GlassFish Monitoring with JMX, Jconsole, Glassbox and AMX

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Agenda

• GlassFish Monitoring OOTB
• JConsole and JMX Monitoring
• Open Source project Glassbox
• AMX and GlassFish Management Rules
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• GlassFish Monitoring OOTB
• JConsole and JMX Monitoring
• Open Source project Glassbox
• AMX and GlassFish Management Rules
GlassFish Monitoring OOTB

Features include:
- CallFlow Monitoring
- Run-Time Monitoring
- Application Monitoring
- Resource Monitoring
- Transaction Monitoring
GlassFish Monitoring OOTB

Configuration

```
asadmin start-callflow-monitoring [-filtertype type=value:type=value] instancename
```

OR

[Image of GlassFish Monitoring Configuration in the GlassFish Management Console]

GlassFish Monitoring OOTB

Call Flow Monitoring

Application Server

Call Flow Details
View call flow details of the request. Click on the view tree button to look at call flow in tree view.

Hide Chart

Request Information
- Back to config: May 28, 2007 12:09:51 AM
- User: anonymous
- Start Container: REMOTE_WEB
- Response: Success
- Response Time(ms): 31.013

Request Time Distribution
- Web Container: 75.454\% 23.37 ms
- Web Application: 24.546\% 7.603 ms
GlassFish Monitoring OOTB

Runtime Monitoring

```
<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Details</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CommittedNonHeapSize</td>
<td>82804736 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Amount of non-heap memory that is committed for the JVM to use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>CommittedHeapSize</td>
<td>255893504 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Amount of memory that is committed for the JVM to use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>ObjectsPendingFinalization</td>
<td>0 count</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Approximate number of objects that are pending finalization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>UsedHeapSize</td>
<td>143120968 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Size of the heap currently in use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>MaxNonHeapSize</td>
<td>127467562 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Maximum amount of non-heap memory that can be used for memory management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>MaxHeapSize</td>
<td>518979584 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Maximum amount of memory that can be used for memory management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>UsedNonHeapSize</td>
<td>82683864 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Size of the non-heap area currently in use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>InitialNonHeapSize</td>
<td>82804736 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Size of the non-heap area initially requested by the JVM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
<tr>
<td>InitialHeapSize</td>
<td>0 bytes</td>
<td>Last Sample Time: May 28, 2007 1:07:30 AM</td>
<td>Size of the heap initially requested by the JVM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start Time: May 27, 2007 8:11:29 PM</td>
<td></td>
</tr>
</tbody>
</table>
```
GlassFish Monitoring OOTB

Application Monitoring

<table>
<thead>
<tr>
<th>Application Server</th>
<th>JVM Settings</th>
<th>Logging</th>
<th>Monitor</th>
<th>Diagnostics</th>
<th>Administrator Password</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log</td>
<td>Call Flow</td>
<td>Runtime</td>
<td>Applications</td>
<td>Resources</td>
<td>Transactions</td>
<td></td>
</tr>
</tbody>
</table>

### Monitoring Applications

View monitorable attributes for applications and components. Before monitoring data can be viewed, monitoring must be turned on for that application or component. Select the Configure Monitoring link on this page to turn on monitoring.

**Application:** adminapp **Component:** ConnectServlet

#### Application Statistics (5)

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Details</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ErrorCount</td>
<td>0 count</td>
<td>Last Sample Time: May 28, 2007 1:09:31 AM</td>
<td>Provides the cumulative value of the error count. The error count represents the number of cases where the response code was greater than or equal to 400.</td>
</tr>
<tr>
<td>RequestCount</td>
<td>0 count</td>
<td>Last Sample Time: May 28, 2007 1:09:31 AM</td>
<td>Provides cumulative number of the requests processed so far.</td>
</tr>
<tr>
<td>ProcessingTime</td>
<td>0 milliseconds</td>
<td>Last Sample Time: May 28, 2007 1:09:31 AM</td>
<td>Provides cumulative value of the times taken to process each request. The processing time is the average of request processing times over the request count.</td>
</tr>
<tr>
<td>MaxTime</td>
<td>0 milliseconds</td>
<td>Last Sample Time: May 28, 2007 1:09:31 AM</td>
<td>Provides the longest response time for a request - not a cumulative value, but the largest response time from among the response times.</td>
</tr>
</tbody>
</table>
## GlassFish Monitoring OOTB

### Resource Monitoring

#### Monitoring Resources

View monitorable attributes for pools such as the JDBC connection pool or a connector connection pool. Before monitoring data can be viewed, monitoring must be turned on. To turn on monitoring, select the Configure Monitoring link on this page.

**View:** DerbyPool

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Details</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NumConnSuccessfullyMatched</td>
<td>0 Count</td>
<td>Last Sample Time: May 28, 2007 1:11:09 AM Start Time: May 28, 2007 12:26:42 AM</td>
<td>Number of Connections successfully matched</td>
</tr>
<tr>
<td>NumConnUsed</td>
<td>0 Count</td>
<td>High Water Mark: 0 Count Low Water Mark: 0 Count Last Sample Time: May 28, 2007 1:11:09 AM Start Time: May 28, 2007 12:26:42 AM</td>
<td>Provides Connection usage statistics. In addition to number of connections being used currently, this also provides information about the Maximum number of connections that were used (High Watermark).</td>
</tr>
<tr>
<td>WaitQueueLength</td>
<td>0 Count</td>
<td>Last Sample Time: May 28, 2007 1:11:09 AM Start Time: May 28, 2007 12:26:42 AM</td>
<td>Provides a count value indicating the number of connection requests in the queue waiting to be served.</td>
</tr>
<tr>
<td>NumConnDestroyed</td>
<td>0 Count</td>
<td>Last Sample Time: May 28, 2007 1:11:09 AM Start Time: May 28, 2007 12:26:42 AM</td>
<td>Provides a count value reflecting the number of connections that were destroyed since the last sampling</td>
</tr>
<tr>
<td>ConnRequestWaitTime</td>
<td>0 milliseconds</td>
<td>High Water Mark: 0 milliseconds Low Water Mark: 0 milliseconds Last Sample Time: May 28, 2007 1:11:09 AM Start Time: May 28, 2007 12:26:42 AM</td>
<td>Provides a range value that indicates the longest, shortest wait times of connection requests since the last sampling. The current value indicates the wait time of the last request that was serviced by the pool.</td>
</tr>
</tbody>
</table>
GlassFish Monitoring OOTB

Quick Demo
Agenda

- GlassFish Monitoring OOTB
- JConsole and JMX Monitoring
- Open Source project Glassbox
- AMX and GlassFish Management Rules
JMX Support in GlassFish v2

JMX = Java Management Extensions
JConsole and JMX Monitoring

• JConsole Features Include:
  > Overview: Displays overview information about the Java VM and monitored values.
  > Memory: Displays information about memory use.
  > Threads: Displays information about thread use.
  > Classes: Displays information about class loading.
  > VM: Displays information about the Java VM.
  > MBeans: Displays information about MBeans.
JConsole and JMX Monitoring
JConsole and JMX Monitoring
JConsole and JMX Monitoring
JConsole and JMX Monitoring
## JConsole and JMX Monitoring

![JConsole and JMX Monitoring](image)

### MBeanInfo

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info:</td>
<td></td>
</tr>
<tr>
<td>ObjectName</td>
<td>com.sun.appserv</td>
</tr>
<tr>
<td>ClassName</td>
<td>com.sun.enterprise.admin.runtime.J2eeRuntimeMBean</td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
</tbody>
</table>

### Descriptor

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info:</td>
<td></td>
</tr>
<tr>
<td>descriptorType</td>
<td>mbean</td>
</tr>
<tr>
<td>displayName</td>
<td>com.sun.enterprise.admin.runtime.J2eeRuntimeMBean</td>
</tr>
<tr>
<td>domainName</td>
<td>com.sun.appserv</td>
</tr>
<tr>
<td>JNDI</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>com.sun.enterprise.admin.runtime.J2eeRuntimeMBean</td>
</tr>
<tr>
<td>namingLocation</td>
<td>[com.sun.appserv, server, server1204555538:06]</td>
</tr>
<tr>
<td>namingType</td>
<td>JVM</td>
</tr>
<tr>
<td>ObjectName</td>
<td>-0:J2eeType=VM, name=25, J2EEserver=1, category=runtime</td>
</tr>
<tr>
<td>persistPolicy</td>
<td>never</td>
</tr>
<tr>
<td>visibility</td>
<td></td>
</tr>
<tr>
<td>xpath</td>
<td>/jdomain/config/config[0</td>
</tr>
</tbody>
</table>
JConsole and JMX Monitoring

Quick Demo
Agenda

• GlassFish Monitoring OOTB
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• Open Source project Glassbox
• AMX and GlassFish Management Rules
Open Source Project Glassbox

Glassbox Inspector 2.0 - an open source non-intrusive and light-weight Java application monitoring package with:

- Monitoring metrics collection based on Aspect-Oriented Programming (AOP) approach using AspectJ 5
- Collected monitoring metrics exposed via the Java Management Extensions (JMX) Managed Beans (MBeans)
Open Source Project Glassbox

Configuration

• Both commons-logging_1.1.x and log4j_1.2.x must be added to the system classpath for GlassFish
• The Glassbox JVM parameters must be added to the launch configuration
Open Source Project Glassbox

Configuration (Cont.)

• Deploy glassbox.war
Open Source Project Glassbox

Sample Screenshot

Glassbox Web Client - Mozilla Firefox

<table>
<thead>
<tr>
<th>Status</th>
<th>Analysis</th>
<th>Server</th>
<th>Operation</th>
<th>Application</th>
<th>Avg. Time</th>
<th>Executions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOW</td>
<td>Thread Contention Failure</td>
<td>local</td>
<td>SearchProductsAction</td>
<td>jpetstore</td>
<td>10.13 sec</td>
<td>13</td>
</tr>
<tr>
<td>SLOW</td>
<td>Slow Database</td>
<td>local</td>
<td>SearchProductsAction</td>
<td>jpetstore</td>
<td>34 ms</td>
<td>8</td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>ClientController</td>
<td>Glassbox Web Client</td>
<td>220 ms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>ItemOrderFormAction</td>
<td>jpetstore</td>
<td>45 ms</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>ItemOrderAction</td>
<td>jpetstore</td>
<td>34 ms</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>SignOutAction</td>
<td>jpetstore</td>
<td>27 ms</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>ViewCartAction</td>
<td>jpetstore</td>
<td>23 ms</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>AddItemToCartAction</td>
<td>jpetstore</td>
<td>22 ms</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>ViewItemAction</td>
<td>jpetstore</td>
<td>16 ms</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>OperationDetailController</td>
<td>Glassbox Web Client</td>
<td>5.7 ms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>ExpiringAction</td>
<td>jpetstore</td>
<td>7.6 ms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>OperationDropdownController</td>
<td>Glassbox Web Client</td>
<td>3.5 ms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>OperationConfigAction</td>
<td>Glassbox Web Client</td>
<td>0.75 ms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>OperationColorAction</td>
<td>Glassbox Web Client</td>
<td>0.42 ms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>OperationBodyController</td>
<td>Glassbox Web Client</td>
<td>0.46 ms</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>local</td>
<td>OperationHelperAction</td>
<td>Glassbox Web Client</td>
<td>0.25 ms</td>
<td>1984</td>
<td></td>
</tr>
</tbody>
</table>

SLOW OPERATION: SearchProductsAction

Cause: Java bottleneck due to too many operations waiting on the same resource

Slow 11 times (84 %)
Exceeded 1.0 sec goal 11 times (84 %)
Operation ran 13 times since 8/16/06 12:46 PM

Average Execution Time Overall: 10.13 sec
Average Execution Time While Slow: 11.97 sec

Technical Summary

Thread Contention: When the SearchProductsAction operation ran slowly, it took an average of 7.88 sec., including time in method com.ibatis.jpetstore.presentation.action.BaseAction.acquireResource() waiting for threads to release a lock on a Java object.
Open Source Project Glassbox

Quick Demo
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• **AMX and GlassFish Management Rules**
AMX and GlassFish Management Rules

• AppServer Management EXtensions. The terms “AppServer” and “Management” should be self-explanatory. The term “Extensions” refers to the addition of a considerable number of interfaces beyond the basic structure defined by the J2EE Management specification (JSR 77).

• AMX is composed of several hundred Java interfaces (eg “public interface DomainRoot {...} ”). Each of this interfaces represents the runtime capabilities of a server-side JMX MBean residing in the AppServer.

• A good introductory article to read:

  http://today.java.net/pub/a/today/2008/01/15/dynamic-load-balancing-in-glassfish.html
AMX and GlassFish Management Rules

Objectives

• Manage complexity by self-configuring
• Improve ease-of-use by automating mundane management tasks
• Improve performance by self-tuning in unpredictable run-time conditions
• Improve availability by preventing and recovering (self-healing) from failures
• Improve security by taking self-protective actions when security threats are detected
AMX and GlassFish Management Rules

Features

• Using AMX we can:

1. Change application server configurations—create resources, delete resources, enable or disable, etc.
2. Manage servers, node agents, clusters, etc.
3. Receive notifications for almost any event happening in the application server and react accordingly.
4. Monitor the state of many objects that are hosted inside the application server. These include EJBs, web applications, enterprise applications, connection pools, etc.
AMX and GlassFish Management Rules

Features

- A management rule is a set of:
  - Event: An event uses the JMX notification mechanism to trigger actions. Events can range from an *MBean* attribute change to specific log messages.
  - Action: Actions are associated with events and are triggered when related events happen. Actions can be *MBeans* that implement the *NotificationListener* interface.
AMX and GlassFish Management Rules

Features

- Important types of events are as follows:
  - Monitor events: These type of events trigger an action based on an **MBean** attribute change.
  - Notification events: **MBeans** can implement **NotificationBroadcaster** in order to send notifications to all listeners that registered their interest on its event notifications.
  - System events: This is a set of predefined events that come from the internal infrastructure of GlassFish application server. These events include: lifecycle, log, timer, trace, and cluster events.
AMX and GlassFish Management Rules

How-To's

1) Connect to the Domain Admin Server (DAS)
   - The port used by AMX is an RMI port (default 8686), not the GUI (http/s) port. Connecting to the GUI port will not work.
   - You will need to know whether TLS (SSL) is enabled or not in order to connect.

2) Use method, `public static com.sun.appserv.management.client.AppserverConnectionSource connect`

3) From that point on, call `getDomainRoot()` to get an instance of `DomainRoot` and call methods from there.
AMX and GlassFish Management Rules

A Simple (but useful) example

A snippet of code to retrieve the cluster “Cluster-1” from the default domain then retrieve an instance, “instance-01” from the cluster and set the Load Balancing Weight to 25.

```java
AppserverConnectionSource ASConnection = Connect.connectNoTLS("127.0.0.1", 8686, "admin", "adminadmin");
DomainRoot dRoot = ASConnection.getDomainRoot();
Map<String, ClusterConfig> clusters = dRoot.getContaineeMap(XTypes.CLUSTER_CONFIG);
ClusterConfig clusterConf = clusters.get("Cluster-1");
Map <String, ClusteredServerConfig< servers = clusterConf.getClusteredServerConfigMap();
ClusteredServerConfig instance1 = servers.get("instance-01");
instance1.setLBWeight("25");
```
AMX and GlassFish Management Rules

A Simple (but useful) example

- Define your management rule in a configuration file.
- There are three cluster events fired; when a cluster is started, stopped, or has failed.
- Remember each management rule has an event that will trigger an action. An action is a **MBean** that implements the **NotificationListener** interface.
- When the management rule triggers the **handleNotification** action method will be called
AMX and GlassFish Management Rules

A Simple (but useful) example

Once you have written your rule file and your MBean class you can then deploy/register the MBean with GlassFish:

create-mbean --host <HOSTNAME> --port <PORT> --user <ADMIN USER> --name <BEAN NAME> --attributes ConfigurationFilePath=<CONFIGURATION FILE.XML> <CLASS FILENAME>

For Example:

create-mbean --host localhost --port 4848 --user admin --name ClusterInstanceWeightsManager --attributes ConfigurationFilePath=c:\config.xml
samples.glassfish.management.clustermanager.ClusterWeightManager
AMX and GlassFish Management Rules

A Simple (but useful) example

Lastly, define the management rule, which will automatically send the cluster start notification to the new MBean when the cluster starts.

```
create-management-rule --eventtype cluster --host <HOST> --port <PORT> --user <ADMIN USER> --ruleenabled=true --action <BEAN NAME> --event loglevel INFO --recordevent=true --eventproperties name=<NAME OF RULE>
```
Resources

- http://weblogs.java.net/blog/kalali/archive/2007/05/glassfish_versi_1.html
- http://www.glassbox.com
- https://glassfish.dev.java.net/javaee5/amx/
Questions?

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2007-2008

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