.

When executed, this action generates an instrumentation event that is dispatched to the events archive. It captures the stack trace as an event payload. The event carries following information:

- Timestamp
- Context identifier from the diagnostic context that uniquely identifies the request
- Transaction identifier, if available
- User identity
- Action type (that is, StackDumpAction)
- Domain
- Server name
- Instrumentation scope name (for example, application name)
- Diagnostic monitor name
- Module name
- Location in code from where the action was called. This location information consists of:
  - Class name
  - Method name
  - Method signature
  - Line number
  - Thread name
- Payload carried by the diagnostic context, if any
- Stack trace as an event payload

ThreadDumpAction

ThreadDumpAction is a stateless action that is compatible with Before and After monitor types.

ThreadDumpAction generates an instrumentation event at the affected location in the program execution to capture a thread dump, if the underlying VM supports it. JDK 8 and later (Oracle HotSpot) supports this action.

This action generates an instrumentation event that is dispatched to the events archive. This action may be used only with HotSpot. It is ignored when used with other JVMs. It captures the thread dump as event payload. The event carries the following information:

- Timestamp
- Context identifier from the diagnostic context that uniquely identifies the request
- Transaction identifier, if available
- User identity
- Action type (that is, ThreadDumpAction)
- Domain
- Server name
- Instrumentation scope name (for example, application name)
- Diagnostic monitor name
- Module name
- Location in code from where the action was called. This location information consists of:
  - Class name
  - Method name
  - Method signature
  - Line number
  - Thread name
- Payload carried by the diagnostic context, if any
- Thread dump as an event payload

MethodInvocationStatisticsAction

MethodInvocationStatisticsAction is an Around action that is compatible with Around monitor types.

MethodInvocationStatisticsAction captures performance metrics around a joinpoint in memory without persisting an event in the Archive for each invocation. The statistics are collected and made available through the WLDFInstrumentationRuntimeMBean. The collected statistics are also consumable by the Harvester and the Policies and Actions components. This makes it possible to create watch rules that can combine request information from the instrumentation system and metric information from other run-time MBeans.

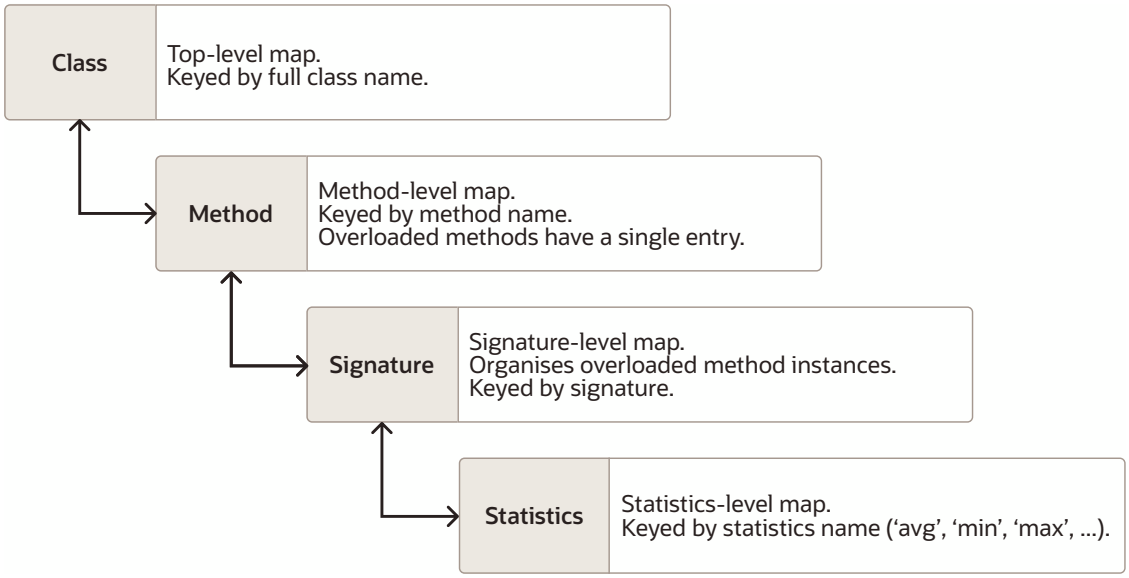
Some of the statistics that can be captured include the following:

- Number of invocations
- Average execution time (in nanoseconds)

- Standard deviation in observed execution time
- Minimum execution time
- Maximum execution time

The WLDFInstrumentationRuntimeMBean instance for a given scope exposes the data collected from MethodInvocationStatisticsAction instances, which are attached to configured Diagnostic Around monitors, using the MethodInvocationStatistics attribute. The MethodInvocationStatistics attribute contains a hierarchy of Map objects, keyed as shown in Figure D-1.

Figure D-1 Structure of MethodInvocationStatistics Attribute



The following semantics are used in the MethodInvocationStatistics attribute:

```
MethodInvocationStatistics::= Map<className, MethodMap>
MethodMap::= Map<methodName, MethodParamsSignatureMap>
MethodParamsSignatureMap::= Map<MethodParamsSignature, MethodDataMap>
MethodDataMap::= <MetricName, Statistic>
MetricName:= min | max | avg | count | sum | sum_of_squares | std_deviation
```

Because the MethodInvocationStatisticsAction only captures information in memory, and does not persist that information in the Archive, this action does not incur the I/O overhead of other instrumentation actions. This makes this action a lightweight mechanism for capturing performance statistics and helping identify bottlenecks in your application. You can navigate through the map structures and identify the low performing parts of your application.

- Instrumenting an Application with MethodInvocationStatisticsAction and Querying the Results
- Configuring the Harvester to Collect MethodInvocationStatisticsAction Data
- Configuring Policies Based on MethodInvocationStatistics Metrics
- Using JMX to Collect Data

Instrumenting an Application with MethodInvocationStatisticsAction and Querying the Results

This section shows an example of instrumenting the Avitek Medical Records (MedRec) sample application with a custom monitor that uses MethodInvocationStatisticsAction. This example then shows using WLST online to query the performance statistics that have been collected, which can be done by navigating the WLDFInstrumentationRuntimeMBean instance associated with the instrumented application.

WLST online provides simplified access to MBeans. While JMX APIs require you to use JMX object names to interrogate MBeans, WLST enables you to navigate a hierarchy of MBeans in a similar fashion to navigating a hierarchy of files in a file system. See Navigating and Interrogating MBeans in *Understanding the WebLogic Scripting Tool*.

The following subsections are included in this example:

> **Note:**
>
> Code examples demonstrating Jakarta EE APIs and other WebLogic Server features are provided with your WebLogic Server installation. To work with these examples, select the custom installation option when installing WebLogic Server, and select to install the Server Examples. See Code Examples and Sample Applications in *Understanding Oracle WebLogic Server.*

- Using WLST to Query Method Performance Statistics

Using WLST to Query Method Performance Statistics

Once MedRec is redeployed, the MethodInvocationStatisticsAction begins capturing method performance statistics as the instrumented code is executed. This section shows how to generate statistics quickly and simply by navigating the MedRec patient application with the custom monitor enabled. This section then shows how to examine those statistics using WLST online.

To capture method performance statistics using the custom monitor configured for MedRec and query the results using WLST, complete the following steps:

1. Start the MedRec application, as described in Sample Applications and Code Examples in *Understanding Oracle WebLogic Server*.

   Log in as a patient, administrator, or physician, and perform a small number of operations.

2. Invoke WLST online and navigate to the WLDFInstrumentationRuntimeMBean instance, as shown in the following example steps:

   a. Connect to the MedRec server:

```
wls:/offline> connect('weblogic','password','localhost:7011')
Connecting to t3://localhost:7011 with userid weblogic ...
Successfully connected to Admin Server 'MedRecServer' that belongs to domain 'medrec'.
```

   b. Use the `cd` command to navigate to the WLDFInstrumentationRuntimeMBean instance associated with the MedRec application:

```
cd('serverRuntime:/WLDFRuntime/WLDFRuntime/WLDFInstrumentationRuntimes/medrec')
Location changed to serverRuntime tree. This is a read-only tree with
```

```
ServerRuntimeMBean as the root.
For more help, use help(serverRuntime)
```

3. Access specific values collected by MethodInvocationStatisticsAction by invoking the following method on the WLDFInstrumentationRuntimeMBean:

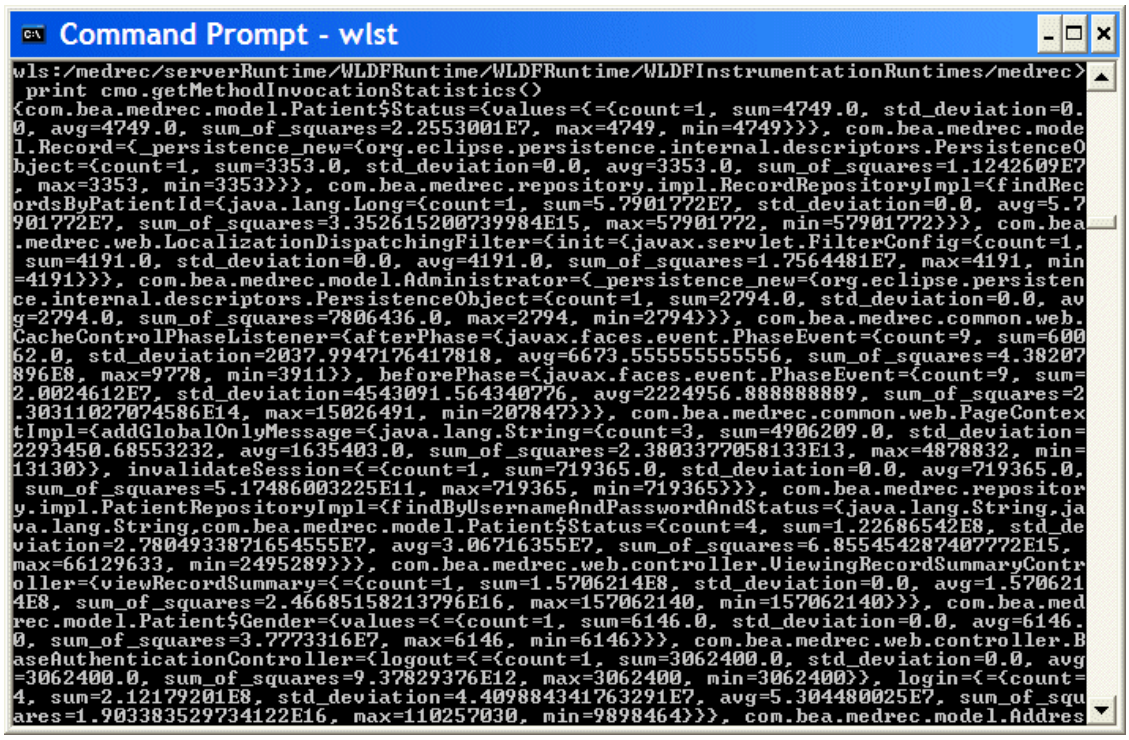
```
public Object getMethodInvocationStatisticsData(String expr) throws
ManagementException;
```

Using WLST interactively, you can pass a lookup expression to this method. The lookup expression specifies the particular subset of values that you are interested in viewing. These values are obtained from the map structure created by MethodInvocationStatisticsAction. For example, the following WLST command returns the average execution time (in nanoseconds) of all methods instrumented by MethodInvocationStatisticsAction:

```
cmo.getMethodInvocationStatisticsData("(com.bea%)(*)(?)(avg)")
array(java.lang.Object,[3352.0, 3632.0, 145270.0, 4050.5, 8450.916666666666,
1798645.75,
583538.0, 3610515.0, 1.9541031E7, 1.2796319E7, 3.07897E8, 4470.0, 3073.0, 3073.0,
2.4644752E7, 3492.5, 1051530.0, 2794.0, 390552.3333333333, 3632.0, 2095.5,
189409.33333333334,
2607.6666666666665, 2793.6666666666665, 4749.333333333333, 5308.0, 65930.0,
3.3950405E7,
3353.0, 3911.5])
```

Note that if you display the entire set of data values that have been collected, a large amount of information could be displayed in the WLST console, as shown in Figure D-2:

Figure D-2 Displaying All Data Values Collected by MethodInvocationStatisticsAction



As an alternative, you can create a WLST script to invoke MethodInvocationStatistics and to format the collected data so that it is more easily read, as in Example D-1:

Example D-1 Using WLST to Invoke MethodInvocationStatistics and Display Results

```
import sys

def getPositionalArgument(pos, default):
  value=None
  try:
    value=sys.argv[pos]
  except:
    value=default
  return value

url = getPositionalArgument(1, "t3://localhost:7001")
user = getPositionalArgument(2, "weblogic")
password = getPositionalArgument(3, "password")
appName = getPositionalArgument(4, "myapp")

connect(user,password,url)
serverRuntime()
cd('/WLDFRuntime/WLDFRuntime/WLDFInstrumentationRuntimes/' + appName)

print "# Class Method | Count | Min | Max | Average | Std-dev |"
stats=cmo.getMethodInvocationStatistics()
for className in stats.keySet():
      classMap=stats.get(className)
      for methodName in classMap.keySet():
        methodMap=classMap.get(methodName)
        for sig in methodMap.keySet():
          str= className + " " + methodName + "(" + sig + ")"
          sigMap=methodMap.get(sig)
          count=sigMap.get('count')
          min=sigMap.get('min')
          max=sigMap.get('max')
          avg=sigMap.get('avg')
          std_deviation=sigMap.get('std_deviation')
          print str, "|", count, "|", min, "|", max, "|", avg, "|", std_deviation, "|"
```

The following shows the output produced by the WLST script shown in Example D-1:

```
# Class Method | Count | Min | Max | Average | Std-dev |
jsp_servlet.__index _isStale() | 1 | 1378000 | 1378000 | 1378000.0 | 0.0 |
jsp_servlet.__index _getBytes(java.lang.String) | 3 | 1000 | 754000 | 252666.66666666666 | 354497.1399351795 |
jsp_servlet.__index _staticIsStale(weblogic.servlet.jsp.StaleChecker) | 1 | 861000 | 861000 | 861000.0 | 0.0 |
jsp_servlet.__index _jspService(javax.servlet.http.HttpServletRequest,javax.servlet.http.HttpServletResponse) | 2 |
70000 | 2113000 | 1091500.0 | 1021500.0 |
jsp_servlet.__index$MyMap containsKey(java.lang.Object) | 2 | 2000 | 101000 | 51500.0 | 49500.0 |
jsp_servlet.__index$MyMap containsValue(java.lang.Object) | 2 | 1000 | 2000 | 1500.0 | 500.0 |
```

Configuring the Harvester to Collect MethodInvocationStatisticsAction Data

To configure the Harvester to collect data gathered by MethodInvocationStatisticsAction instances, you must configure an instance of WLDFHarvesterBean using the following attribute:

```
Name=weblogic.management.runtime.WLDFInstrumentationRuntimeMBean
```

The scope is selected by the instance configuration.

The attribute specification defines the data that is collected by the Harvester. You can access the successive elements of the map by using the following notation:

```
MethodInvocationStatistics(className)(methodName)(methodParamSignature)
(metricName)
```

In the preceding notation:

- *className* represents the fully qualified Java class name. You can use the asterisk (*) wildcard character in a class name.
- *methodName* selects a specific method from the given class. You can use the asterisk (*) wildcard character in a method name.
- *methodParamSignature* represents a string that is a comma-separated list of a method's input argument types. Only the Java type names, without the argument names, are included in the signature specification. As in the Java language, the order of the parameters in the signature is significant.

  This element also supports the asterisk (*) wildcard character, which can be used to specify the entire list of input argument types for a given method. The asterisk (*) wildcard character matches zero or more argument types at the position following its occurrence in the *methodParamSignature* expression.

  You can also use the question mark (?) wildcard character to match a single argument type at any given position in the ordered list of parameter types.

  Both of these wildcard characters can appear anywhere in the expression. See MethodInvocationStatisticsAction Examples.
- *metricName* represents the statistics to be harvested. You can use the asterisk (*) wildcard character in this key to harvest all of the supported metrics.

MethodInvocationStatistics Examples

Consider a class with the following overloaded methods:

```
package.com.foo;
public interface Bar {
  public void doIt();
  public void doIt(int a);
  public void doit(int a, String s)
  public void doIt(Stringa, int b);
  public void doIt(String a, String b);
  public void doIt(String[] a);
  public void doNothing();
  public void doNothing(com.foo.Baz);
}
```

Table D-3 provides examples that show to use MethodInvocationStatisticsAction to harvest various statistics.

Table D-3 MethodInvocationStatisticsAction Examples

The following MethodInvocationStatisticsAction instance configuration . . .	. . . causes the following to be harvested
`MethodInvocationStatistics(com.foo.Bar)(*)(*)(*)`	All statistics for all methods on `com.Foo.Bar`.
`MethodInvocationStatistics(com.foo.Bar)(doIt)()(*)`	All statistics for the `doIt()` method that has no input arguments.
`MethodInvocationStatistics(com.foo.Bar)(doIt)(*)(*)`	All statistics for all `doIt()` methods.

Table D-3 (Cont.) MethodInvocationStatisticsAction Examples

The following MethodInvocationStatisticsAction instance configuration . . .	. . . causes the following to be harvested
`MethodInvocationStatistics(com.foo.Bar)(doIt)(int, *)(*)`	All statistics for the `doIt(int)` and `doIt(int, String)` methods.
`MethodInvocationStatistics(com.foo.Bar)(doIt)(String[])(*)`	All statistics for the `doIt(String[])` method. Note that array parameters are specified by the use of a pair of square brackets (`[]`) following the type name. Space characters are insignificant for the Harvester.
`MethodInvocationStatistics(com.foo.Bar)(doIt)(String, ?)(*)`	All statistics for `doIt()` methods that have two input parameters and `String` as the first argument type. In this example class, this instance configuration matches the following methods: • `doIt(String, int)` • `doIt(String, String)`
`MethodInvocationStatistics(com.foo.Bar)(doNothing)(com.foo.Baz)(min,max)`	The `min` and `max` execution time for the `doNothing()` method that has the single input parameter of type `com.foo.Baz`.

> **Note:**
>
> Using a wildcard character in the *`className`* specification can have a negative impact on performance.

Configuring Policies Based on MethodInvocationStatistics Metrics

You can use the same syntax described in the previous sections to use MethodInvocationStatistics metrics in a policy expression. You can create meaningful watch rules that do not use a wildcard character in the *`MetricName`* element by specifying whether you want the `min`, `max`, `avg`, `count`, `sum`, `sum_of_squares`, or `std_deviation` variable for a given method.

Using JMX to Collect Data

When using straight JMX to collect data, you can potentially impact server performance negatively if you invoke the `getAttribute("MethodInvocationStatistics")` method on the WLDFInstrumentationRuntimeMBean. This occurs because, depending on the instrumented classes, the nested map structure can contain a lot of data that involves expensive serialization.

When you use JMX to collect data, Oracle recommends using the `getMethodInvocationStatisticsData(String)` method.

MemoryAllocationStatisticsAction

The MemoryAllocationStatisticsAction uses the HotSpot ThreadMXBean API API to track the number of bytes allocated by a thread during a method call. Statistics are kept in-memory on the memory allocations, and no instrumentation events are created by this action.

The MemoryAllocationStatisticsAction is very similar to the existing MethodInvocationStatisticsAction. However, statistics tracked by MemoryAllocationStatisticsAction are related to the memory allocated within a method call.

The MemoryAllocationStatisticsAction does not create an instrumentation event. When HotSpot is available, the statistics are available through the WLDFInstrumentationRuntimeMBean.

The following statistics for each method are kept:

- `count`
- `min`
- `max`
- `avg`
- `sum`
- `sum_of_squares`
- `std_deviation`

E

Using Wildcards in Expressions

The WebLogic Diagnostics Framework (WLDF) supports the ability to use wildcards in expressions.WLDF allows for the use of wildcards in instance names within the <harvested-instance> element, and also provides drill-down and wildcard capabilities in the attribute specification of the <harvested-attribute> element.
WLDF also allows the same wildcard capabilities for instance names in Harvester policies, as well as specifying complex attributes in Harvester policies.

This appendix includes the following sections:

- Using Wildcards in Harvester Instance Names
- Specifying Complex and Nested Harvester Attributes
- Using the Accessor with Harvested Complex or Nested Attributes
  While a large number of complex or nested attributes can be specified as a single expression in terms of the Harvester and Policy and Actions configuration, the actual metrics are persisted in terms of each individually gathered metric.
- Using Wildcards in Policy Instance Names
  Within Harvester policy expressions, you can use the asterisk (*) wildcard character to specify portions of an ObjectName. This gives you the ability to watch for multiple instances of a type.
- Specifying Complex Attributes in Harvester Policies

Using Wildcards in Harvester Instance Names

When specifying instance names within the <harvested-instance> element, you have some flexibility with regards to the property list order.Specifically, you can:

- Express the instance name in non-canonical form, allowing you to specify the property list of the ObjectName out of order.
- Express the ObjectName as a JMX ObjectName query pattern without concern as to the order of the property list.
- Use zero or more asterisk (*) wildcard characters in any of the values in the property list of an ObjectName, such as `Name=*`.
- Use zero or more asterisk (*) wildcard characters to replace any character sequence in a canonical ObjectName string. In this case, you must ensure that any properties of the ObjectName not substituted by a wildcard character are in canonical form.
- Examples

Examples

The instance specification in Example E-1 indicates that all instances of the WorkManagerRuntimeMBean are to be harvested. This is equivalent to not providing any instance-name qualification in the <harvested-type> declaration.

Example E-1 Harvesting All Instances of an MBean

```
<harvested-type>
  <name>weblogic.management.runtime.WorkManagerRuntimeMBean</name>
  <harvested-instance>*<harvested-instance>
  <known-type>true</known-type>
  <harvested-attribute>PendingRequests</harvested-attribute>
</harvested-type>
```

Example E-2 shows a JMX ObjectName pattern as the <harvested-instance> value:

Example E-2 Using a JMX ObjectName Pattern

```
<harvested-type>
  <name>com.acme.CustomMBean</name>
  <harvested-instance>adomain:Type=MyType,*</harvested-instance>
  <known-type>false</known-type>
</harvested-type>
```

In Example E-3, some of the values in the ObjectName property list contain wildcard characters:

Example E-3 Using Wildcards in the Property List

```
<harvested-type>
  <name>com.acme.CustomMBean</name>
  <harvested-instance>adomain:Type=My*,Name=*,*</harvested-instance>
  <known-type>false</known-type>
</harvested-type>
```

In Example E-4, all harvestable attributes of all instances of com.acme.CustomMBean are to be harvested, but only those in which the instance name contains the string `Name=mybean`.

Example E-4 Harvesting All Attributes of Multiple Instances

```
<harvested-type>
  <name>coma.acme.CustomMBean</name>
  <harvested-instance>*Name=mybean*</harvested-instance>
  <known-type>true</known-type>
</harvested-type>
```

Specifying Complex and Nested Harvester Attributes

The Harvester provides the ability to access metric values nested within complex attributes of an MBean.A complex attribute can be a map or list object, a simple POJO, or different nestings of these types of objects. For example:

- `anObject.anAttribute`
- `arrayAttribute[1]`
- `mapAttribute(akey)`
- `aList[1](aKey)`

In addition, wildcard characters can be used for list indexes and map keys to specify multiple elements within a collection of those types. The following wildcard characters are available:

- You can use the asterisk (`*`) wildcard character to specify all key values for Map attributes.
- You can use the percent (`%`) wildcard character to replace parts of a Map key string and identify a group of keys that match a particular pattern.

You can also specify a discrete set of key values by using a comma-separated list.

For example:

- `aList[1](partial%Key%)`
- `aList[*](key1,key3,keyN)`
- `aList[*](*)`

In the last example, where the asterisk (`*`) wildcard character is used for the index to a list and as the key value to a nested map object, nested arrays of values are returned.

Embedding the asterisk (`*`) wildcard character in a comma-separated list of map keys is equivalent to specifying all map keys. For example, the following two specifications are equivalent:

- `aList[*](key1,*,keyN)`
- `aList[*](*)`

> **Note:**
>
> Leading or trailing spaces will be stripped from a map key unless the map key is enclosed within quotation marks.
>
> Using a map key pattern can result in a large number of elements being scanned, returned, or both. The larger the number of elements in a map, the bigger the impact is on performance.
>
> The more complex the matching pattern is, the more processing time is required.

Examples

To use drill-down syntax to harvest the nested State property of the HealthState attribute on the ServerRuntime MBean, use the diagnostic descriptor shown in Example E-5.

Example E-5 Using Drill-Down Syntax

```
<harvester>
  <sample-period>10000</sample-period>
  <harvested-type>
    <name>weblogic.management.runtime.ServerRuntimeMBean</name>
    <harvested-attribute>HealthState.State</harvested-attribute>
  </harvested-type>
</harvester>
```

To harvest the elements of an array or list, the Harvester supports a subscript notation in which a value is referred to by its index position in the array or list. For example, to refer to the first element in the array attribute `URLPatterns` in the ServletRuntimeMBean, specify `URLPatterns[0]`. Example E-6 shows referencing all elements of `URLPatterns` using a wildcard character.

Example E-6 Using a Wildcard Character to Reference All Elements of an Array

```
<harvester>
  <sample-period>10000</sample-period>
```

```
  <harvested-type>
    <name>weblogic.management.runtime.ServletRuntimeMBean</name>
    <harvested-attribute>URLPatterns[*]</harvested-attribute>
  </harvested-type>
</harvester>
```

To harvest the elements of a map, each individual value is referenced by the key enclosed in parentheses. Multiple keys can be specified as a comma-delimited list, in which case the values corresponding to specified keys in the map are harvested, as shown in the following examples.

The following example . . .	. . . shows the following
`<harvested-attribute>MyMap(Foo)</harvested-attribute>`	Harvesting the value from the map with key `Foo`.
`<harvested-attribute>MyMap(Foo,Bar)</harvested-attribute>`	Harvesting the value from the map with keys `Foo` and `Bar`.
`<harvested-attribute>MyMap(Foo%Bar)</harvested-attribute>`	Using the percent (`%`) wildcard character with a key specification to harvest all values from the map if their keys start with `Foo` and end with `Bar`.
`<harvested-attribute>MyMap(*)</harvested-attribute>`	Harvesting all values from a map by using the asterisk (`*`) wildcard character.
`<harvested-attribute>MyBeanMyMap(Foo)</harvested-attribute>`	The MBean has a JavaBean attribute `MyBean`, which has a nested map type attribute `MyMap`. This example harvests this value from the map that has the key `Foo`.

Using the Accessor with Harvested Complex or Nested Attributes

While a large number of complex or nested attributes can be specified as a single expression in terms of the Harvester and Policy and Actions configuration, the actual metrics are persisted in terms of each individually gathered metric.

For example, the attribute specification `mymap(*).(a,b,c)` maps to the following actual nested attributes:

```
mymap(key1).a
mymap(key1).b
mymap(key1).c
mymap(key2).a
mymap(key2).b
mymap(key2).c
```

Each of the preceding six metrics are stored in a separate record in the HarvestedDataArchive, with the shown attribute names stored in the ATTRNAME column in each corresponding record. The values in the ATTRNAME column are the values you must use in Accessor queries when retrieving them from the archive.

The following are examples of query strings:

```
NAME="foo:Name=MyMBean" ATTRNAME="mymap(key1).a"
NAME="foo"Name=MyBean" ATTRNAME LIKE "mymap(%).a"
NAME="fooName=MyMBean" ATTRNAME MATCHES "mymap\((.*?)\).a"
```

Using Wildcards in Policy Instance Names

Within Harvester policy expressions, you can use the asterisk (*) wildcard character to specify portions of an ObjectName. This gives you the ability to watch for multiple instances of a type.

For example, to specify the OpenSocketsCurrentCount attribute for all instances of the ServerRuntimeMBean that begin with the name managed:

- The instance-name pattern can be a valid JMX ObjectName pattern, in which case the property list order is not important. For example:

  ```
  ${com.bea:Name=managed*,Type=ServerRuntime,*//OpenSocketCurrentCount}
  ```

  This example is a valid JMX ObjectName pattern that can match:

  - Any ObjectName that contains a `Name` key with a value that starts with `managed`
  - A `Type` key that exactly matches the value `ServerRuntime`
  - Any other property pairs

  For more examples of valid JMX ObjectName patterns, see the ObjectName API documentation at http://docs.oracle.com/javase/8/docs/api/javax/management/ObjectName.html.

- If the name is a pattern but is not a JMX ObjectName pattern, WebLogic Server does pattern-matching using the pattern as-is. For example:

  ```
  ${com.bea:*Name=managed*,Type=ServerRuntime,*//OpenSocketCurrentCount}
  ```

  This example is not a valid JMX ObjectName pattern. This pattern is matched using straight string substitution, where the pattern is matched as-is against the canonical form of the ObjectName for any target MBean instance.

> **Note:**
>
> The ObjectName query pattern syntax supported by the Harvester is determined by whatever is supported by the underlying JMX implementation. The preceding example demonstrates the syntax supported by JDK 5 and later. For information about the full syntax that is supported, see the description of the `javax.management.ObjectName` class corresponding to the version of the JDK with which your installation of WebLogic Server is configured.

Specifying Complex Attributes in Harvester Policies

You can specify complex attributes (a collection, an array type or an Object with nested intrinsic attribute types) within Harvester policy expressions.There are several ways to do this. The following example shows a drill-down into a nested attribute in a complex type, which is then checked to see if it is greater than 0:

```
${somedomain:name=MyMbean//complexAttribute.nestedAttribute} > 0
```

You can also use wildcard characters to specify multiple Map keys. The following wildcard characters are available for specifying complex attributes:

- You can use an asterisk character (*) to specify all key values for Map attributes.

- You can use a percent character (%) to replace parts of a Map key string and to identify a group of keys that match a particular pattern.

In addition, you can use a comma-separated list to specify a discrete set of key values.

For example:

```
${[com.bea.foo.BarClass]//aList[*].(some%partialKey%).(aValue,bValue)} > 0
```

The rule in the preceding example examines all elements of the `aList` attribute on all instances of `com.bea.foo.BarClass`, drilling down into a nested map for all keys starting with the text `some` and containing the text `partialKey` afterwards. The returned values are assumed to be Map instances, from which values for the keys `aValue` and `bValue` are compared to determine if they are greater than 0.

When using the MethodInvocationStatistics attribute on the WLDFInstrumentationRuntime type, the system needs to determine the type from the variable. If the system cannot determine the type when validating the attribute expression, the expression is not valid. For example, the following expression is not valid:

```
${ com.bea:Name=myScope, * //MethodInvocationStatistics.(...).(...)
```

You must explicitly declare the type in this situation, as shown in the following example that shows drilling down into the nested map structure:

```
$(com.bea:Name=hello,Type=WLDFInstrumentationRuntime,*//MethodInvocationStatistics(*)(*)
(*)(count)) >= 1
```

F

WebLogic Scripting Tool Examples

The WebLogic Diagnostics Framework (WLDF) includes examples that show using WLST and JMX to interact with WLDF components.

> **Note:**
>
> The following examples are also included with the WebLogic Server code examples:
>
> - Example: Configuring a Policy and a JMX Action
> - Example: Writing a JMXWatchNotificationListener Class
> - Example: Registering MBeans and Attributes For Harvesting
>
> These examples are bundled under the title "Configuring the Policies and Actions System and Harvesting Data Using WLST". For information about installing and configuring the WebLogic Server code examples, see Sample Applications and Code Examples in *Understanding Oracle WebLogic Server*.

For information about running WebLogic Scripting Tool (WLST) scripts, see Running WLST from Ant in *Understanding the WebLogic Scripting Tool*. For information about developing JMX applications, see Understanding JMX in *Developing Manageable Applications Using JMX for Oracle WebLogic Server*.

This appendix includes the following sections:

WLST Commands for Diagnostics

WLST includes a set of commands that you can use to retrieve diagnostic data and manage diagnostic system resources.These commands are summarized in Table F-1.

Table F-1 WLST Commands Used with WLDF

Command	Summary
`captureAndSaveDiagnosticImage`	Captures a diagnostics image and downloads it locally.

Table F-1 (Cont.) WLST Commands Used with WLDF

Command	Summary
`createSystemResourceControl`	Creates a diagnostics system resource control using specified descriptor file that is not persisted in the domain configuration. See Using WLST to Activate and Deactivate Diagnostic System Modules.
`destroySystemResourceControl`	Destroys an external diagnostics system resource control; that is, one that is created in a server or cluster instance but that is not persisted in the domain configuration. See Using WLST to Activate and Deactivate Diagnostic System Modules.
`disableSystemResource`	Deactivates a diagnostic system resource control that is persisted in the domain configuration. See Using WLST to Activate and Deactivate Diagnostic System Modules.
`dumpDiagnosticData`	Dumps the diagnostics data from a Harvester to a local file.
`enableSystemResource`	Activates a diagnostic resource control. See Using WLST to Activate and Deactivate Diagnostic System Modules.
`exportDiagnosticData`	Execute a query against the specified log file.
`exportDiagnosticDataFromServer`	Executes a query on the server side and retrieves the exported WLDF data.
`getAvailableCapturedImages`	Returns a list of the previously captured diagnostic images.
`listSystemResourceControls`	Lists the diagnostic system modules that are currently configured in the domain. See Using WLST to Activate and Deactivate Diagnostic System Modules.
`mergeDiagnosticData`	Merges a set of data files that were previously generated by the `dumpDiagnosticData()` command.
`saveDiagnosticImageCaptureFile`	Downloads the specified diagnostic image capture.
`saveDiagnosticImageCaptureEntryFile`	Downloads a specific entry from the diagnostic image capture.

For complete details about each of these commands, including additional examples, see Diagnostics Commands in *WLST Command Reference for WebLogic Server*.

Example: Dynamically Creating DyeInjection Monitors

You can create a DyeInjection monitor dynamically using WLST.This demonstration script shown in Example F-1does the following:

- Connects to a server (boots the server first if necessary).
- Looks up or creates a WLDF System Resource.
- Creates the DyeInjection monitor.
- Sets the dye criteria.
- Enables the monitor.
- Saves and activates the configuration.
- Enables the Diagnostic Context feature via the ServerDiagnosticConfigMBean.

The demonstration script in Example F-1 only configures the dye monitor, which injects dye values into the diagnostic context. To fire events, you must implement downstream diagnostic monitors that use dye filtering to fire on the specified dye criteria. An example downstream monitor artifact is shown in Example F-2. This must be placed in a file named `weblogic-`

`diagnostics.xml` and placed into the `META-INF` directory of a application archive. It is also possible to create a monitor using a JSR-88 deployment plan. See *Deploying Applications to Oracle WebLogic Server*.

Example F-1 Example: Using WLST to Dynamically Create DyeInjection Monitors (demoDyeMonitorCreate.py)

```
# Script name: demoDyeMonitorCreate.py
########################################################################
# Demo script showing how to create a DyeInjectionMonitor dynamically
# via WLST. This script will:
# - Connect to a server, booting it first if necessary
# - Look up or create a WLDF System Resource
# - Create the DyeInjection Monitor (DIM)
# - Set the dye criteria
# - Enable the monitor
# - Save and activate
# - Enable the Diagnostic Context functionality via the
#   ServerDiagnosticConfig MBean
# Note: This will only configure the dye monitor, which will inject dye
# values into the Diagnostic Context.  To fire events requires the
# existence of "downstream" monitors set to fire on the specified
# dye criteria.
########################################################################
myDomainDirectory="domain"
url="t3://localhost:7001"
user="weblogic"
password="password"
myServerName="myserver"
myDomain="mydomain"
props="weblogic.GenerateDefaultConfig=true,weblogic.RootDirectory="\
       +myDomainDirectory
try:
  connect(user,password,url)
except:
  startServer(adminServerName=myServerName,domainName=myDomain,
     username=user,password=password,systemProperties=props,
     domainDir=myDomainDirectory,block="true")
  connect(user,password,url)
# Start an edit session
edit()
startEdit()
cd ("/")
# Look up or create the WLDF System resource.
wldfResourceName = "mywldf"
myWldfVar = cmo.lookupSystemResource(wldfResourceName)
if myWldfVar==None:
  print "Unable to find named resource,\
         creating WLDF System Resource: " + wldfResourceName
  myWldfVar=cmo.createWLDFSystemResource(wldfResourceName)
# Target the System Resource to the demo server.
wldfServer=cmo.lookupServer(serverName)
myWldfVar.addTarget(wldfServer)
# create and set properties of the DyeInjection Monitor (DIM).
mywldfResource=myWldfVar.getWLDFResource()
mywldfInst=mywldfResource.getInstrumentation()
mywldfInst.setEnabled(1)
monitor=mywldfInst.createWLDFInstrumentationMonitor("DyeInjection")
monitor.setEnabled(1)
# Need to include newlines when setting properties
# on the DyeInjection monitor.
monitor.setProperties("\nUSER1=larry@celtics.com\
```

```
                        \nUSER2=brady@patriots.com\n")
monitor.setDyeFilteringEnabled(1)
# Enable the diagnostic context functionality via the
# ServerDiagnosticConfig.
cd("/Servers/"+serverName+"/ServerDiagnosticConfig/"+serverName)
cmo.setDiagnosticContextEnabled(1)
# save and disconnect
save()
activate()
disconnect()
exit()
```

Example F-2 Example: Downstream Monitor Artifact

```
<?xml version="1.0" encoding="UTF-8"?>
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
   <instrumentation>
      <enabled>true</enabled>
      <!-- Servlet Session Monitors -->
      <wldf-instrumentation-monitor>
          <name>Servlet_Before_Session</name>
          <enabled>true</enabled>
          <dye-mask>USER1</dye-mask>
          <dye-filtering-enabled>true</dye-filtering-enabled>
          <action>TraceAction</action>
          <action>StackDumpAction</action>
          <action>DisplayArgumentsAction</action>
          <action>ThreadDumpAction</action>
      </wldf-instrumentation-monitor>
      <wldf-instrumentation-monitor>
          <name>Servlet_After_Session</name>
          <enabled>true</enabled>
          <dye-mask>USER2</dye-mask>
          <dye-filtering-enabled>true</dye-filtering-enabled>
          <action>TraceAction</action>
          <action>StackDumpAction</action>
          <action>DisplayArgumentsAction</action>
          <action>ThreadDumpAction</action>
      </wldf-instrumentation-monitor>
   </instrumentation>
</wldf-resource>
```

Example: Configuring a Policy and a JMX Action

You can use WLST to configure a policy and a JMX action using the WLDF Policies and Actions component.The demonstration script shown in Example F-3 does the following:

- Connects to a server and boots the server first if necessary.
- Looks up/creates a diagnostic system module.
- Creates a policy expression on the ServerRuntimeMBean for the OpenSocketsCurrentCount attribute.
- Configures the actuion to use a JMXNotification medium.

> **Note:**
>
> This example is also included with the WebLogic Server code examples. For information about installing and configuring these examples, see Sample Applications and Code Examples in *Understanding Oracle WebLogic Server*.

This script can be used in conjunction with the following files and scripts:

- The `JMXWatchNotificationListener.java` class (see Example: Writing a JMXWatchNotificationListener Class).
- The `demoHarvester.py` script, which registers the OpenSocketsCurrentCount attribute with the Harvester for collection (see Example: Registering MBeans and Attributes For Harvesting).

To see these files work together, perform the following steps:

1. To run the policy configuration script (`demoWatch.py`), type:

   ```
   java weblogic.WLST demoWatch.py
   ```

2. To compile the `JMXWatchNotificationListener.java` source, type:

   ```
   javac JMXWatchNotificationListener.java
   ```

3. To run the `JMXWatchNotificationListener.class` file, type:

   ```
   java JMXWatchNotificationListener
   ```

   > **Note:**
   >
   > Be sure the current directory is in your class path, so it will find the class file you just created.

4. To run the `demoHarvester.py` script, type:

   ```
   java weblogic.WLST demoHarvester.py
   ```

When the `demoHarvester.py` script runs, it executes the JMXNotification action for the policy configured in step 1.

Example F-3 Example: Policy and JMXNotification (demoWatch.py)

```
# Script name: demoWatch.py
###########################################################################
# Demo script showing how to configure a policy and a JMXNotification
# using the WLDF Policies and Action framework.
# The script will:
# - Connect to a server, booting it first if necessary
# - Look up or create a WLDF System Resource
# - Create a policy expression on the ServerRuntimeMBean for the
#     "OpenSocketsCurrentCount" attribute
# - Configure the policy to use a JMXNotification medium
#
# This script can be used in conjunction with
# - the JMXWatchNotificationListener.java class
# - the demoHarvester.py script, which registers the
#   "OpenSocketsCurrentCount" attribute with the harvester for collection.
# To see these work together:
```

```
# 1. Run the policy configuration script
#       java weblogic.WLST demoWatch.py
# 2. Compile and run the JMXWatchNotificationListener.java source code
#       javac JMXWatchNotificationListener.java
#         java JMXWatchNotificationListener
# 3. Run the demoHarvester.py script
#       java weblogic.WLST demoHarvester.py
# When the demoHarvester.py script runs, it fires the
# JMXNotification for the policy configured in step 1.
###########################################################################
myDomainDirectory="domain"
url="t3://localhost:7001"
user="weblogic"
myServerName="myserver"
myDomain="mydomain"
props="weblogic.GenerateDefaultConfig=true\
       weblogic.RootDirectory="+myDomainDirectory
try:
  connect(user,user,url)
except:
  startServer(adminServerName=myServerName,domainName=myDomain,
     username=user,password=password,systemProperties=props,
     domainDir=myDomainDirectory,block="true")
  connect(user,user,url)
edit()
startEdit()
# Look up or create the WLDF System resource
wldfResourceName = "mywldf"
myWldfVar = cmo.lookupSystemResource(wldfResourceName)
if myWldfVar==None:
  print "Unable to find named resource"
  print "creating WLDF System Resource: " + wldfResourceName
  myWldfVar=cmo.createWLDFSystemResource(wldfResourceName)
# Target the System Resource to the demo server
wldfServer=cmo.lookupServer(myServerName)
myWldfVar.addTarget(wldfServer)
cd("/WLDFSystemResources/mywldf/WLDFResource/mywldf/WatchNotification/mywldf")
watch=cmo.createWatch("mywatch")
watch.setEnabled(1)
jmxnot=cmo.createJMXNotification("myjmx")
watch.addNotification(jmxnot)
serverRuntime()
cd("/")
on=cmo.getObjectName().getCanonicalName()
watch.setRuleExpression("${"+on+"} > 1")
watch.getRuleExpression()
watch.setRuleExpression("${"+on+"//OpenSocketsCurrentCount} > 1")
watch.setAlarmResetPeriod(10000)
edit()
save()
activate()
disconnect()
exit()
```

Example: Writing a JMXWatchNotificationListener Class

You can use the JMX API to write a JMXWatchNotificationListener.Example F-4 shows an example.

> **Note:**
>
> This example is also included with the WebLogic Server code examples. For information about installing and configuring these examples, see Sample Applications and Code Examples in *Understanding Oracle WebLogic Server*.

Example F-4 Example: JMXWatchNotificationListener Class (JMXWatchNotificationListener.java)

```
import javax.management.*;
import weblogic.diagnostics.watch.*;
import weblogic.diagnostics.watch.JMXWatchNotification;
import javax.management.Notification;
import javax.management.remote.JMXServiceURL;
import javax.management.remote.JMXConnectorFactory;
import javax.management.remote.JMXConnector;
import javax.naming.Context;
import java.util.Hashtable;
import weblogic.management.mbeanservers.runtime.RuntimeServiceMBean;
public class JMXWatchNotificationListener implements NotificationListener, Runnable {
  private MBeanServerConnection rmbs = null;
  private String notifName = "myjmx";
  private int notifCount = 0;
  private String serverName = "myserver";
  public JMXWatchNotificationListener(String serverName) {
  }
  public void register() throws Exception {
    rmbs = getRuntimeMBeanServerConnection();
    addNotificationHandler();
  }
  public void handleNotification(Notification notif, Object handback) {
    synchronized (this) {
      try {
        if (notif instanceof JMXWatchNotification) {
          WatchNotification wNotif =
                ((JMXWatchNotification)notif).getExtendedInfo();
          notifCount++;
  System.out.println("================================================");
          System.out.println("Notification name:    " +
                 notifName + " called. Count= " + notifCount + ".");
          System.out.println("Watch severity:         " +
                 wNotif.getWatchSeverityLevel());
          System.out.println("Watch time:             " +
                 wNotif.getWatchTime());
          System.out.println("Watch ServerName:       " +
                 wNotif.getWatchServerName());
          System.out.println("Watch RuleType:         " +
                 wNotif.getWatchRuleType());
          System.out.println("Watch Rule:             " +
                 wNotif.getWatchRule());
          System.out.println("Watch Name:             " +
                 wNotif.getWatchName());
          System.out.println("Watch DomainName:       " +
                 wNotif.getWatchDomainName());
          System.out.println("Watch AlarmType:        " +
                 wNotif.getWatchAlarmType());
          System.out.println("Watch AlarmResetPeriod: " +
                 wNotif.getWatchAlarmResetPeriod());
  System.out.println("================================================");
```

```
      }
    } catch (Throwable x) {
      System.out.println("Exception occurred processing JMX policy
               action: " + notifName +"\n" + x);
      x.printStackTrace();
    }
  }
}
private void addNotificationHandler() throws Exception {
  /*
   * The JMX policy action listener registers with a Runtime MBean
   * that matches the name of the corresponding policy bean.
   * Each policy has its own Runtime MBean instance.
   */
  ObjectName oname =
    new ObjectName(
        "com.bea:ServerRuntime=" + serverName + ",Name=" +
        JMXWatchNotification.GLOBAL_JMX_NOTIFICATION_PRODUCER_NAME +
        ",Type=WLDFWatchJMXNotificationRuntime," +
        "WLDFWatchNotificationRuntime=WatchNotification," +
        "WLDFRuntime=WLDFRuntime"
        );
   System.out.println("Adding notification handler for: " +
     oname.getCanonicalName());
  rmbs.addNotificationListener(oname, this, null, null);
}
private void removeNotificationHandler(String name,
             NotificationListener list) throws Exception {
  ObjectName oname =
    new ObjectName(
        "com.bea:ServerRuntime=" + serverName + ",Name=" +
        JMXWatchNotification.GLOBAL_JMX_NOTIFICATION_PRODUCER_NAME +
        ",Type=WLDFWatchJMXNotificationRuntime," +
        "WLDFWatchNotificationRuntime=WatchNotification," +
        "WLDFRuntime=WLDFRuntime"
        );
  System.out.println("Removing notification handler for: " +
      oname.getCanonicalName());
  rmbs.removeNotificationListener(oname, list);
}
public void run() {
  try {
    System.out.println("VM shutdown, unregistering notification
        listener");
    removeNotificationHandler(notifName, this);
  } catch (Throwable t) {
    System.out.println("Caught exception in shutdown hook");
    t.printStackTrace();
  }
}
private String user = "weblogic";
private String password = "password";
public MBeanServerConnection getRuntimeMBeanServerConnection()
  throws Exception {
  String JNDI = "/jndi/";
  JMXServiceURL serviceURL;
  serviceURL =
    new JMXServiceURL("t3", "localhost", 7001,
                      JNDI + RuntimeServiceMBean.MBEANSERVER_JNDI_NAME);
  System.out.println("URL=" + serviceURL);
  Hashtable h = new Hashtable();
  h.put(Context.SECURITY_PRINCIPAL,user);
```

```
    h.put(Context.SECURITY_CREDENTIALS,password);
    h.put(JMXConnectorFactory.PROTOCOL_PROVIDER_PACKAGES,
          "weblogic.management.remote");
    JMXConnector connector = JMXConnectorFactory.connect(serviceURL,h);
    return connector.getMBeanServerConnection();
  }
  public static void  main(String[] args) {
    try {
      String serverName = "myserver";
      if (args.length > 0)
        serverName = args[0];
      JMXWatchNotificationListener listener =
              new JMXWatchNotificationListener(serverName);
      System.out.println("Adding shutdown hook");
      Runtime.getRuntime().addShutdownHook(new Thread(listener));
      listener.register();
      // Sleep waiting for notifications
      Thread.sleep(Long.MAX_VALUE);
    } catch (Throwable e) {
      e.printStackTrace();
    } // end of try-catch
  } // end of main()
}
```

Example: Registering MBeans and Attributes For Harvesting

You can use WLST to register MBeans and attributes for collection by the WLDF Harvester.The script shown in Example F-5 does the following:

- Connects to a server and boots the server first if necessary.
- Looks up or creates a WLDF system resource.
- Sets the sampling frequency.
- Adds a type for collection.
- Adds an attribute of a specific instance for collection.
- Saves and activates the configuration.
- Displays a few cycles of the harvested data.

> **Note:**
>
> This example is also included with the WebLogic Server code examples. For information about installing and configuring these examples, see Sample Applications and Code Examples in *Understanding Oracle WebLogic Server*.

Example F-5 Example: MBean Registration and Data Collection (demoHarvester.py)

```
# Script name: demoHarvester.py
###############################################################
# Demo script showing how register MBeans and attributes for collection
# by the WLDF Harvester Service.  This script will:
# - Connect to a server, booting it first if necessary
# - Look up or create a WLDF System Resource
# - Set the sampling frequency
# - Add a type for collection
# - Add an attribute of a specific instance for collection
```

```
# - Save and activate
#########################################################################
from java.util import Date
from java.text import SimpleDateFormat
from java.lang import Long
import jarray
#########################################################################
# Helper functions for adding types/attributes to the harvester
# configuration
#########################################################################
def findHarvestedType(harvester, typeName):
  htypes=harvester.getHarvestedTypes()
  for ht in (htypes):
    if ht.getName() == typeName:
      return ht
  return None
def addType(harvester, mbeanInstance):
  typeName = "weblogic.management.runtime."\
              + mbeanInstance.getType() + "MBean"
  ht=findHarvestedType(harvester, typeName)
  if ht == None:
    print "Adding " + typeName + " to harvestables collection for "\
           + harvester.getName()
    ht=harvester.createHarvestedType(typeName)
  return ht;
def addAttributeToHarvestedType(harvestedType, targetAttribute):
  currentAttributes = PyList()
  currentAttributes.extend(harvestedType.getHarvestedAttributes());
  print "Current attributes: " + str(currentAttributes)
  try:
    currentAttributes.index(targetAttribute)
    print "Attribute is already in set"
    return
  except ValueError:
    print targetAttribute + " not in list, adding"
  currentAttributes.append(targetAttribute)
  newSet = jarray.array(currentAttributes, java.lang.String)
  print "New attributes for type "\
           + harvestedType.getName() + ": " + str(newSet)
  harvestedType.setHarvestedAttributes(newSet)
  return
def addTypeForInstance(harvester, mbeanInstance):
  typeName = "weblogic.management.runtime."\
              + mbeanInstance.getType() + "MBean"
  return addTypeByName(harvester, typeName, 1)
def addInstanceToHarvestedType(harvester, mbeanInstance):
  harvestedType = addTypeForInstance(harvester, mbeanInstance)
  currentInstances = PyList()
  currentInstances.extend(harvestedType.getHarvestedAttributes());
  on = mbeanInstance.getObjectName().getCanonicalName()
  print "Adding " + str(on) + " to set of harvested instances for type "\
        + harvestedType.getName()
  print "Current instances : " + str(currentInstances)
  for inst in currentInstances:
    if inst == on:
      print "Found " + on + " in existing set"
      return harvestedType
  # only get here if the target attribute is not in the set
  currentInstances.append(on)
  # convert the new list back to a Java String array
  newSet = jarray.array(currentInstances, java.lang.String)
  print "New instance set for type " + harvestedType.getName()\
```

```
        + ": " + str(newSet)
  harvestedType.setHarvestedInstances(newSet)
  return harvestedType
def addTypeByName(harvester, _typeName, knownType=0):
  ht=findHarvestedType(harvester, _typeName)
  if ht == None:
    print "Adding " + _typeName + " to harvestables collection for "\
          + harvester.getName()
    ht=harvester.createHarvestedType(_typeName)
    if knownType == 1:
        print "Setting known type attribute to true for " + _typeName
        ht.setKnownType(knownType)
  return ht;
def addAttributeForInstance(harvester, mbeanInstance, attributeName):
  typeName = mbeanInstance.getType() + "MBean"
  ht = addInstanceToHarvestedType(harvester, mbeanInstance)
  return addAttributeToHarvestedType(ht,attributeName)
###########################################################################
# Display the currently registered types for the specified harvester
###########################################################################
def displayHarvestedTypes(harvester):
  harvestedTypes = harvester.getHarvestedTypes()
  print ""
  print "Harvested types:"
  print ""
  for ht in (harvestedTypes):
    print "Type: " + ht.getName()
    attributes = ht.getHarvestedAttributes()
    if attributes != None:
      print "  Attributes: " + str(attributes)
    instances = ht.getHarvestedInstances()
    print "  Instances:  " + str(instances)
    print ""
  return
###########################################################################
# Main script flow -- create a WLDF System resource and add harvestables
###########################################################################
myDomainDirectory="domain"
url="t3://localhost:7001"
user="weblogic"
myServerName="myserver"
myDomain="mydomain"
props="weblogic.GenerateDefaultConfig=true,weblogic.RootDirectory="\
        +myDomainDirectory
try:
  connect(user,user,url)
except:
  startServer(adminServerName=myServerName,domainName=myDomain,
     username=user,password=password,systemProperties=props,
     domainDir=myDomainDirectory,block="true")
  connect(user,user,url)
# start an edit session
edit()
startEdit()
cd("/")
# Look up or create the WLDF System resource
wldfResourceName = "mywldf"
systemResource = cmo.lookupSystemResource(wldfResourceName)
if systemResource==None:
  print "Unable to find named resource,\
        creating WLDF System Resource: " + wldfResourceName
  systemResource=cmo.createWLDFSystemResource(wldfResourceName)
```

```
# Obtain the harvester bean instance for configuration
print "Getting WLDF Resource Bean from " + str(wldfResourceName)
wldfResource = systemResource.getWLDFResource()
print "Getting Harvester Configuration Bean from " + wldfResourceName
harvester = wldfResource.getHarvester()
print "Harvester: " + harvester.getName()
# Target the WLDF System Resource to the demo server
wldfServer=cmo.lookupServer(myServerName)
systemResource.addTarget(wldfServer)
# The harvester Jython wrapper maintains refs to
# the SystemResource objects
harvester.setSamplePeriod(5000)
harvester.setEnabled(1)
# add an instance-based RT MBean attribute for collection
serverRuntime()
cd("/")
addAttributeForInstance(harvester, cmo, "OpenSocketsCurrentCount")
# have to return to the edit tree to activate
edit()
# add a RT MBean type, all instances and attributes,
# with KnownType = "true"
addTypeByName(harvester,
        "weblogic.management.runtime.WLDFInstrumentationRuntimeMBean", 1)
addTypeByName(harvester,
        "weblogic.management.runtime.WLDFWatchNotificationRuntimeMBean", 1)
addTypeByName(harvester,
        "weblogic.management.runtime.WLDFHarvesterRuntimeMBean", 1)
try:
    save()
    activate(block="true")
except:
    print "Error while trying to save and/or activate."
    dumpStack()
# display the data
displayHarvestedTypes(harvester)
disconnect()
exit()
```

Example: Setting the WLDF Diagnostic Volume

You can use WLST to configure the volume of Java Flight Recorder data that is captured in a diagnostic image.By default, WLDF gathers data and record most events in a WebLogic Server instance, unless specifically configured otherwise. Note that even when WLDF diagnostic volume is set to `Off`, WLDF, and potentially the JVM if flight recording is enabled, generate global events that have information about the recording settings; for example, JVM metadata events that list active recordings, and WLDF GlobalInformationEvents that list the volume level for the domain, server, and machine.
Example F-6 shows changing the WLDF diagnostic volume to `Medium`:

Example F-6 Setting WLDF Diagnostic Volume

```
connect()
edit()
startEdit()
cd("Servers/myserver")
cd("ServerDiagnosticConfig")
cd("myserver")
cmo.setWLDFDiagnosticVolume("Medium")
save()
activate()
```

Example: Capturing a Diagnostic Image

You can use WLST to create a diagnostic image capture for a WebLogic Server instance.

> **Note:**
>
> If WebLogic Server is running in production mode, the server's SSL port must be used when executing the commands included in this script.

Example F-7 show a sample WLST script that captures a diagnostic image. This example does the following:

- Captures an diagnostic image after connecting, and then waits for the image task to complete.
- Uses the `getAvailableCapturedImages()` command to obtain a list of available diagnostic image files in the server's image directory.
- Loops through the list of available images in the diagnostic image capture and saves each image file locally using the `saveDiagnosticImageCaptureFile()` command.

Example F-7 Creating a Diagnostic Image Capture

```
#
# WLST script to capture a WLDF Diagnostic Image and
# retrieve the image files to a local dir.
#
# Usage:
#
# java weblogic.WLST captureImage.py [username] [passwd] [url] [output-dir]
#
# where
#
#   username       Username to use to connect
#   passwd         Password for connecting to server
#   url            URL to connect to the server
#   output-dir     Path to place saved entries
#
from java.io import File

# Retrieve a positional argument if it exists; if not,
# the provided default is returned.
#
# Params:
# pos   The integer location in sys.argv of the parameter
# default  The default value to return if the parameter does not exist
#
# returns the value at sys.argv[pos], or the provided default if necesssary
def getPositionalArgument(pos, default):
  value=None
  try:
    value=sys.argv[pos]
  except:
    value=default
  return value

# Credential arguments
```

```
uname=getPositionalArgument(1, "weblogic")
passwd=getPositionalArgument(2, "password")
url=getPositionalArgument(3, "t3://localhost:7001")
outputDir=getPositionalArgument(4, ".")

connect(uname, passwd, url)
serverRuntime()
currentDrive=currentTree()

# Capture a new diagnostic image
try:
  cd("serverRuntime:/WLDFRuntime/WLDFRuntime/WLDFImageRuntime/Image")
  task=cmo.captureImage()
  Thread.sleep(1000)
  while task.isRunning():
    Thread.sleep(5000)
  cmo.resetImageLockout();
finally:
  currentDrive()

# List the available diagnostic image files in the server's image capture dir
images=getAvailableCapturedImages()
if len(images) > 0:
  # For each diagnostic image found, retrieve image file, renaming it as
  # the user sees fit
  for image in images:
    saveName=outputDir+File.separator+serverName+'-'+image
    saveDiagnosticImageCaptureFile(image,saveName)
```

Example: Retrieving a JFR File from a Diagnostic Image Capture

You can use WLST to retrieve the Java Flight Recorder (JFR) file from each diagnostic image capture that is located in the image destination directory on the server and copy it to a local directory.The script shown in Example F-8 does the following:

- Connects to WebLogic Server, passing the required credentials.
- Creates a diagnostic image capture.
- Obtains a list of the available diagnostic image files in the server's configured image directory.
- For each diagnostic image file, attempts to retrieve the JFR file and save it to a local directory, ensuring that each file is renamed as necessary to avoid any from being overwritten.

> **Note:**
>
> If WebLogic Server is running in production mode, the server's SSL port must be used when executing the commands included in this script.

Example F-8 Retrieving a Diagnostic Image Capture File

```
#
# WLST script to capture a WLDF Diagnostic Image and
# save the FlightRecording.jfr entry locally
#
# Usage:
```

```
#
# java weblogic.WLST captureImageEntry.py [username] [passwd] [url] [output-dir] [image-
suffix]
#
# where
#
#   username       Username to use to connect
#   passwd         Password for connecting to server
#   url            URL to connect to the server
#   output-dir     Path to place saved entries
#   image-suffix   Suffix to use to rename JFR image entries locally
#
import os.path
from java.io import File

# Retrieve a positional argument if it exists; if not,
# the provided default is returned.
#
# Params:
# pos   The integer location in sys.argv of the parameter
# default  The default value to return if the parameter does not exist
#
# returns the value at sys.argv[pos], or the provided default if necesssary
def getPositionalArgument(pos, default):
  value=None
  try:
    value=sys.argv[pos]
  except:
    value=default
  return value

# Credential arguments
uname=getPositionalArgument(1, "weblogic")
passwd=getPositionalArgument(2, "password")
url=getPositionalArgument(3, "t3://localhost:7001")
outputDir=getPositionalArgument(4, ".")
imageSuffix=getPositionalArgument(5, "_WLS")

connect(uname, passwd, url)
serverRuntime()
currentDrive=currentTree()

# Capture a new diagnostic image capture file
try:
  cd("serverRuntime:/WLDFRuntime/WLDFRuntime/WLDFImageRuntime/Image")
  task=cmo.captureImage()
  Thread.sleep(1000)
  while task.isRunning():
    Thread.sleep(5000)
  cmo.resetImageLockout();
finally:
  currentDrive()

# List the available diagnostic image captures in the server's image capture dir
images=getAvailableCapturedImages()
if len(images) > 0:
  # For each image capture found, retrieve the JFR entry and save it to a local
  # file, renaming it to avoid collisions in the event there are multiple
  # diagnostic image capture files with JFR entries.
  i=0
  for image in images:
    saveName=outputDir+File.separator+"FlightRecording_"+imageSuffix+"-"+str(i)+".jfr"
```

```
while os.path.exists(saveName):
  i+=1
  saveName=outputDir+File.separator+"FlightRecording_"+imageSuffix+"-"+str(i)+".jfr"
saveDiagnosticImageCaptureEntryFile(image,'FlightRecording.jfr',saveName)
i+=1
```

G

WLDF Query Language-Based Policies

The WebLogic Diagnostics Framework (WLDF) provides the WLDF query language for creating policy expressions.

> **Note:**
>
> The WLDF query language is deprecated in WebLogic Server as of version 12.2.1. Oracle recommends using Java Expression Language (EL) instead. Diagnostic system modules containing policy expressions that use the WLDF query language are supported for backward compatibility. For information about using Java EL in policy expressions, see Configuring Policies.

- Types of Policies
  WLDF supports policies that you can configure within the context of using the WLDF query language.
- Policy Configuration Options
  WLDF provides several tool options for configuring policies.
- Configuring Harvester Policies Using the WLDF Query Language
  WLDF provides three main types of Harvester policies that can be configured with WLDF query language-based expressions. Each policy type is based on what the policy can monitor.
- Configuring Log Policies Using the WLDF Query Language
  Use log policies to monitor the occurrence of specific messages or strings in the server or domain log. Policies of this type are triggered as a result of a log message containing the specified data being issued.
- Configuring Instrumentation Policies Using the WLDF Query Language
  You use instrumentation policies to monitor the events from the WLDF Instrumentation component. Policies of this type are triggered as a result of the event being posted.

Types of Policies

WLDF supports policies that you can configure within the context of using the WLDF query language.

WLDF provides three main types of policies, based on what the policy can monitor:

- **Harvester** policies monitor the set of harvestable MBeans in the local runtime MBean server.
- **Log** policies monitor the set of messages generated into the server or domain logs.
- **Instrumentation** (or Event Data) policies monitor the set of events generated by the WLDF Instrumentation component.

In the WLDF system resource configuration file for a diagnostic module, each type of policy is defined in a <rule-type> element, which is a child of <watch>. For example:

```
<watch>
   <rule-type>Harvester</rule-type>
   <!-- Other configuration elements -->
</watch>
```

Policies with different rule types differ in two ways:

- The rule syntax for specifying the conditions being monitored are unique to the type.
- Log and instrumentation policies are triggered in real time, whereas Harvester policies are triggered only after the current harvest cycle completes.

Policy Configuration Options

WLDF provides several tool options for configuring policies.

For information about policy configuration options, see How Policies Are Configured.

Configuring Harvester Policies Using the WLDF Query Language

WLDF provides three main types of Harvester policies that can be configured with WLDF query language-based expressions. Each policy type is based on what the policy can monitor.

> **Note:**
>
> If you define a policy to monitor an MBean (or MBean attributes) that the Harvester is not configured to harvest, the policy will work. The Harvester will implicitly harvest values to satisfy the requirements set in the defined policy expressions. However, data harvested in this way (that is, implicitly for a policy) is not archived. See Configuring the Harvester for Metric Collection.

Harvester policies are triggered in response to a harvest cycle. So, for Harvester policies, the Harvester sample period defines a time interval between when a situation is identified and when it can be reported though an action. On average, the delay is SamplePeriod/2.

Example G-1 shows a configuration example of a Harvester policy that monitors several runtime MBeans. When the policy expression (defined in the <rule-expression> element) evaluates to true, six different actions are executed to generate the following: a JMX notification, an SMTP notification, an SNMP notification, an image action, and JMS notifications for both a topic and a queue.

The policy is a logical expression composed of four Harvester variables. The expression has the form:

```
( (A >= 100) AND (B > 0) ) OR C OR D.equals("active")
```

Each variable is of the form:

```
{entityName}//{attributeName}
```

In the preceding syntax, `{entityName}` is the JMX ObjectName as registered in the runtime MBean server or the type name as defined by the Harvester, and `{attributeName}` is the name of an attribute defined on that MBean type.

> **Note:**
>
> The comparison operators are qualified in order to be valid in XML.

Example G-1 Sample Harvester Policy Configuration (in DIAG_MODULE.xml)

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <harvester>
  <!-- Harvesting does not have to be configured and enabled for harvester
       policies. However, configuring the Harvester can provide advantages;
       for example the data will be archived. -->
    <harvested-type>
      <name>myMBeans.MySimpleStandard</name>
      <harvested-instance>myCustomDomain:Name=myCustomMBean1
      </harvested-instance>
      <harvested-instance>myCustomDomain:Name=myCustomMBean2
      </harvested-instance>
    </harvested-type>
    <!-- Other Harvester configuration elements -->
  </harvester>
  <watch-notification>
    <watch>
      <name>simpleWebLogicMBeanWatchRepeatingAfterWait</name>
      <enabled>true</enabled>
      <rule-type>Harvester</rule-type>
      <rule-expression>
       (${mydomain:Name=WLDFHarvesterRuntime,ServerRuntime=myserver,Type=
       WLDFHarvesterRuntime,WLDFRuntime=WLDFRuntime//TotalSamplingTime}
          &gt;= 100
           AND
          ${mydomain:Name=myserver,Type=
                   ServerRuntime//OpenSocketsCurrentCount} &gt; 0)
           OR
         ${mydomain:Name=WLDFWatchNotificationRuntime,ServerRuntime=
             myserver,Type=WLDFWatchNotificationRuntime,
               WLDFRuntime=WLDFRuntime//Enabled} = true
           OR
         ${myCustomDomain:Name=myCustomMBean3//State} =
                 'active')
      </rule-expression>
      <severity>Warning</severity>
      <alarm-type>AutomaticReset</alarm-type>
      <alarm-reset-period>10000</alarm-reset-period>
      <notification>myJMXNotif,myImageNotif,
         myJMSTopicNotif,myJMSQueueNotif,mySNMPNotif,
         mySMTPNotif</notification>
    </watch>
    <!-- Other policy-action configuration elements -->
  </watch-notification>
</wldf-resource>
```

This policy uses an alarm type of AutomaticReset, which means that it may be triggered repeatedly, provided that the last time it was triggered was longer than the interval set as the alarm reset period (in this case 10000 milliseconds).

The severity level provided, Warning, has no effect on the triggering of the policy, but will be passed on through the actions.

Configuring Log Policies Using the WLDF Query Language

Use log policies to monitor the occurrence of specific messages or strings in the server or domain log. Policies of this type are triggered as a result of a log message containing the specified data being issued.

The following example shows the configuration, in *DIAG_MODULE*.xml, for a server log policy:

```
<wldf-resource xmlns="http://xmlns.oracle.com/weblogic/weblogic-diagnostics"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-diagnostics/2.0/
weblogic-diagnostics.xsd">
  <name>mywldf1</name>
  <watch-notification>
    <enabled>true</enabled>
    <log-watch-severity>Info</log-watch-severity>
    <watch>
      <name>myLogWatch</name>
      <rule-type>Log</rule-type>
      <rule-expression>MSGID='BEA-000360'</rule-expression>
      <severity>Info</severity>
      <notification>myMailNotif2</notification>
    </watch>
    <smtp-notification>
      <name>myMailNotif2</name>
      <enabled>true</enabled>
      <mail-session-jndi-name>myMailSession</mail-session-jndi-name>
      <subject>This is a log alert</subject>
      <recipient>username@emailservice.com</recipient>
    </smtp-notification>
  </watch-notification>
</wldf-resource>
```

In the preceding example, note how the <rule-type> of `Log` causes messages or strings entered in the server log to be monitored. A <rule-type> of `DomainLog` monitors messages or strings in the domain log.

Configuring Instrumentation Policies Using the WLDF Query Language

You use instrumentation policies to monitor the events from the WLDF Instrumentation component. Policies of this type are triggered as a result of the event being posted.

The following example shows the configuration, in *DIAG_MODULE*.xml, for an instrumentation policy:

```
<watch-notification>
    <watch>
    <name>myInstWatch</name>
    <enabled>true</enabled>
    <rule-type>EventData</rule-type>
    <rule-expression>
      (PAYLOAD &gt; 100000000) AND (MONITOR = 'Servlet_Around_Service')
    </rule-expression>
    <alarm-type xsi:nil="true"></alarm-type>
```

```
    <notification>mySMTPNotification</notification>
  </watch>
  <smtp-notification>
    <name>mySMTPNotification</name>
    <enabled>true</enabled>
    <mail-session-jndi-name>myMailSession</mail-session-jndi-name>
    <subject xsi:nil="true"></subject>
    <body xsi:nil="true"></body>
    <recipient>username@emailservice.com</recipient>
  </smtp-notification>
</watch-notification>
```