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JBoss Cookbook: **Secret Recipes**

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May 5th 2011

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Secret Recipes

- Byteman
- Cluster and Load Balancing Configuration Generator
- Troubleshooting High CPU
- Mocking a JBoss “Hang” State

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Byte (code) Man (ipulation)

- Tool that **simplifies tracing and testing** of Java programs
- **Inject code** almost anywhere without recompiling, repackaging or redeployment of your application
- Works by modifying the bytecode of your application at **runtime** (can modify codes whose sources are not available)
- Injected codes are **reversible** (load/unload scripts)



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Driving Byteman

- Install as “Java agent” through java options
 - `-javaagent:$BYTEMAN_HOME/lib/byteman.jar=agentoptions`
 - Can start as **listener** on a port (allows upload/unload/reload of rules while program still running)
 - agentoptions are comma separated name:value pairs
 - e.g. `script:./rules.btm,script:./morerules.btm,boot:byteman.jar`
 - **script:script.btm** install rules from script.btm at agent startup
 - **boot:my.jar** add my.jar to bootstrap classpath
 - **sys:my.jar** add my.jar to system classpath
 - **listener:true** start up agent listener
 - **port:999** use listener port 999
 - **address:192.168.0.1** use listener host 192.168.0.1



Driving Byteman

- Install agent into **already running program**
 - **bminstall process_id**
 - Always **starts listener**
 - **bmsubmit [-l | -u] [script1 . . . scriptN]**
 - Load or unload rule scripts to listener
 - e.g.: `bmsubmit -l /path/to/myscript.btm`
 - **bmcheck [-cp path|jar]* [-p prefix]* script1 ... scriptN**
 - e.g.: `bmcheck -cp /path/to/my.jar -p org.example myscript.btm`



Driving ByteMan

- Start your java program with the agent
 - Use in place of java command
 - **bmjava javaargs**
 - e.g.: `bmjava org.my.App`
 - Then install script: `bmsubmit -l myscript.btm`



Sample ByteMan Rule Script

```
RULE trace HelloWorld methods
CLASS org.jboss.samples.webservices.Echo
METHOD echo(String)
AT ENTRY
IF TRUE
DO
trace("Byteman Entering")
ENDRULE
```

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Sample Byteman Rule Script

```
[RULE trace HelloWorld methods] Rule name
CLASS org.jboss.samples.webservices.Echo
METHOD echo(String)
AT ENTRY
IF TRUE
DO
trace("Byteman Entering")
ENDRULE
```

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Sample Byteman Rule Script

```
RULE trace HelloWorld methods
[CLASS org.jboss.samples.webservices.Echo]
[METHOD echo(String)]
[AT ENTRY]
IF TRUE
DO
trace("Byteman Entering")
ENDRULE
```

Event (Trigger point)

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Sample Byteman Rule Script

```
RULE trace HelloWorld methods
CLASS org.jboss.samples.webservices.Echo
METHOD echo(String)
AT ENTRY
[IF TRUE]
[DO]
trace("Byteman Entering")
ENDRULE
```

Condition

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Sample Byteman Rule Script

```
RULE trace HelloWorld methods  
CLASS org.jboss.samples.webservices.Echo  
METHOD echo(String)  
AT ENTRY  
IF TRUE  
DO  
[trace("Byteman Entering")]  
ENDRULE
```

Action

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in **Action** (Demo)

ByteMan

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Byteman Built In Methods

- **Tracing**
 - traceOpen, traceClose, traceIn, traceStack, ...
- **Managing Shared Rule State**
 - flag, clear, countDown, incrementCounter, ...
- **Timing**
 - createTimer, getElapsedTime, resetTimer
- **Checking Caller Stack**
 - callerEquals, callerMatches
- ****Check out the Programmer's Guide****



Byteman Helper Classes

- You can use any **POJO** as Helper

```
class DBHelper {  
    public void trace(String msg, Record rec) { . . . }  
    . . . }
```

```
RULE use my own trace method  
CLASS org.my.db.DBManager  
METHOD update(Record)  
AT CALL setName(String)  
HELPER org.my.bmutil.DBHelper  
IF $@[1] == "David"  
DO trace("found interesting record update ", $1)  
ENDRULE
```

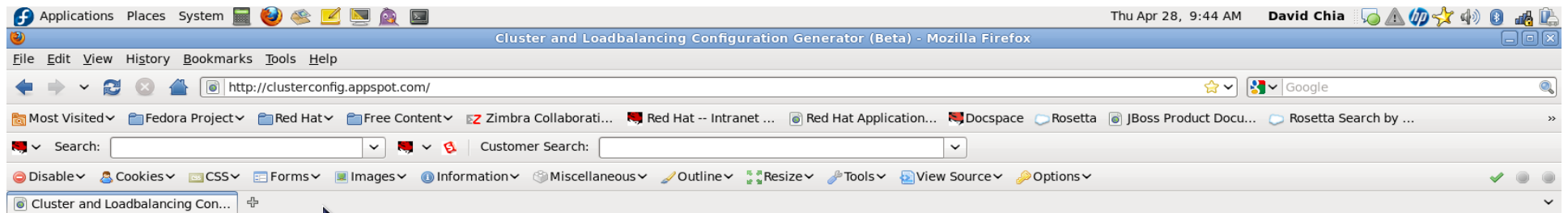


Cluster and Load Balancing Configuration Generator

- **Automatically generates the optimal configuration** for your cluster and load balancer based on your server setup
- Cluster and load balancing configuration generator:
 - <http://clusterconfig.appspot.com/>
- Load balancer configuration generator:
 - <http://lbconfig.appspot.com/>



http://clusterconfig.appspot.com/



Please contact Samuel.Mendenhall@gmail.com
with your questions, comments, suggestions, and bug reports.
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Cluster and Loadbalancing Configuration Generator (Beta)

See <http://bconfiq.appspot.com> for creating optimized mod_jk / mod_proxy / mod_cluster configurations

Loadbalancing software	<input type="text" value="mod_jk"/>
Jboss Type	<input type="text" value="Enterprise"/>
Architecture	<input type="text" value="RHEL 5 / Fedora i386"/>
JBoss version	<input type="text" value="EAP 5.1.0.GA"/>
Apache version	<input type="text" value="2.2.15"/>
mod_jk version	<input type="text" value="1.2.30"/>
JBoss Instances	<input type="text" value="2"/>
JBoss bind addresses	<input type="text" value="127.0.0.1,127.0.0.2"/>
	<input type="button" value="Generate"/>

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http://clusterconfig.appspot.com/

Applications Places System Thu Apr 28, 9:44 AM David Chia

Cluster and Loadbalancing Configuration Generator (Beta) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://clusterconfig.appspot.com/

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Cluster and Loadbalancing Con...

Loadbalancing software: mod_jk, mod_proxy, mod_cluster

Jboss Type: Enterprise, Community

Architecture: RHEL 5 / Fedora i386

JBoss version: EAP 5.1.0.GA

Apache version: 2.2.15

mod_jk version: 1.2.30

JBoss Instances: 2

JBoss bind addresses: 127.0.0.1,127.0.0.2

Generate

First download the [clusterconfig.py](#) script (Right click -> Save Link As) then copy and paste the below command into your terminal. The script will automatically download or prompt you to download any necessary files like JBoss, mod_jk, ect... All works is done in a sandbox directory where the script was downloaded and files are saved in the sandbox directory + /archives for future use of the script. After the script has finished setting everything up it will spawn a terminal for each JBoss instance and start JBoss, then spawn a third terminal for Apache. All you must do then is run the command `sudo .japache.sh start` then open <http://localhost/counter> to verify everything is properly functioning.

```
python clusterconfig.py --jboss-version 5.1.0 --jboss-type Enterprise --jboss-instances 2 --ip-addresses 127.0.0.1,127.0.0.2 --httpd-version 2.2.15 --loadbalancer mod_jk --architecture rhel5_32 --modjk-version 1.2.30
```

An easy way to run multiple IPs on 1 machine for testing is to use the loopback device
in /etc/rc.local add this:
ifconfig lo:2 127.0.0.2
ifconfig lo:3 127.0.0.3
ect...

Then in /etc/hosts add
127.0.0.2 localhost2.localdomain localhost2 lo2
127.0.0.3 localhost3.localdomain localhost3 lo3
ect...

And either restart or run the command
source /etc/rc.local

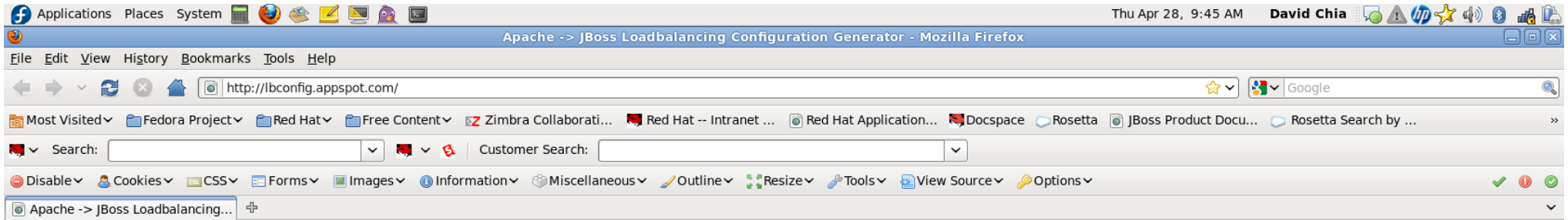
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http://lbconfig.appspot.com/



Apache -> JBoss Loadbalancing Configuration Generator

See <http://lclusterconfig.appspot.com> for creating full Loadbalanced / Clustered testbeds automatically

Loadbalancing software	<input type="text" value="mod_jk"/>
mod_jk version	<input type="text" value="1.2.30"/>
# CPU cores on Apache servers	<input type="text" value="4"/>
# CPU cores on JBoss servers	<input type="text" value="4"/>
# Apache servers	<input type="text" value="1"/>
# JBoss servers	<input type="text" value="2"/>
# JBoss instances per Server	<input type="text" value="1"/>
Is there a Firewall between Apache/JBoss?	<input type="checkbox"/>
Are Apache/JBoss on the same server?	<input type="checkbox"/>
Are there long running requests (greater than 10s)?	<input type="checkbox"/>
Apache mpm	<input type="text" value="Prefork"/>
	<input type="button" value="Generate"/>

Please contact Samuel.Mendenhall@gmail.com with your questions, comments, and suggestions.
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http://lbconfig.appspot.com/

The screenshot shows a Mozilla Firefox browser window with the title "Apache -> JBoss Loadbalancing Configuration Generator - Mozilla Firefox". The address bar contains "http://lbconfig.appspot.com/". The browser's menu bar includes "File", "Edit", "View", "History", "Bookmarks", "Tools", and "Help". The toolbar shows various navigation and utility icons. The page content area is mostly blank, with a few search and utility buttons visible at the top.

Apache configuration

There are 1 Apache servers each containing 1 Apache instance giving a total of 1 Apache instance(s). Each Apache server has 4 cores which means MaxClients = 800 giving a total processing power of all Apache instances combined being 800 threads. The MaxClients is optimal at 200 * no cpu cores for the prefork mpm and around 300 * no. Cpu Cores for the worker mpm.

Apache mpm module configuration:

```
<IfModule mpm_prefork_module>
  ServerLimit      800
  StartServers     5
  MinSpareServers  5
  MaxSpareServers  20
  MaxClients       800
  MaxRequestsPerChild 0
</IfModule>
```

Apache Configuration

httpd.conf mod_cluster configuration:

```
LoadModule slotmem_module modules/mod_slotmem.so
LoadModule manager_module modules/mod_manager.so
LoadModule proxy_cluster_module modules/mod_proxy_cluster.so
LoadModule advertise_module modules/mod_advertise.so

Listen 127.0.0.1:6666
<VirtualHost 127.0.0.1:6666>

  <Directory />
    Order deny,allow
    Deny from all
    Allow from 127.0.0.1
  </Directory>

  KeepAliveTimeout 60
  MaxKeepAliveRequests 0

  ManagerBalancerName mycluster
  AdvertiseFrequency 5
```

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Troubleshooting High CPU

- Identify the **cause**:
 - **Garbage collection logs** (rule out GC issues first)
 - **Thread dumps**
- For application servers, gather **logs**:
 - JBoss EAP
 - `$JBOSS_HOME/server/$PROFILE/log/server.log`
 - `$JBOSS_HOME/server/$PROFILE/log/boot.log`
 - Tomcat
 - `catalina.out`



Troubleshooting High CPU (cont.)

- Garbage collection basics
 - OpenJDK, SunOracle JDK, and IBM JDK all use generation collectors, meaning there are two distinct regions within the heap: one for new objects (**young generation space**) and one for objects that have been around a while (**old generation space**).
 - When a generation **fills up**, the JVM may stop all threads in the JVM to do garbage collection.
 - The JVM uses **different collectors**, some with multiple phases to do collections.
 - **Not every phase** of a collector is blocking. Some phases are concurrent, meaning threads in the JVM are running at the same time.



Troubleshooting High CPU (cont.)

- Garbage collection basics
 - 2 Main GC Issues: **long pauses** and **bad throughput**
 - Throughput is the **percentage of time spent not doing garbage collection** vs. total time. So 100% means no GC was happening, all time was spent running application threads. 0% means all time spent doing GC.
 - Throughput of 95% and above is generally considered "good".
 - Acceptable max pause depends on **system requirements**, but 10 seconds seems to be a dividing line for many customers.
 - It is generally not a close call. Generally it's **quite clear** when the real issue is GC, not a threading problem. **Max pauses will be very high** or **throughput will be very low** (one collection after another w/ very little time in between)



Troubleshooting High CPU (cont.)

- Garbage collection logs
 - To enable when using OpenJDK/Sun JDK
 - `-verbose:gc -Xloggc:gc.log -XX:+PrintGCDetails -XX:+PrintGCTimeStamps`
 - Analyze logs for **long pauses** times and/or **low throughput**
 - <http://code.google.com/a/eclipselabs.org/p/garbagecat/>
 - <http://www.alphaworks.ibm.com/tech/pmat>



Troubleshooting High CPU (cont.)

- Analyzing Sample Report

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Troubleshooting High CPU (cont.)

- GC Tuning
 - Long pauses (long full GC)
 - Change from the parallel throughput collector to the **CMS low pause collector**
 - -XX:+UseConcMarkSweepGC)
 - Enable **large page support**
 - (SunJDK/OpenJDK) -XX:+UseLargePages
-XX:LargePageSizeInBytes=4m
 - (IBM JDK) -lp
 - (Jrockit JDK) -XXlargePages



Troubleshooting High CPU (cont.)

- GC Tuning
 - Long pauses (long full GC)
 - Check to see if the JVM is running in a **virtual or physical environment**. If running in a virtual environment, explicitly set `-XX:ParallelGCThreads` based on the number of CPUs assigned to the guest OS



Troubleshooting High CPU (cont.)

- How do **thread dumps** help?
 - Show **deadlocks**
 - Show **monitor contention** for a point in time
 - Show **thread progression**



Troubleshooting High CPU (cont.)

- Producing thread dumps
 - `kill -3 JAVA_PID`
 - Output sent to std out
 - Redirect std out to a file
 - `jstack -l JAVA_PID > jstack.out`
 - JDK 1.6 and later
 - Script that takes a series of thread dumps given an interval



Troubleshooting High CPU (cont.)

- Thread Dump Analysis Tools
 - Thread Dump Analyzer (TDA)
 - Samurai

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Troubleshooting High CPU (cont.)

- Thread Dump Analysis Tools [Demo](#)

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Mocking a JBoss “Hang” State

- Useful in cluster setup – test load balancing functionality
- To “pause” the JBoss process
 - Press “CTRL-Z”
 - If run as a service, “kill -STOP <pid>”
- To “resume” JBoss in foreground
 - Press “fg”
 - If run as a service, “kill -STOP <pid>”



Resources

- Byteman
 - <http://www.jboss.org/byteman>
- Cluster and load balancing configuration generator:
 - <http://clusterconfig.appspot.com/>
- Load balancer configuration generator:
 - <http://lbconfig.appspot.com/>
- Thread Dump Analyzer (TDA)
 - <http://java.net/projects/tda>
- Samurai
 - <http://yusuke.homeip.net/samurai/en/index.html>



Resources

- GarbageCat
 - <http://code.google.com/a/eclipselabs.org/p/garbagecat/>
- IBM Thread and Monitor Dump Analyzer
 - <http://www.alphaworks.ibm.com/tech/jca>
- EAP 5 Performance Tuning White Paper
 - http://www.jboss.com/pdf/JB_JEAP5_PerformanceTuning_wp_web.pdf

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