

# Kofax Kapow

## Administrator's Guide

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# Preface

This guide includes administration information for Kapow including:

- Runtime
- Tomcat Management Console

## Related Documentation

In addition to the Administrator's Guide, the Kapow documentation set includes the following documentation.

- Installation Guide
- Developer's Guide
- User's Guide

## Training

Kofax offers both classroom and computer-based training to help you make the most of your Kofax Kapow solution. Visit the Kofax website at [www.kofax.com](http://www.kofax.com) for details about the available training options and schedules.

## Getting Help for Kofax Products

Kofax regularly updates the Kofax Support site with the latest information about Kofax products.

To access some resources, you must have a valid Support Agreement with an authorized Kofax Reseller/ Partner or with Kofax directly.

Use the tools that Kofax provides for researching and identifying issues. For example, use the Kofax Support site to search for answers about messages, keywords, and product issues. To access the Kofax Support page, go to [www.kofax.com/support](http://www.kofax.com/support).

The Kofax Support page provides:

- Product information and release news  
Click a product family, select a product, and select a version number.
- Downloadable product documentation  
Click a product family, select a product, and click **Documentation**.
- Access to product knowledge bases

Click **Knowledge Base**.

- Access to the Kofax Customer Portal (for eligible customers)

Click **Account Management** and log in.

To optimize your use of the portal, go to the Kofax Customer Portal login page and click the link to open the *Guide to the Kofax Support Portal*. This guide describes how to access the support site, what to do before contacting the support team, how to open a new case or view an open case, and what information to collect before opening a case.

- Access to support tools

Click **Tools** and select the tool to use.

- Information about the support commitment for Kofax products

Click **Support Details** and select **Kofax Support Commitment**.

Use these tools to find answers to questions that you have, to learn about new functionality, and to research possible solutions to current issues.

## Chapter 1

# Introduction

This guide is intended for system administrators who deploy Kapow in the enterprise environment.

## Upgrade Notes

If you are running a previous version of Management Console, this topic describes how to upgrade to the latest version.

Upgrading includes the following steps:

1. Create a backup of your data from the previous version of Management Console.
2. Install a new version of the Management Console.
3. Update the Management Console configuration.
4. Restore the backup.

### Create a Backup

Check the online documentation of your previous version of Management Console to learn how to create a backup.

Users upgrading from version 9.x can also consult our notes on upgrading and the Data Migration Tutorial topic in the Installation Guide.

### Install Management Console

Follow the next steps in this guide to learn how to install the Management Console. If you are upgrading from 8.1 or later you can reuse your old Configuration.xml, see next section.

### Upgrade Management Console Configuration

If you are upgrading from version 8.0 or earlier, you will have to re-configure your new Management Console from scratch. Prior to version 8.1 some configuration was done in web.xml this is no longer the case. You may no longer copy or modify the web.xml.

As of version 8.2 , LDAP integration is no longer container-managed. If you used LDAP for authentication in a previous version, you should remove the Realm definition in the ManagementConsole.xml inside Tomcat's conf/Catalina/localhost/. LDAP integration is now configured in WEB-INF/login.xml, as described in LDAP Integration

### Restore the Backup

Check the Management Console user's guide for details on how to restore a backup.

## Chapter 2

# Runtime

Kapow offers a number of tools for executing the robots you have developed. The following sections describe these tools:

- RoboServer is a server application that allows remote clients to execute robots. It is configured using both the Management Console and the RoboServer Settings application (for advanced configuration, such as security and authentication).
- The Management Console allows you to schedule execution of Robots, view logs and extracted data. Also provides a dashboard for monitoring system health, and a centralized place where settings for clusters of RoboServers can be configured.

**Note** Timezone definitions are embedded in the bundled JRE. In case there are changes to the definitions since the release date, the JRE can be updated using the *Timezone Updater Tool* provided by Oracle. Refer to the Oracle website for further information.

## RoboServer

RoboServer runs robots created in Design Studio. Robots can be started in various ways; either scheduled to run at specific times by the Management Console, called via a REST web service, through the Java or .NET APIs or from a Kapplet.

**Important** The minimal Linux installation must include the following packages to be able to run Robots created with Default browser engine.

- `libX11.so.6`
- `libGL.so.1`
- `libXext.so.6`

Use `yum install` or `sudo apt-get` command to install necessary libraries on a Linux platform.

Also make sure the system has some fonts installed. This might be necessary in case a headless Linux install is used, because some of the Linux installation packages do not contain fonts.

In order for RoboServer to be able to execute robots, it must be activated by a Management Console. A RoboServer is active when it belongs to a cluster in a Management Console with a valid license, and sufficient KCUs have been assigned to the cluster. The RoboServer also receives settings from the Management Console where they are configured on the clusters. Please refer to Management Console for more information on the administration of RoboServers and clusters.



## Start RoboServer

RoboServer can be started in several different ways:

- By clicking the RoboServer program icon (or the Start Management Console program icon which starts both the Management Console and RoboServer).
- By invoking it from the command line.
- By running it as a service. See Starting Servers Automatically below.

To invoke RoboServer from the command line, open a Command Prompt window, navigate to the `bin` folder in the `Kapow` installation folder and type:

```
RoboServer
```

If all necessary parameters are specified in the [roboserver.settings](#) configuration file, the RoboServer starts.

If any of the necessary parameters is missing, the RoboServer specifies an error and displays the usage help and available parameters.

## RoboServer Parameters

The command line for starting a RoboServer may include the following parameters:

```
RoboServer [-s <service:params>] [-mcUrl <url>] [-cl <Cluster Name>]
           [-b <url>] [-jmsNamespace <name>] [-p <port number>]
           [-sslPort <port number>] [-v]
```

Regardless of how you start RoboServer, it accepts the parameters in the following table. Note that you can edit all the parameters in the RoboServer Settings utility. See [RoboServer Configuration](#) for more details.

Parameter	Description
-s -service <service:params>	This parameter specifies a RQL or JMX service that RoboServer should start. This parameter must be specified at least once, and may be specified multiple times to start multiple services in the same RoboServer. The available services depend on your installation.  Example: <code>-service socket:50000</code> Example: <code>-service jmx:50100</code>
-mcUrl <arg>	<b>Required parameter.</b> Specify which Management Console to register to in the following format:  <code>http[s]://</code> <code>&lt;username&gt;:&lt;password&gt;@&lt;hostname&gt;:&lt;port number&gt;</code>  Example: <code>-mcUrl http://admin:password@localhost:8080/ManagementConsole</code>

Parameter	Description
-cl -cluster <Cluster Name>	<b>Required parameter.</b> This parameter automatically registers the roboServer with the specified cluster on the Management Console. In the following example the roboServer registers itself with the <i>Production</i> cluster. Example: -cl Production Example: -mcUrl http://admin:password@localhost:8080/ManagementConsole -cl Production
-eh -externalHost <name>	Explicitly specifies the name or IP address of the RoboServer's host.*  This parameter should be specified when the host address is different from what a RoboServer discovers on the local machine, such as when running with NAT in the cloud, or when you run the RoboServer in a Docker container. Example: -eh 10.10.0.123
-ep -externalPort <port number>	Explicitly specifies the port number of the RoboServer's host.*  This parameter should be specified when the host port is different from what a RoboServer discovers on the local machine, such as when running with NAT in the cloud, or when you run the RoboServer in a Docker container.
-v -verbose	This optional parameter causes RoboServer to output status and runtime events.
-b -brokerUrl <url>	The URL of the message broker (when running a JMS service).
-jmsNamespace <name>	Namespace for JMS destinations. Default is <i>Kapow</i> .
-p -port <port-number>	This is shorthand for calling -s socket:<port-number> Example: -port 50000
-sslPort <port number>	This is a shorthand for writing -s ssl:<port number>
<b>Available services</b>	
-service socket:<portNumber>	<portNumber>: The port number for the socket-service to listen on.
-service ssl:<portNumber>	<portNumber>: The port number for the socket-service to listen on.
-service jmx:<jmx_port_Number>,<jmx_rmi_url>	<jmx_port_Number>: The port number for the JMX service to listen on.  <jmx_rmi_url>: Optional RMI host and port for the JMX service. Use if you need to connect through a firewall. Example: -service jmx:example.com:51001
-service jms:<number>	<number>: A number that uniquely identifies the RoboServer on this host. Example: -service jms:1

\* Specified name or IP address and a port number for the RoboServer host is not valid in [JMS mode](#).

To set passwords, either use the RoboServer Settings utility or the ConfigureRS tool. For more information, see [RoboServer Configuration](#) and [RoboServer Configuration - Headless Mode](#).

**Note** Starting from Kapow version 10, all RoboServers must auto register to the Management Console. Therefore, the URL and credentials for the Management Console along with the cluster name must be specified when starting a RoboServer (either at the command line as in the following example or using the [RoboServer Settings](#) application on the General tab under Register to a Management Console option).

```
RoboServer.exe -mcUrl http://admin:admin@localhost:8080/ManagementConsole -cluster
Production -service socket:50000
```

## Start Servers Automatically

If your installation includes any server functionality, you can configure it to start the servers automatically.

When referring to "server functionality", we mean RoboServers and the Management Console (license server). In fact these two functionalities are provided by the same server program, RoboServer, depending on the arguments supplied to it when it starts.

The RoboServer Parameters topic contains a detailed description of the command-line arguments for the RoboServer program. To enable the RoboServer program to execute robots, specify the `-service` argument. Similarly, the `-MC` argument enables the Management Console functionality (see Management Console (License Server) in the Installation Guide).

The following topics details how to start RoboServer automatically on Windows and Linux.

### Start Servers on Windows

To make RoboServer start automatically on Windows, you need to add it as a Windows service. We will show how to add and remove Windows services using the `ServiceInstaller.exe` program that is included in the Kofax Kapow installation.

#### Add Windows Services

To run RoboServer as a service you need to install it first using the `ServiceInstaller.exe` program. The following is a general example outlining the command-line arguments to this program (although displayed on multiple lines here, this is a one-line command):

```
ServiceInstaller.exe -i RoboServer.conf wrapper.ntservice.account=Account
wrapper.ntservice.password.prompt=true wrapper.ntservice.name=Service-
name wrapper.ntservice.starttype=Start-method wrapper.syslog.loglevel=INFO
wrapper.app.parameter.1="First-Argument" wrapper.app.parameter.2="Second-argument"
```

#### wrapper.ntservice.account

The account of the user that has to run RoboServer. Kapow stores configuration in the user's directory and it is important to choose a user that has the correct configuration.

If RoboServer has to run as a domain user you need to enter the account in the form `domain \account`

If RoboServer has to run as a regular user you need to enter the account in the form `.\account`

**Note** For security reasons, do not use the `LocalSystem` account for the RoboServer service's login. If `LocalSystem` is used, the following error occurs when webkit (default) robots run: "Could not establish connection to WebKitBrowser. Failed to connect to bus."

**wrapper.ntservice.password.prompt**

The value true will prompt the user for the password for the account. If you prefer to enter the password on the command line, you must instead use

```
wrapper.ntservice.password=whatever-the-password-is.
```

**wrapper.ntservice.name**

The name of the service to install. The name of the service can not contain spaces.

**wrapper.ntservice.starttype**

AUTO\_START if the service should be started automatically when the system is restarted.

DELAY\_START if the service should be started after a short delay. (Not supported on Windows XP and 2003).

DEMAND\_START if you want to start the service manually.

**wrapper.syslog.loglevel**

Redirect the console output from RoboServer to the event log.

**wrapper.app.parameter.\***

The arguments for RoboServer. You can enter as few or as many as needed. For a list of RoboServer arguments, please refer to the *Starting RoboServer* section in the Administrator's Guide.

When the service is installed, the user is granted the "log on as a service" rights. If the service fails to start, check that the right is granted by opening gpedit.msc and (on Windows 7) navigate to **Computer Configuration > Windows Settings > Security Settings > Local Policies > User Rights Assignment > Log on as a service** and add the user.

The following are examples of installing RoboServers in different configurations:

- This script creates a Windows Service that only starts the Management Console. This is the recommended configuration as the Management Console should run under its own JVM if possible. The name of the Windows Service can be changed as needed:

```
ServiceInstaller.exe -i RoboServer.conf wrapper.ntservice.account=.
\USER_NAME_HERE wrapper.ntservice.password.prompt=true
wrapper.ntservice.name="RoboServer10.1.0.4_MC" wrapper.ntservice.starttype=MANUAL
wrapper.syslog.loglevel=INFO wrapper.app.parameter.1="-p"
wrapper.app.parameter.2="PORT NUMBER FOR MC RS TO RUN ON"
wrapper.app.parameter.3="-mcUrl" wrapper.app.parameter.4="http://localhost:8080"
wrapper.app.parameter.5="-cl" wrapper.app.parameter.6="NAME OF CLUSTER -
Production or Non Production"
```

- The following scripts install services that start two RoboServers: one on port 50000 and the other on 50001. The service name can be different:

```
ServiceInstaller.exe -i RoboServer.conf wrapper.ntservice.account=.
\USER_NAME_HERE wrapper.ntservice.password.prompt=true
wrapper.ntservice.name="RoboServer10.1.0.4_50000"
wrapper.ntservice.starttype=AUTO_START wrapper.syslog.loglevel=INFO
wrapper.app.parameter.1="-service" wrapper.app.parameter.2="socket:50000"

ServiceInstaller.exe -i RoboServer.conf wrapper.ntservice.account=.
\USER_NAME_HERE wrapper.ntservice.password.prompt=true
wrapper.ntservice.name="RoboServer10.1.0.4_50001"
```

```
wrapper.ntservice.starttype=AUTO_START wrapper.syslog.loglevel=INFO
wrapper.app.parameter.1="-service" wrapper.app.parameter.2="socket:50001"
```

### Remove Windows Services

To uninstall a service you can run the following command:

```
ServiceInstaller.exe -r RoboServer.conf wrapper.ntservice.name=Service-name
```

#### **wrapper.ntservice.name**

The name of the service to remove.

### Start Servers on Linux

The simplest way to make RoboServer start automatically on Linux is to use crontab. Use the following command to create or edit the list of scheduled jobs in Linux for the desired user (it may be easiest to do this either as root or as that particular user):

```
crontab -u someUser -e
```

To the list of scheduled jobs add for example:

```
@reboot $HOME/Kapow_10.1.0.4/bin/RoboServer -p 50000
```

or

```
@reboot $HOME/Kapow_10.1.0.4/bin/RoboServer -p 50000 -MC
```

This way the RoboServer program will be started with the indicated command-line arguments upon reboot. Note that you must identify the bin directory under the actual installation folder.

## Shut Down RoboServer

RoboServer can be shut down using the command line tool ShutDownRoboServer. Run ShutDownRoboServer without arguments to see the various options for how to shut down the server, particularly how to handle any robots currently running on the server.

## Production Configuration

RoboServer runs robots created with Design Studio. Robots can be started in various ways; either scheduled to run at specific times by the Management Console, called via a REST web service, through the Java or .NET APIs or from a Kapplet.

In order to get a stable and performing production environment, you may have to tweak some of the default RoboServer parameters. We will look at the following configuration options:

- Number of RoboServer instances
- Memory allocation
- Number of concurrent robots
- Automatic memory overload detection

RoboServer runs on Oracle's Java Virtual Machine (JVM), which in turn runs on top of an operating system (OS), which runs on top of your hardware. JVM's and OS's are patched, hardware architecture changes, and each new iteration aims to bring better performance. Although we can give some general guidelines about performance, the only way to make sure you have the optimal configuration is to test it.

As a general rule you get a little more performance by starting two instances of RoboServer. The JVM uses memory management known as garbage collection (GC). On most hardware only a single CPU core is active during GC, which leaves 75% of the CPU idle on a quad-core CPU. If you start two instances of RoboServer, one instance can still use the full CPU while the other is in running GC.

The amount of concurrent robots a RoboServer can run depends on the amount of CPU available, and how fast you can get the data RoboServer needs to process. The number of concurrent robots is configured in the Management Console cluster settings. A robot running against a slow website will use a lot less CPU than a robot running against a website with a fast response time, and here is why. The amount of CPU used by a program can be described with the following formula

$$\text{CPU (core)\%} = 1 - \text{WaitTime/TotalTime}$$

If a robot takes 20 seconds to execute, but 15 seconds are spent waiting for the website, it is only executing for 5 seconds, thus during the 20 seconds it is using an average of 25% (of a CPU core). The steps in a robot are executed in sequence, which means that a single executing robot will only be able to utilize one CPU core at a time. Most modern CPUs have multiple cores, so a robot that executes in 20 seconds, but waits for 15 seconds, will in fact only use about 6% of a quad-core CPU.

By default RoboServer is configured to maximally run 20 robots concurrently. The number of concurrent robots is configured in the Management Console cluster settings. If all your robots use 6% CPU, the CPU will be fully utilized when you are running 16-17 robots concurrently. If you start 33 of these 6% robots concurrently, you will overload RoboServer; because the amount of CPU available is constant, the result is that each robot will take twice as long to finish. In the real world the CPU utilization of a robot may be anywhere between 5-95% of a CPU core, depending on robot logic and the website it interacts with. As a result it is hard to guess or calculate the correct value for the max concurrent robots, the only way to be sure you have the right value is to do a load test and monitor the RoboServer CPU utilization, as well as the robot runtime as load increases.

Another parameter that may affect the number of concurrent robots each RoboServer can handle is the amount of memory. The amount of memory used by robots can vary from a few megabytes (MB) to hundreds of MB. By default RoboServer is configured to use 2048MB. Check [Change the RAM Allocation](#) to see how to control memory allocation. If you don't provide enough memory to RoboServer, you run the risk of crashing it with an out of memory error. To ensure proper memory allocation, monitor memory utilization during your load tests. The JVM does not allocate all of the available memory, but it reserves it from the OS (this is why allocating more than 1200 MB frequently fails on 32bit Windows). Once the JVM starts to use the memory, it is not given back to the OS. To find the optimal memory allocation, run a series of load tests that push the CPU to 100%. After each test is complete, check how much of the reserved memory was actually used by the JVM (the java.exe process). If all 2048MB (default) were used, increase (usually double) the memory and run the test again. At some point the JVM will not use all of the reserved memory, and the number of the used memory reflects the actual memory requirement and should be specified for the RoboServer.

Since RoboServer will crash if it runs out of memory, RoboServer tries to prevent this from occurring. Before RoboServer starts a new robot it will check the memory utilization. If it is above 80% it will queue the robot instead of starting it; this greatly reduces the risk of crashing RoboServer if the memory allocation is configured incorrectly. This mechanism is often referred to as the 80% memory threshold. The threshold value is configurable through the system property `kapow.memoryThreshold=80`.

## RoboServer Configuration

You can configure RoboServer through the RoboServer Settings application. RoboServer Settings can be started from the Windows Start menu.

### Settings Main Window

The screenshot shows a settings window with several tabs: General, Security, Certificates, Project, JMX Server, and Management Console. The 'General' tab is active and contains the following fields:

- Enable Socket Service:
- Port:
- Enable SSL Socket Service:
- Port:
- Enable JMS Service:
- Message broker URL:
- RoboServer JMS Id:
- Username:
- Password:
- Use SSL over JMS:
- Keystore Location:
- Keystore Password:
- Truststore Location:
- Truststore Password:
- Register to a Management Console:
- Management Console URL:
- User Name:
- Password:
- Cluster:
- External Host:
- External Port:
- Verbose:

At the bottom of the window are three buttons:  on the left, and  and  on the right.

Using this application, you can configure the following:

- General: Socket service options, enable and configure [JMS Service](#) options, Management Console connection options including RoboServer host settings, and the Verbose option.



- Security: [Security settings](#) such as authentication and permissions.
- Certificates: The use of [certificates](#).
- Project: The location of the [default project](#).
- JMX Server: [JMX Server Configuration](#).
- Management Console: [embedded Management Console configuration](#).

After changing any of the settings, click OK to store the new settings, and then restart any RoboServers that are running, to make the changes take effect.

Starting from Kapow version 10, all RoboServers must auto register to the Management Console. Therefore, the URL and credentials for the Management Console along with the cluster name must be specified when starting the RoboServer (either at the command line or using the RoboServer Settings application).

The name or IP address and the port number of the RoboServer's host should be specified when those parameters are different from what a RoboServer discovers on the local machine, such as when running with NAT in the cloud, or when you run the RoboServer in a Docker container.

Kapow contains several command-line tools to help you modify the settings in batch mode. For example, you can create several users with specified permissions. See [Configuring RoboServer in Headless Mode](#).

If you need to change the maximum amount of RAM that RoboServer can use, see [Change the RAM Allocation](#).

## Embedded Management Console Configuration

RoboServer contains an embedded web server which runs the Management Console. The web server is part of RoboServer, but is activated only when RoboServer is started with the `-MC` option enabled. By default, the web server will listen on port 50080, and thus the Management Console web interface is available on:

```
http:// host:50080/
```

### Protocols and Ports

You can configure the web server to be accessible through HTTP and HTTPS on separate ports. If a protocol is enabled, a port number must be chosen; the defaults are port 50080 (HTTP) and port 50443 (HTTPS).

To enable HTTPS, a server certificate in JKS format must be stored in a file called `webserver.keystore` in the `Certificates/Web` folder in the installation. If a certificate password other than the default (*changeit*) must be used, enter it in the Certificate Password field.

### Enable Administration Security

The Management Console can be accessed not only from the same computer (localhost), but also from others. One of the points of having a Management Console is that it coordinates execution of robots, and thus it typically must be accessible to many clients.

To mitigate the potential security risk of having access to the Management Console from other machines, you can enable an administrator password. Select the **Enable User Management** option and enter the

administrator user name and password. You must use these credentials both when you publish a robot to the Management Console from Design Studio and when you access the web interface from a browser.

You can also restrict who is allowed to upload JDBC driver to the embedded Management Console (see more about uploading JDBC drivers here). Possible choices are Not Allowed, where no one can upload JDBC drivers, "Admin from localhost," which means that the admin user can upload drivers when accessing the Management Console from the local machine; and finally, "Admin from any host," which means the admin user can always upload JDBC drivers.

## Security

On the RoboServer settings Security tab, you specify RoboServer TLS configuration, general security restrictions, whether authentication is required for accessing the RoboServer, and audit logging preferences.

### **Allow File System and Command Line Access**

Enables RoboServer to create and edit files on the computer.

### **Accept JDBC Drivers from Management Console**

Distributes JDBC drivers from the Management Console to the RoboServer.

### **Command Time-Out**

Specifies how long the RoboServer must wait for a reply from a command, such as click or scroll mouse from a remote device.

## RoboServer TLS Configuration

Kapow provides means for setting up TLS communication between Automation Device and RoboServer. The communication uses certificates for encrypting the communication. The encryption uses a public - private key structure for securing the connection.

In **TLS Configuration Settings** on the **Security** tab, you can specify whether to use the built-in set of certificates or specify some other.

- To use the Kapow certificates, select **Use Default TLS Configuration**
- To use other certificates, clear the **Use Default TLS Configuration** box and specify the following paths to private and public keys as well as to the trusted certificates folder in the corresponding fields.

See Use TLS Communication in Kapow help for more information.

## Restrictions

You can specify whether the RoboServer is allowed file system and command line access. By default, this is not allowed. If you enable it, however, robots running on RoboServer are allowed to access the file system and, using the Execute Command Line step, execute arbitrary commands on the machine running RoboServer.

**Caution** Enabling file system and command line access IS a security risk, and you should carefully consider whether it is necessary. If enabled, you should make sure the machine is not accessible from outside the local network, and/or you should require user authentication. Having a RoboServer with file system and command line access running on a machine accessible from the Internet and not requiring authentication, opens up the machine to the outside, and anyone can modify the file system according to the access rights of the user running RoboServer.

You can also disable accepting JDBC drivers from the Management Console. When activating RoboServers, the Management Console also sends settings to them. By default, this includes any JDBC drivers that have been uploaded to the Management Console. If a malicious user has gained administrator access to the Management Console, he could upload equally malicious jar files which would then be sent to the RoboServers. If the admin Management Console user is only allowed to upload JDBC drivers from the localhost, the preceding would occur only if the attacker is in fact sitting in front of the machine running the Management Console, or has gained access to, for instance, a VPN (in which case you probably have bigger problems). So in general, it should not be necessary to disable accepting JDBC drivers. If you do, you can make JDBC drivers available to the RoboServer by manually putting them into the lib/jdbc directory of the installation folder as described here.

## Request Authentication

To protect your RoboServer against unauthorized access, you can turn on authentication. This has effect on all RoboServers run from your Kapowinstallation, including a RoboServer started as a service or from a command line.

To turn on authentication, select the Require RoboServer Authentication check box. To run robots on a v with authentication turned on, you have to add users by clicking the add button. This will insert a new unnamed user. You can then fill out the information about the user including the username which will then be shown in the list of users.

A user is configured using the properties in the following table.

### User Properties

Property	Description
Username	This is the username used by the user when accessing the v.
Password	This is the password used by the user when accessing the RoboServer.
Comments	Here you can write a comment about the user.
Start Robot	This enables the user to start robots on the RoboServer.
Stop Robot	This enables the user to stop robots on the RoboServer.
Shutdown RoboServer	This enables the user to shutdown the RoboServer from the Management Console.

To run robots on a RoboServer configured with authorization, the caller must provide proper credentials. In the Management Console, this is done in the settings. When running a robot via the Java API, credentials are provided as explained in Execution Parameters.

## Configure RoboServer Logging

To automatically have every HTTP and FTP request made by RoboServer logged, select the Log HTTP/FTP Traffic option. This will log HTTP and FTP requests using the Log4J logger specified by `log4j.logger.kapow.auditlog`. Log4J is configured by the `log4j.properties` file in the Configuration folder in the application data folder.

The audit log includes all requests to both web pages and all of its resources. Here's an excerpt from the log produced by loading the front page of Google:

```
02-29 13:51:21 INFO kapow.auditlog - google google.com http://google.com/ 301 0
02-29 13:51:21 INFO kapow.auditlog - google www.google.com http://www.google.com/ 200 81688
02-29 13:51:22 INFO kapow.auditlog - google www.google.com http://www.google.com/extern_js/f/
CgJkYRICZGsrMEUjtw.js 200 328960
02-29 13:51:22 INFO kapow.auditlog - google www.google.com http://www.google.com/extern_chrome/
d9924a47b8c72e1a.js 200 43796
02-29 13:51:23 INFO kapow.auditlog - google ssl.gstatic.com http://ssl.gstatic.com/gb/js/
sem_6501b4b3093bbedb61d2e.js 200 31642
```

The log contains the following information:

- Timestamp
- Log level (INFO)
- Logger (kapow.auditlog)
- Robot name
- Hostname
- Request URL
- HTTP/FTP response code
- Number of bytes loaded from the response body

## Certificates

A key problem in establishing secure communications is to make sure that you're communicating with the right party. It is not sufficient just to request identity information from the other party - there must also be a way to verify this information before you can trust it. Certificates provide a solution to this, as they embody both a party's identity information (including that party's hostname and public key) and a signature from a trusted third party who vouches for the correctness of the identity information. A certificate should be trusted only:

- If the hostname stated within the certificate matches the hostname of the site that it comes from (otherwise it is a record of someone else's identity, which amounts to using false credentials).
- And if the certificate is signed by a third party that you trust.
- (Additionally, the certificate expiration date and the like should be checked, but we will not be concerned with these details here.)

We will not go into the technical details of the signing process, other than mentioning that it is based on public/private key cryptography. A signature for a certificate is the (fairly compact) result of a complex calculation that involves both the contents of the certificate and the signer's private key, and which cannot be reproduced without that same private key. The signature can be verified by doing another calculation that involves the contents of the certificate, the signature and the signer's public key. This calculation will tell whether the certificate matches the signature and thus is genuine. Note that the public key only enables you to verify a signature, not generate one. Thus the public key will not enable anyone to fake a certificate.

The signing party must never give the private key to anyone, but will distribute the public key as widely as possible. However, one issue still remains before you can trust a signature: You must be sure that you have a genuine copy of the signing party's public key. Public keys for well-known signing authorities like VeriSign are distributed with every browser and Java Runtime, and your trust in the signature (and thus the certificate) is in fact based on your trust in the way the browser or Java Runtime was installed.

It is possible to create your own signing authority by creating a public/private key pair and distributing the public key. This is done by embedding the public key in a certificate (a so-called self-signed certificate). Of course a party receiving such a certificate will not trust it based on its signature, but because he trusts you and the way that the certificate was communicated to him.

In order to make this scheme more flexible in actual implementation, it is possible to delegate the authority to sign. That is, the signature on a certificate may not actually be from a third party that you trust, but rather from yet another party who can display a certificate that you will trust. This may be extended to any number of levels, representing a chain of trust. To make verification practical, the signed certificate contains copies of all the certificates associated with the chain of trust (the last one being a self-signed root certificate). At least one of the certificates in this chain should be previously trusted by you.

Certificates are used in four different ways on RoboServer, corresponding to the four properties on the "Certificates" tab. Two of these have to do with how robots access web servers as part of their execution:

### **Verify HTTPS Certificates**

A robot may need to verify the identity of a web server that it accesses (via HTTPS). Such a verification is routinely (and invisibly) done by ordinary browsers in order to detect phishing attacks. However, the verification often is not necessary when robots collect information, because the robots only access those well-known web sites that they have been written for. Thus the verification it is not enabled by default.

If enabled, verification is done in the same way a browser does it: The web server's certificate is checked based on an installed set of trusted HTTPS certificates similar to those you can configure in a browser.

### **HTTPS Client Certificates**

This is almost the same as described above, but in the opposite direction. A robot may need to access a web server which wants to verify the identity of the client (robot) that accesses it. Presumably the web server contains confidential or commercial data that should be passed on only to clients with a proven identity. This identity is represented by a HTTPS client certificate.

Two other properties have to do with authentication in the communication between RoboServer and API clients that want robots to be executed on RoboServer. These properties apply only when clients connect to RoboServer via the secure socket based RQL protocol. The main purpose of the secure protocol is to encrypt communication, but with a little configuration it will also provide authentication, i.e., identity verification:

### Verify API Client Certificates

RoboServer is able to verify the identity of any client that connects to it in order to execute robots. This verification is disabled by default.

If enabled, the mechanics of verification is the same as for HTTPS certificates even though the purpose is quite different. The connecting client's certificate is checked based on an installed set of trusted API client certificates.

### API Server Certificate

RoboServer also has a server certificate that it will present to connecting clients. This certificate has a dual purpose: It makes the encryption side of SSL work (for this reason RoboServer comes with a default self-signed certificate), and it identifies this particular RoboServer to the clients.

The default API server certificate is the same for all RoboServers and thus is not any good for identification. If your clients need to verify the identity of the RoboServer they connect to, as described in SSL, you must create and install a unique API Server Certificate for each RoboServer.

## Install HTTPS Certificates

When a robot accesses a web site over HTTPS, it will verify the site's certificate (if the Verify HTTPS Certificates check box is selected). Verification is done based two sets of trusted certificates: the set of root certificates and an additional set of server certificates.

The root certificates are installed with Kapow just as root certificates are installed with your browser. They are found in the Certificates/Root folder in the application data folder.

Some HTTPS sites may use certificate authorities that are not included by default. In this case, you need to install the appropriate certificates for Kapow to load from these sites. Most often, these would be installed in the Certificates/Server folder in the application data folder.

To be precise, it does not matter - for the purpose of handling HTTPS sites - whether you add certificates to the set of root certificates or to the set of server certificates. However, please note that the root certificates have a broader scope, as they are also used when checking API client certificates.

To install a certificate, you need to obtain the certificate as a PKCS#7 certificate chain, as a Netscape certificate chain, or as a DER-encoded certificate. You install the certificate by copying it to either of the two folders mentioned above. The name of the file containing the certificate does not matter.

The following example explains how to install a server certificate for the website <https://www.foo.com>. The example is based on Internet Explorer.

**Note** You must install the certificates on all installations that need to load from the particular HTTPS sites.



1. Open <https://www.foo.com> in Internet Explorer.
2. Select **File > Properties > Certificates**.  
A Certificates window appears.
3. Click **Install Certificate**.
4. Click **Next** twice, click **Finish**, and exit the certificate window.  
Now you have installed the certificate in your browser. The next step is to export it to a file.

5. Click **Tools > Internet Options**.  
The Internet Options window appears.
6. On the Content tab, click the **Certificates** button.
7. Locate the installed certificate, which is typically on the Other People tab.
8. Select the certificate and click **Export**.
9. Click **Next** twice.
10. In the application data folder, save the certificate as foo.cer in the Certificates/Server subfolder.
11. Restart all your running RoboServers.

## Install HTTPS Client Certificates

When a robot accesses a HTTPS site, it may need to provide its own certificate to the web server. This is set up in the robot's Default Options or in the step-specific Options. One way to provide the certificate is to reference one of those that have been configured into the Kapow installation.

**Note** The HTTPS client certificates must be configured into all Kapow installations that need to run the robot.

1. On the RoboServer Settings Certificates tab, under the list of HTTPS client certificates, click the  icon.
2. When prompted, select a certificate file, which must be in PKCS12 format.
3. Enter the password used to encrypt the certificate file.
4. Optionally change the unique ID assigned to the certificate by clicking the  icon.  
The ID is used later in the robot to select the certificate.

## Install API Client Certificates

When API clients connect to RoboServer over SSL, RoboServer will verify the certificates presented to it (If the Verify API Client Certificates check box is selected). Verification means that RoboServer will reject connections from clients that fail verification, and is done based on two sets of trusted certificates: The set of root certificates and an additional set of API client certificates.

The root certificates are installed with Kapow just as root certificates are installed with your browser. They are found in the Certificates/Root folder in the application data folder. These are the same root certificates which are used for checking HTTPS certificates; however, root certificates probably will play a much smaller role when verifying API clients.

This is because in most cases, you will create your own self-signed API client certificates rather than use (expensive) certificates issued by official signing authorities. You should install your API client certificates in the Certificates/API/TrustedClients folder in the application data folder so that RoboServer will recognize them.

Technically speaking, it does not matter - for the purpose of verifying connecting API clients - whether you add API client certificates to the set of root certificates or to the set of API client certificates. However the

guidelines given above will help you avoid problems caused by the fact that the root certificates are also (even mainly) used when checking HTTPS certificates.

You can generate a self-signed certificate for your API client with the Java keytool command as follows:

```
keytool -genkey -keystore client.p12 -alias client -keyalg RSA -storetype "PKCS12"
```

You will be prompted for the following information: Name (domain), name of Organizational Unit, Organization, City, State, Country and password. Do not forget the password, there is no way to retrieve it if lost. This call of keytool will put the certificate into the keystore client.p12. You then must extract it into a separate file:

```
keytool -export -keystore client.p12 -alias client -storetype "PKCS12" -file  
client.pub.cer
```

You will be prompted for the password used when the certificate was generated. The output file client.pub.cer is what should be copied into the Certificates/API/TrustedClients folder in the application data folder.

## Install API Server Certificate

For technical reasons, RoboServer must have a server certificate that it can present to API clients when they connect to it using SSL. During installation, a default self-signed certificate is installed. This certificate is invalid for identification purposes since it is the same for all RoboServers, and should be replaced if the API clients need to verify the identity of the RoboServer.

1. On the RoboServer Settings Certificates tab, click **Change**.
2. On the file selection window, select the certificate.
3. When prompted, enter the certificate password.  
The certificate is imported and the following properties appear: Issued To, Issued By, and Expires.
4. Use the following Java keytool command to generate a new self-signed certificate for RoboServer:  

```
keytool -genkey -keystore server.p12 -alias server -keyalg RSA -storetype "PKCS12"
```
5. When prompted, enter the following information:
  - Organizational Unit
  - Organization
  - City
  - State
  - Country
  - password

**Note** Be sure to note the password, because it cannot be retrieved if lost.

The certificate is saved in the keystore file server.p12, which can be imported.



## RoboServer Configuration - Headless Mode

Kapow ships with several utilities to configure your RoboServer from a command line. The utilities are located in the `bin` subfolder of the Kapow installation folder. Note that the configuration files are user-dependent and stored in the user folder. For more information, see the Important Folders topic in the Kapow Installation Guide.

- `ConfigureRS`: Sets the JMX password and the Management Console password in the RoboServer settings file (`roboserver.settings`).
- `ConfigureMC`: Sets Management Console administrator and certificate passwords in the `mc.settings` file.
- `ConfigureRSUser`: Adds and removes users and updates user credentials in the `rsusers.xml` file. Information in this file is used to authenticate API requests.

For help on usage, run utilities with an `-h` option.

To set a connection to the Management Console that the RoboServer will register to, type the following command:

```
ConfigureRS -mcUrl http://admin:password@localhost:8080/ManagementConsole/
```

To create a user `user1` with `Password1` password and all permissions type the next command:

```
ConfigureRSUser user1 Password1 -a
```

To enable authentication of API requests, you must open `rsusers.xml` and change the `enabled` attribute to `true`, as shown in the following example.

### Sample `rsusers.xml` configuration file

```
<?xml version="1.0" encoding="UTF-8"?>
<userConfiguration enabled="true">
  <users>
    <user username="user1" password_hash="20c7628c31534b8718a1da00435505e4262e3f4dc305">
      <startRobot/>
      <stopRobot/>
      <shutdownRoboServer/>
    </user>
  </users>
</userConfiguration>
```

### Sample `roboserver.settings` configuration file

```
# Settings file for RoboServer. Some configurations contains encrypted passwords and should
  not be edited by hand, these should be modified using dedicated commandline tools.

# The directory of use on RoboServer when the API used the DefaultRoboLibrary. On windows \ must
  be escaped like this
c:\\\\users\\AppData\\Local\\Kapow\\...
defaultProject = /home/mikael.nilsson/Kapow/trunk

# Should RoboServer be allowed to access the fileSystem, or call commands/scripts. Values: true/
  false
sec_allow_file_system_access = false

# Will RoboServer accept JDBC drivers sent from the Management Console. Values: true/false
sec_accept_jdbc_drivers = true
```

```

# Should RoboServer log all loaded URLs to the log4j audit log. Values true/false
sec_log_http_traffic = false

# If enabled RoboServer will check credentials for API requests. Values: true/false
sec_authenticate_api_requests = false

# If enabled RoboServer generate an error when accessing a https site without a valid
  certificate. Values: true/false
cert_verify_https_certificates = false

# If enabled, RoboServer will only allow SSL connections from trusted client. Values true/false
cert_verify_api_certificates = false

# Configures if the the JMX service should be enabled
enable_jmx = false

# The port number for the JMX service to listen on.
jmx_port_Number = 50100

# If enabled, input for robots is exposed through JMX. Values: true/false
jmx_show_inputs = true

# Heartbeat notification interval, in seconds
jmx_heartbeat_interval = 0

# Configure if JMX should use RMI
enable_jmx_rmi = false

# Optional RMI host and port for the JMX service. Use if you need to connect through a firewall.
  Example: example.com:51001
jmx_rmi_url =

# Enables authentication for JMX requests. Values: true/false
jmx_enable_authentication = true

# The user-name used for JMX authentication
jmx_username =

# The password used for JMX authentication. This should be created using the ConfigureRS command
  line tool.
jmx_password =

# Configures if the socket service should be enabled
enable_socket_service = false

# Configures which port the RoboServer should be listening on
port = 50000

# Configures if the ssl socket service should be enabled
enable_ssl_socket_service = false

# Configures which ssl port the RoboServer should be listening on
ssl_port = 50001

# Configures if the JMS service should be enabled
enable_jms_service = false

# Configures which id the RoboServer should have when running JMS
jms_id = 1

# Configures the URL of the message broker when running JMS
broker_url =

# Configures if the RoboServer should register to a Management Console
enable_mc_registration = false

# Specify which Management Console to register to formatted as: http[s]://<hostname>:<port
  number>
mc_URL =

# The user name to use for authentication to the Management Console
mc_username =

```

```
# The password to use for authentication to the Management Console
mc_password =

# Specifies which cluster the RoboServer should be registered to
cluster =

# Causes RoboServer to output status and runtime events
verbose = false
```

### Sample mc.settings configuration file

```
# Settings file for Management Console. Passwords should not be edited by hand, but using the
'ConfigureMC' command line utility.

# Should the MC web-server start a HTTP listener. Values true/false
mc_http = true

# Configures the port of the http listener.
mc_http_port = 50080

# Should the MC web-server start a HTTPs listener. Values true/false
mc_https = false

# Configures the port of the HTTPS listener.
mc_https_port = 50443

# Password for the certificate used by the HTTPs listener. This should be created using the
ConfigureMC command line tool.
mc_https_cert_password = 3W2MTrL/b2k=

# Enables MC internal user management, to support multi user scenarios. Values: true/false
mc_enable_usermanagement = true

# The user-name of the MC super user.
mc_admin_user =admin

# The passwordHash of the MC super user. This is a salted SHA-256 hash.
mc_admin_password
=7800451255702ef8ae5f5fa0337833059d80b81d5af5872bdeafed230bab479896b6df4f63b25a24

# Configures which hosts are allowed to upload JDBC jar files to MC. Values: NONE, LOCALHOST,
ANY_HOST
mc_allow_jdbc_upload = LOCALHOST
```

## JMS Mode

Apart from socket mode, robots can communicate with RoboServers via message brokers using Java Message Service or JMS. To start the system in JMS mode, first start the JMS broker. The Management Console and RoboServers cannot start if the broker is not started or unaccessible. We recommend starting the Management Console before starting the RoboServers.

It takes some time (depending on network speed) for the RoboServers to register to the Management Console and for the Management Console to discover that the RoboServers are online.

See [Configure JMS Mode](#) for information on how to configure Kapow to use JMS.

**Note** Starting from Kapow version 10, all RoboServers must auto register to the Management Console. Therefore, the URL and credentials for the Management Console along with the cluster name must be specified when [starting the RoboServer](#) (either at the command line or using the [RoboServer Settings](#) application).

### Advantages of Running in JMS Mode

When Kapow runs in JMS mode, the system is more resilient towards network errors between the RoboServers, the JMS broker, and the Management Console. Although, it cannot handle a network breakdown lasting hours, it can handle short network problems in terms of minutes.

It is possible to use the standard feature of ActiveMQ to provide broker redundancy for increased stability. Also, the support for writing custom clients to communicate with the RoboServers is greatly improved. With KCP (the Kapow Control Protocol) clients can be created in any major programming language (see Kapow Control Protocol in the Kapow Developer's Guide).

When running JMS, the robots are not queued on the individual RoboServers. Instead, the RoboServers within a cluster all share a common queue, which is managed by the JMS broker. When a RoboServer is ready to start a new robot run, it picks a robot from the queue. This has two major advantages:

- Queued robots are not lost due to failure in the communication between the Management Console and the RoboServers.
- Robot cannot get stuck on a RoboServer queue while other RoboServers are idle, thus the pool of RoboServers is used more effectively.

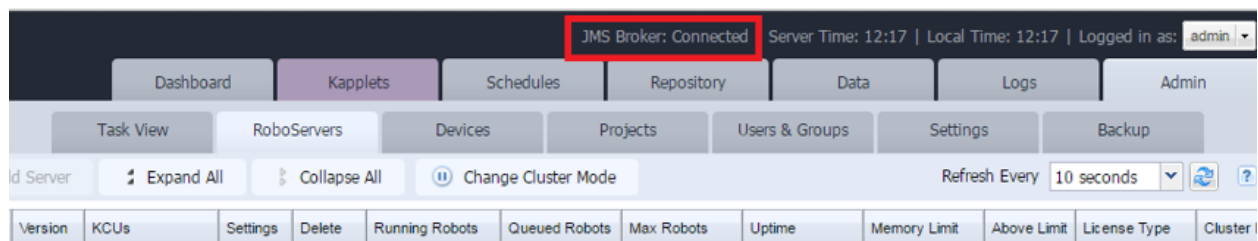
As opposed to the socket mode configuration, in JSM mode it is not necessary to open custom ports for the communication between the Management Console and the RoboServers. The only ports needed are those for the Management Console UI (default 8080) and the port used for communication with the JMS broker (default 61616).

To some extent robot run may be queued on the common execution queue while the RoboServers are unavailable, such as, not started yet. Note that the execution requests do not time out.

## Management Console in JMS Mode

To configure the Management Console to run in JMS mode, set `jmsEnabled` to "true" in the `Configuration.xml` file. The `brokerUri`, name space, message time to live, and broker credentials are also specified in `Configuration.xml`.

After the broker starts, you can start the Management Console. If the Management Console is unable to reach the broker upon start up, it does not start. In that case, fix the problem and restart the Management Console. Once started successfully, the Management Console reports that it is connected to the broker as shown below.



If the Management Console loses the connection to the broker, it reports it in the UI and logs a message. Once the Management Console re-establishes the connection, it returns to normal operation.

## RoboServer Options in JMS Mode

The RoboServer now accepts the following options related to JMS.

Option	Description
-service jms:<id>	Starts a JMS service understanding both RQL and KCP. The jms id together with the IP address of the RoboServer host uniquely identifies the RoboServer. A RoboServer may only define one JMS service. JMS and sockets service (SSL or otherwise) cannot co-exist on the same RoboServer.
-brokerUrl	Specifies the URL of the broker. For example, <code>failover://(tcp://localhost:61616)?startupMaxReconnectAttempts=3&amp;timeout=15000</code> . Refer to the broker documentation for the format of this parameter.
-jmsNamespace	Specifies the name space the RoboServer uses on the broker. It must match the name space used by the Management Console. Default is "Kapow".

It is mandatory to specify a JMS service and a broker URL when running JMS. You can either do it using command line options or the [RoboServer Settings](#) application.

If the RoboServer is unable to connect to the broker during start up, it does not start. If the RoboServer loses the connection to the broker during normal operation, it will continue to execute robots, but will not receive new execution request until the connection is re-established. If the connection is lost for an extended period of time, the Management Console considers the RoboServer to be offline until the connection is re-established. Unless otherwise specified in `Configuration.xml`, the grace interval is set to one minute. For a highly loaded system or slow network, increase the interval.

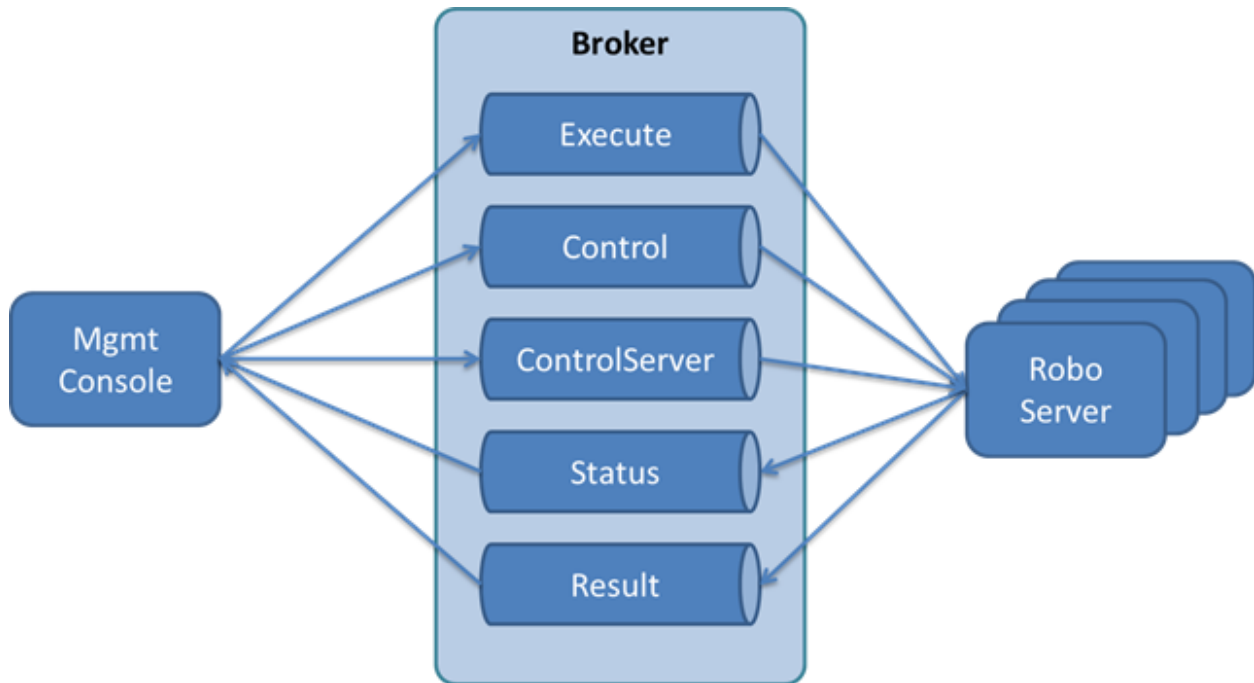
## Queues and Topics

JMS queues and topics used by Kapow are named

`<namespace>.<protocol>.<cluster>.<destination>` where namespace is defined in `Configuraton.xml` for the Management Console and in `roboserver.settings` or in the command line for the RoboServer (the default is Kapow). The protocol is either RQL, which is used by the Management Console or KCP for custom clients using the Kapow Control Protocol based on protobuf (see Kapow Control Protocol in the Kapow Developer's Guide). The cluster name is defined in the **Admin > RoboServer** tab of the Management Console. Since the destinations are cluster specific, there is no risk that messages for one cluster conflicts with messages from other clusters. Finally, the destination is one of the following.

- Execute
- Control

- ControlServer
- Status
- Result



The destinations are created on the fly once the Management Console and RoboServers are started and can be viewed using the ActiveMQ Console.

### Message Time to Live

The default time to live for messages is ten minutes. That is, if a message resides on a queue for more than ten minutes without being consumed, it is deleted. The time to live configuration is essential for execution requests. That is, if an execution request is not picked up by a RoboServer within ten minutes from being placed on the execution queue, it is deleted and the robot run is effectively lost and a message is written to the log. The intention is that the Management Console and other clients do not send out execution request faster than the RoboServers can process them. If this happens, the number of execution request should be scaled down or the RoboServers capability to execute robots should be scaled up. To determine whether this is the case or not, monitor the logs and the size of the execution queue in the **Admin > RoboServer** view of the Management Console as shown below.

Cluster/Server	Version	KCUs	Settings	Delete	Running Robots	Queued Robots	Max Robots	Uptime	Memory Limit	Above Limit	License Type
Production	10.0.0...	Unlimited			0	0	20	1:40 hours	910.50 MB	No	Production

### Execute Queue

All RoboServers ready to accept robot runs are listening for execute request on the execute queue. That is, the queue is common for all RoboServers on the cluster. One of the available RoboServers picks up the request and the others continue to listen for other requests. Which RoboServer receives the request is arbitrary. Depending on the duration of the robot runs uneven loads may be seen from time to time. If the robot runs have short or similar run time duration, the load should be more even.

Unless otherwise configured in the broker, the execute queue is unbounded by default. You can set a bound in the Management Console `Configuration.xml` file. The bound only applies to the execute queue used by the Management Console. If the Management Console is requested to start a robot run either via a schedule or a direct run while the execute queue is full, the run fails and the corresponding message is written to the log.

### Control topic

The control topic is solely used for stopping a robot run. All RoboServers subscribe to the control topic. The Management Console may broadcast a message to all RoboServers to stop a robot run identified by the execution id. The RoboServer running the robot stops the robot and reports back that it is stopped. If the robot is no longer running, the message is ignored silently.

### ControlServer Queue

Each RoboServer listens to the control server queue using a message selector to receive messages that are intended for a particular RoboServer. A RoboServer is identified by its IP address and the JMS id, for example, `127.0.0.1:1`. The Management Console uses the queue for: shutting down a RoboServer, enabling profiling, and requesting a status update of running robots.

### Status Topic

The RoboServers broadcast messages to this topic and the Management Console subscribes to it.

The RoboServer broadcasts a ping every 30 seconds on the topic to inform the Management Console that it is alive. If the Management Console has not received a ping from the RoboServers within a certain interval, the Management Console considers the RoboServer to be offline and the robot runs are lost. Unless otherwise specified in `Configuration.xml`, the interval is set to one minute. For a highly loaded system or slow network, increase the interval.

The RoboServer also reports statistics information about robot run every 20 seconds. This information is used to update the dashboards of the Management Console and stored in a database for creating more advanced reports using Analytics for Kapow.

Finally, if the RoboServer broadcasts the status of running robots, it is shown in the robot run-time view at the bottom of the **Admin > RoboServer** tab.

### Result Queue

The RoboServers send results to this queue about events occurring during a robot run, for example, robot started, failed, or ended. The queue is also used for sending results of robot runs.

## JMX Server Configuration

You can use the embedded JMX server to monitor the running RoboServer through tools such as JConsole. Enable JConsole by providing an argument on the RoboServer command line (see the RoboServer User's Guide for further information.)

### Hiding Sensitive Robot Input

The Show Inputs option controls whether robot input parameters are shown in the management interface. This makes it possible to hide security sensitive information such as passwords.

### JMX Server Access

By default, the JMX server can be accessed by all clients with access to the correct port on the server. By selecting the Use Password option, the selected user name and password are required when connecting.

### Heartbeat Notifications

If an interval (in seconds) greater than 0 is specified, the JMX server sends out a heartbeat notification with the given interval, as long as the RoboServer is running and responding to queries.

## Default RoboServer Project

You can set the location of the default RoboServer project folder in the on the RoboServer Settings Project tab. By default, the folder is set to the default robot project created in during the installation process. See the Design Studio User's Guide for more information on robot projects.

The RoboServer default project is used only by the API. When executing a robot from the API, any references it has to types, snippets or other resources are resolved by looking in the default project.

## Change the RAM Allocation

As installed, each Kapow application is configured with a maximum amount of RAM that it may use. This amount usually is plenty for ordinary work, but if you run many robots in parallel on RoboServer, or if some robots use much RAM, it may be necessary to increase the allocation.

You can change the allocation for any of the applications by editing its `.conf` file, found in the `bin` subfolder of the installation folder.

For RoboServer, the file to edit is: `bin/RoboServer.conf`.

For Design Studio, the file to edit is: `bin/DesignStudio.conf`.

To edit the file, perform the following steps.

1. Open the corresponding `.conf` file in a text editor.
2. Find the line containing the `wrapper.java.maxmemory` parameter.
3. Un-comment the line (remove the leading `#`) and edit its value.  
For example, to permit a roboserver to use up to 4GB of RAM, enter the following:  
`wrapper.java.maxmemory=4096.`

**Note** If the `.conf` file does not contain the `wrapper.java.maxmemory` line, add the whole line to the file.

An allocation this high is possible only on the 64-bit version of Kapow. Also, the `.conf` file can be edited only by the user who installed Kapow, such as the Windows administrator.



## Troubleshoot RoboServer Service Startup

If your service does not start, look for RoboServer messages in the Windows event log. Make sure you have installed the service with the `wrapper.syslog.loglevel=INFO` argument. For more information, see [Kapow Initial Configuration](#) in the Installation Guide.

## Chapter 3

# Tomcat Management Console

By default, Management Console is run as an embedded component inside RoboServer, which makes for easy installation. As an alternative, it can be deployed as a regular web application on a standalone Tomcat web server version 7.0.56 or later.

**Important** If your setup requires access to the Management Console outside of your corporate intranet, set up TLSv1.0 (or a later version of TLS) to work with your Tomcat server.

The following table lists the differences in the feature set.

### Management Console Features and Configuration

Feature	Embedded	Standalone J2SE Web Container
Authentication	Single-user defined in Settings. Users and Roles managed by Management Console Administrator.	Users and Roles managed by Management Console Administrator. Role based security through Active Directory or other LDAP provider. Single Sign-On using SiteMinder.
Management Console data store	Embedded Derby database	Container managed Data Source (supported platforms)

**Note** The derby JDBC driver is not distributed with the Enterprise Management Console. See [Apache Derby](#) Web site for Derby JDBC driver download information. We recommend using MySQL or other enterprise-class database with your Enterprise Management Console.

Instructions on configuring an embedded Management Console can be found in the Kapow online help. To start an embedded Management Console, see Starting the Management Console under the Management Console topic.

## Tomcat Deployment

We will now detail how to install the Management Console on a stand alone J2SE web container. For this guide we have chosen Tomcat, and the distribution has been tested on Tomcat 7.0.56, 7.0.59, and 8.0.20. Your J2SE web container must be using the Java 8 runtime or later. Visit the Oracle Java SE Downloads site and download the latest Java 8 release.

**Important** If your setup requires access to the Management Console outside of your corporate intranet, set up TLSv1.0 (or a later version of TLS) to work with your Tomcat server.

## Install Management Console on Tomcat

### Prerequisites

- Install the latest java 1.8 update from the Oracle web site: <http://www.oracle.com/technetwork/java/javase/downloads/index.html>
- Download tomcat from the Apache web site: <https://tomcat.apache.org/download-70.cgi>
  - Install tomcat and set user password.

### Installation

1. Download full Kapow installer and proceed with the installation. Select the **Management Console WAR** option during the installation.
2. Copy the `ManagementConsole.war` file from the `WebApps` directory in the Kapow installation to the `webapps` directory on the Tomcat server and [configure](#) the `.war` file.
3. Create a `ManagementConsole.xml` Tomcat context file on the Tomcat server at `conf/Catalina/localhost/`. See [Create a Tomcat Context File](#) for details.
4. Edit `webapps/manager/WEB-INF/web.xml` file on Tomcat to be able to upload applications.

```
<multipart-config>
<!-- 150MB max -->
<max-file-size>152428800</max-file-size>
<max-request-size>152428800</max-request-size>
<file-size-threshold>0</file-size-threshold>
</multipart-config>
```

5. [Start Tomcat.](#)
6. [Enter License Information](#)

## Configure ManagementConsole.war

The Management Console application comes in the form of a Web Application Archive (WAR file) named `ManagementConsole.war`, which is located in the `/WebApps` folder in the Kapow installation folder.

The version of `ManagementConsole.war` that ships with Kapow is configured to run embedded inside RoboServer. Before you can deploy it as a standalone application on Tomcat, it must be reconfigured to fit your environment.

A WAR file is compressed using a compressed zip file. To access the configuration files, you must extract the zip file. Once the configuration files are updated, you re-zip and deploy `ManagementConsole.war` to your Tomcat server.

The table below contains a list of the configuration files relative to the root of the unzipped `ManagementConsole.war`.

## Configuration Files

File	Configures	Notes
WEB-INF/Configuration.xml	Clustering, password encryption, REST-Plugin	If you copy the version of the file from 8.1, it will automatically be upgraded once you start the Management Console
WEB-INF/login.xml	Administrators and users, this is where you integrate with LDAP	
WEB-INF/classes/log4j.properties	application logging	

## Spring Configuration Files

Configuration.xml and login.xml are all Spring configuration files ([www.springsource.org](http://www.springsource.org)) and share the same general syntax which we will outline here.

Spring is configured through a series of beans, and each bean has properties that configure a piece of code inside the application. The general syntax:

```
<bean id="id" class="SomeClass">
  <property name="myName" value="myValue" />
</bean>
```

File	Configures
id="id"	The id of the bean is an internal handle, that the application use to refer to the bean. It is also referred to as the bean's name.
class="SomeClass"	The class identifies the code component which the bean configures.
<property name="myName" value="myValue" />	Defines a property with the name myName and the value myValue. This configures a property on the code component defined by the class attribute.

In Kapow versions prior to 9.3, user access credentials were defined manually in the login.xml file. Starting from version 9.3, user management is performed using the Users & Groups tab under the Admin tab in the Management Console. In the enterprise version of Kapow, user management is enabled by default. See the Users Tab topic for more details. User population from previous installations can be performed using the Kapow backup functionality. For LDAP integration you still need to edit the login.xml file.

## Troubleshooting

If you have any problems during the installation, you should check the Tomcat log in the `/logs` folder in your Tomcat installation. During the configuration process it is often easier to run Tomcat from the command line, as it will then print error messages directly in the command line window.

## Create a New Database

We strongly recommend that you create a new database for the tables used by the Management Console. There are two requirements to the database.

- Unicode support
- Case-sensitive comparison

Unicode support is needed because non-ASCII characters, like Danish Æ, German ß or Cyrillic Ё may be given as input to robots. This input is stored in the database, and without Unicode support these characters may be stored incorrectly.

Case-sensitive comparison is needed because it is possible to upload a robot named a.robot and another named A.robot. Without case-sensitive comparison, uploading the latter would override the first.

Database servers handles Unicode and case-sensitive comparison very differently. The following list contains recommendations for the supported database systems.

### Recommendations for Unicode Support and Case-Sensitive Comparison

Database	Recommendations
IBM DB2	Create the database using CODESET UTF-8
MySQL 5.x	Create the database with utf8_bin collation: <code>CREATE DATABASE KAPOW_MC COLLATE utf8_bin</code>
Oracle	We use NVARCHAR2, NCLOB types for Unicode. For case-sensitive comparison ensure that NLS_COMP is set to BINARY
Microsoft SQL Server 2005/2008	We use NVARCHAR, NTEXT types for Unicode. For case-sensitive comparison create the database with a Case-Sensitive collation such as SQL_Latin1_General_CP1_CS_AS: <code>CREATE DATABASE KAPOW_MC COLLATE SQL_Latin1_General_CP1_CS_AS</code>
Sybase Adaptive Server Enterprise	We use NVARCHAR, NTEXT types for Unicode. For case-sensitive comparison ensure that the sort order is binary (see sp_helpsort). The scripts below use NVARCHAR(255) NOT NULL UNIQUE, due to index limitations this will not work on an ASE with 2K page size, unless you modify the scripts to use NVARCHAR(200) NOT NULL UNIQUE (or install on a 4/8/16K page server)

The tables used by the Management Console can be grouped into 3 categories: Platform tables, logging tables, and data view tables. The platform tables hold information exclusive to the Management Console such as the uploaded robots and their scheduling information, while the logging and data view tables are shared with RoboServer.

## User Privileges

When the Management Console starts, it automatically tries to create the required platform tables and logging tables (if not already created by RoboServer). This means that the user account used to access the database must have the CREATE TABLE and ALTER TABLE privileges as well as the CREATE TEMPORARY TABLES privilege to restore a backup. Oracle users also need the CREATE SEQUENCE privilege. If this is not possible you can ask your Database administrator to create the tables using the scripts below.

Additionally the user must be allowed to SELECT, INSERT, UPDATE, DELETE for the system to work properly.

## SQL Scripts for Management Console Tables

SQL scripts are included with your copy of Kapow in the `documentation\sql` directory. See [SQL Scripts for Kapow Tables](#) for details.

The Management Console uses a 3rd party scheduling component called Quartz. Quartz also requires a number of tables which must reside among the other platform tables. These tables are also created automatically when the Management Console starts, or may be created manually using the scripts in the [SQL Scripts for Kapow Tables](#).

## Create a Tomcat Context File

In an enterprise environment, databases are often accessed through a data source. This guide will show you how to configure your Tomcat with a data source that connects to a local MySQL database server.

In Tomcat, data sources are defined within the applications context. The context may be declared either embedded or external to the application. When the context is embedded, it is defined in the file `context.xml`, which must be located inside the WAR file inside the META-INF folder. When declared externally the file must be located in Tomcat's `/conf/Catalina/localhost` folder and the name of the file must be `ManagementConsole.xml` (same name as the deployed WAR file). Although Tomcat recommends deploying with an embedded context, as it provides a single deployment unit, we will use an external context definition in this guide, as it makes modifying the file easier. Once you have refined your configuration, you can embed the context file and deploy the War file to your production environment.

## Add Platform Data Source

Create the file `ManagementConsole.xml` on Tomcat in the `conf/Catalina/localhost` folder and add the following content.

**Note** If you use Tomcat version 7.0.66 to 7.0.67 or 8.0.29 to 8.0.31, add the `mapperContextRootRedirectEnabled="true"` parameter to the first line of the context file as follows `<Context useHttpOnly="true" mapperContextRootRedirectEnabled="true">`.

```
<Context useHttpOnly="true">
  <!-- Default set of monitored resources -->
  <WatchedResource>WEB-INF/web.xml</WatchedResource>

  <Resource name="jdbc/kapow/platform" auth="Container" type="javax.sql.DataSource"
    maxActive="100" maxIdle="30" maxWait="-1"
```

```

        validationQuery="/* ping */" testOnBorrow="true"
        username="MyUser" password="MyPassword" driverClassName="com.mysql.jdbc.Driver"
        url="jdbc:mysql://localhost:3306/KAPOW_MC?
useUnicode=yes&characterEncoding=UTF-8&rewriteBatchedStatements=true"/>
    </Context>

```

The url parameter above is a JDBC URL. The username and password attributes are used by Tomcat to create a connection pool used when connecting to the database.

The data sources are defined differently for other databases. For instance, if you are using Microsoft SQL Server 2005/2008, the relevant three lines above should instead be:

```

username="MyUser" password="MyPassword"
    driverClassName="com.microsoft.sqlserver.jdbc.SQLServerDriver"
    validationQuery="SELECT 1" testOnBorrow="true"
    url="jdbc:sqlserver://localhost:1433;DatabaseName=MyDbName"/>

```

Note that if you are using Microsoft SQL Server, you need to configure it to use mixed mode authentication. Generally, you should consult the JDBC documentation to identify which values to use in the data sources.

The URL `jdbc:mysql://localhost:3306/KAPOW_MC?useUnicode=yes&characterEncoding=UTF-8` refers to a database named KAPOW\_MC in your local MySQL. For MySQL it is recommended that you add `?useUnicode=yes&characterEncoding=UTF-8` to all connection strings, otherwise the JDBC driver will not handle Chinese, Japanese or other 3-byte utf-8 characters correctly, since we can't have `&` directly inside the context xml file, we must encode it as `&amp;`;

`rewriteBatchedStatements=true` instructs the MySQL JDBC driver batch inserts/updates and should give improved insert performance for kapplet robots.

The `driverClassName` parameter controls which JDBC driver is used; each database vendor provides a JDBC driver for their database, which you will have to download. The JDBC driver, typically a single .jar file, must be copied into the `/lib` folder on Tomcat 6/7, or `commons/lib` on Tomcat 5.5.

The `validationQuery` is used by Tomcat to verify that the connection obtained from the connection pool is still valid (as the database server may have closed the connection). The validation query is lightweight and uses very few resources on the database server, this list contains validation queries for the supported databases.

### Validation Queries

Database	Query
MySQL	<code>/* ping */</code>
Microsoft SQL Server 2005/2008	<code>SELECT 1</code>
Sybase Adaptive Server Enterprise	<code>SELECT 1</code>
IBM DB2	<code>VALUES(1)</code>
Oracle	<code>SELECT 1 FROM DUAL</code>

Note that the MySQL JDBC driver supports a special lightweight `/* ping */ 'request'`, check JConnector manual section 6.1 for details

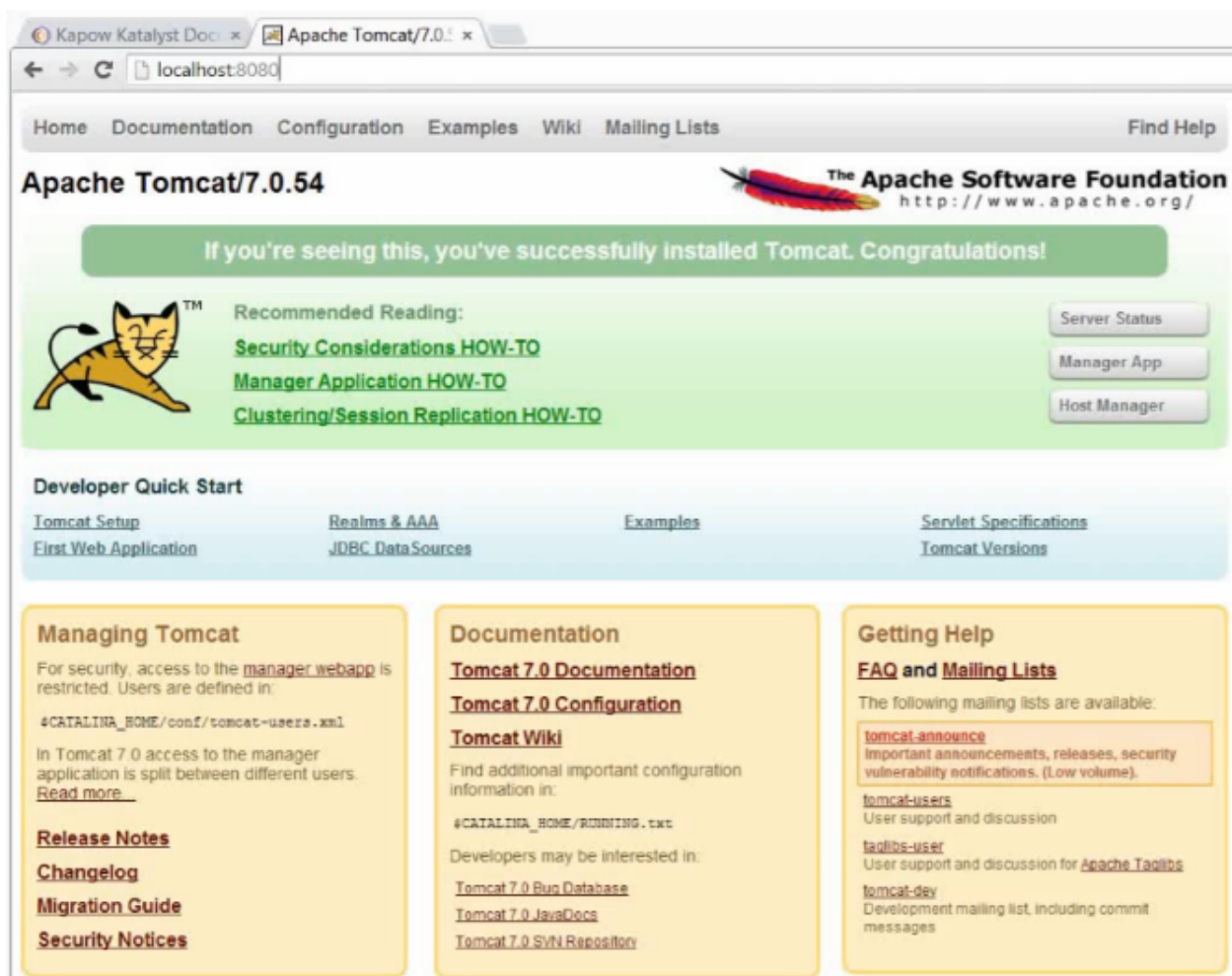
For more information on context configuration and data sources, see JNDI Resources HOW-TO and JNDI data source HOW-TO.

We are now ready to start the Tomcat server.

## Start Tomcat

Start your Tomcat server, wait a couple of seconds for the application to be deployed, then navigate to <http://localhost:8080/>. You should see the following page.

### No Providers Apache Start Page

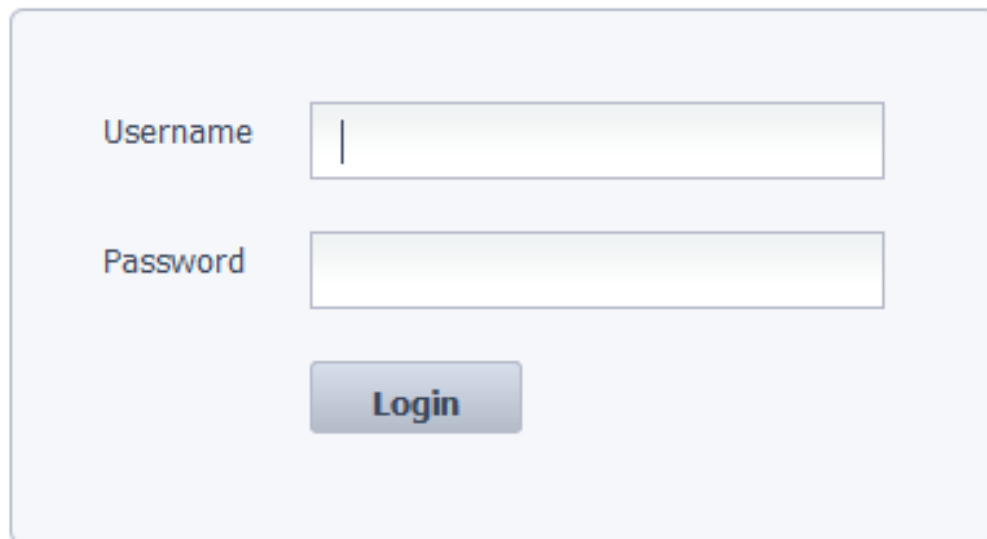
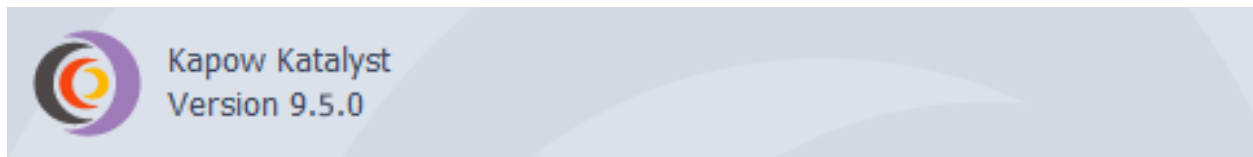


By default there is only one set of credentials (user name - admin, password - admin) with administrator privileges. Later you can change password and create other users and groups on the Users Tab under the Admin tab in the Management Console.

Now open the <http://localhost:8080/ManagementConsole> you should see the following login screen.



## Login Page

A light blue rounded rectangular box containing a login form. It has two input fields: "Username" and "Password". The "Username" field has a vertical cursor. Below the fields is a "Login" button with a blue gradient and white text.

Enter `admin` as the username and `admin` as the password and click **Login**.

## Enter License Information

After logging in, the license window is displayed.

### Enter License Window

**Please enter a license** [X]

Enter license information. The production license is used for Production clusters, the Non-Production license is used for Non-Production clusters, and Design Studio seats.


Name:

E-mail:

Company:

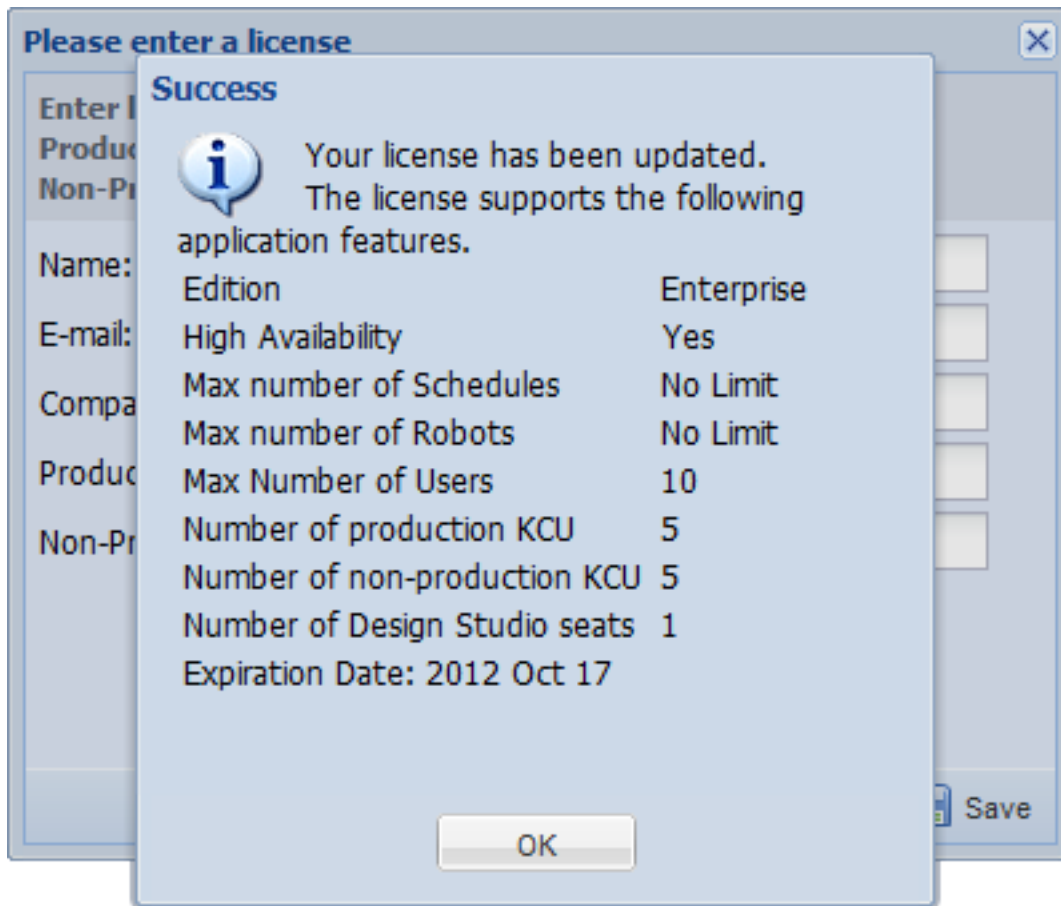
Production Key:

Non-Production Key:

 Save

Now enter the Kofax Kapow license information and click **Save**. You should see the following dialog box displaying which features enabled by your license key.

### License Updated



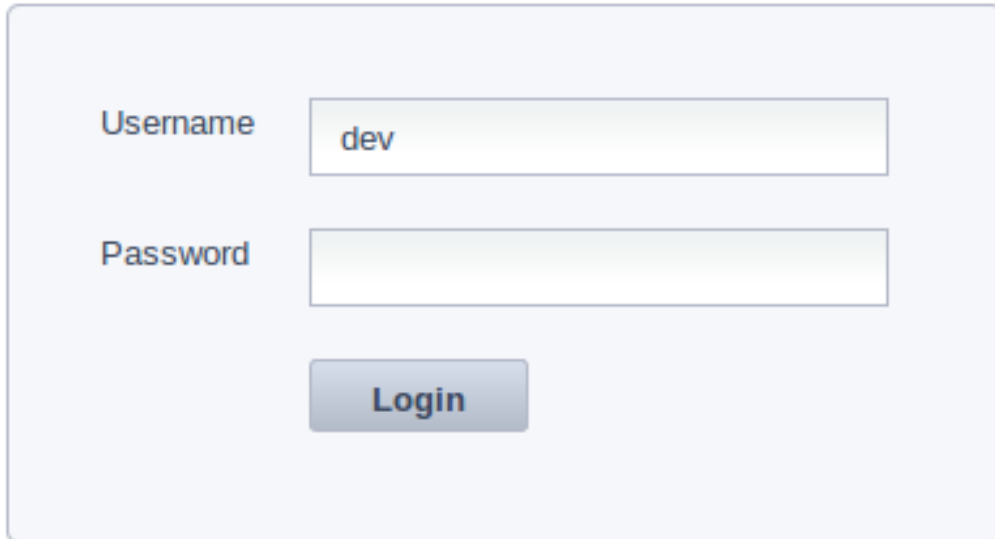
### Project Permissions

The admin user account used to log in bypasses the normal project permissions applied to regular users, because admin is the superuser. The superuser can not be a member of any group, and has an unrestricted access to all projects.

To change the admin password and create new users and groups, go to the Admin tab and then click the **Users and Groups** tab. The security model is role-based; after you create a user, you must add this user to one or more groups associated with specific roles in one or more projects.

Create DEVELOPER group, then create a user dev and add this user to the DEVELOPER group. Try to log in with this user credentials. You should see the following screen:

### User Not Mapped



A login form with a light blue background. It contains two input fields: 'Username' with the value 'dev' and 'Password' which is empty. Below the fields is a blue 'Login' button.

Your login attempt was not successful, try again.  
Reason: This user account is not mapped for access to this application.

For non-administrator users, permissions are based on the user's group membership. The dev user is a member of the group DEVELOPER, and since we have not given users in the DEVELOPER group access to any projects, they are not able to log in.

To allow the dev user to log in, we must log in as administrator and go to the Projects tab which is a sub tab of the Admin tab. It looks like this:

## Initial Project Permissions

Kapow Catalyst Management Console Version 9.3.9

Server Time: 17:18 | Local Time: 17:18 | Logged in as: admin

Admin > Projects

Projects

Project	Description	Edit	Delete	Permissions	REST Cluster	Authenticate Rest
Default project	Default project automatically created			0	Production	true

Application Nodes

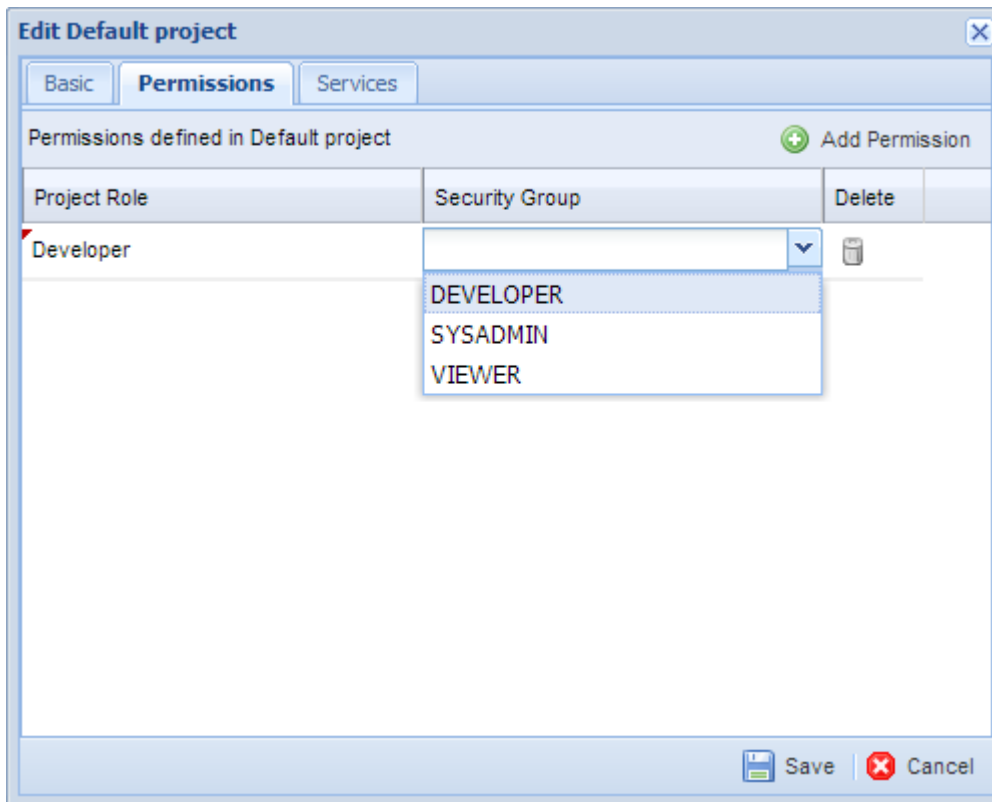
Node Id	Interface	Status	Connected to
Node-1	/127.0.0.1:5701	Running	true

In the Permission column, there are 0 permission mappings.

Click Edit to open the Edit Project dialog box and go to the Permissions tab. There is a grid with columns Project Role, and Security Group. A project role determines a set of actions that may be performed inside the Management Console, such as uploading robots, creating schedules, viewing logs etc. Within a project you assign a project role to a security group. That way, all users of the selected security group will be able to perform the actions allowed by the assigned project role.

Click Add Permission to add permissions in this project. This adds a new line to the grid, and inserts a dropdown box allowing us to select a project role. Select the project role developer. Now double click in the Security Group column and select the DEVELOPER security group (of which our dev user is a member). It should look like this:

### Adding Project Permissions



Now click Save.

All members of the DEVELOPER group can now perform the actions allowed by the role developer.

Let's log in as the dev user and see how the permissions are reflected in the Management Console. You log out by clicking the menu button in the upper right corner, then log in as the dev user. Now go to the Logs tab, select the RoboServer log in the left pane. Notice how the delete button is disabled, and hovering gives a tooltip message that you do not have permissions to delete RoboServer messages.

## View Logs But Not Delete

You can assign multiple roles to the same security group, and you can assign the same role to multiple security groups. If a user holds multiple roles, he can do anything that at least one of the roles allow. With multiple projects in Management Console, users of different projects can be completely separated by assigning their groups to project-specific roles.

The predefined roles are suggestions, but you can add any number of additional roles, or change the existing roles to fit your needs.

Actions that can be performed on the Settings, Backup and License tabs (sub tabs to Admin) are only available to users that are members of the Administrator group.

For using your LDAP user accounts, see the [Advanced Configuration>LDAP Integration](#) topic.

## Security

In the WEB-INF/Configuration.xml file, it is possible to configure some additional security settings for the Management Console.

The security configuration section of the file looks like this:

```
<bean id="securityConfiguration" class="com.kapowtech.mc.config.SecurityConfiguration">
  <property name="allowScriptExecution" value="false"/>
  <property name="jdbcDriverUpload" value="LOCALHOST"/>
</bean>
```

It contains two security settings which are described below.

As part of a schedule, a user may configure a script that is used for Pre/Post processing, e.g. before/after any robots in the schedule are executed. These scripts must be located on the Management Console computer's file system. For security reasons, the running of external scripts is disabled by default. To allow external scripts to execute, you should change the value of the `allowScriptExecution` property to `true`.

If you use a pre/post-processing script in a schedule, and scripts are disabled by the administrator, the schedule will fail immediately with the following message: `Scripts have been disabled by the administrator.` without executing any robots. Users can save schedules with pre/post-processing scripts even if the feature is disabled. NB: Even if external scripts are disabled, you can still use the pseudo script command `"runrobot: test.robot"` as part of pre- or post-processing.

By default, only the admin user when accessing the Management Console from the localhost is allowed to upload JDBC drivers. To change this behavior, modify the `jdbcDriverUpload` property. The following are the possible values, the property can have:

- `NONE`: upload of JDBC drivers is not allowed for any users
- `LOCALHOST`: the default value, the admin user is allowed to upload drivers if accessing the Management Console from the localhost
- `ANY_HOST`: the admin user is allowed to upload drivers from any host

## Deployment Checklist

Use the following checklist to ensure that all deployment tasks are completed in the proper order.

### Deployment Checklist

Item	Description
Download and install a supported version of Apache Tomcat Server	If your setup requires access to the Management Console outside of your corporate intranet, make sure SSL is set up to work with your Tomcat server.
Download and install Java 8 (JDK 1.8.0_40 or later)	Management Console will not initialize correctly if Apache Tomcat is started using any version of Java other than Java 8.
Ensure that the <code>JAVA_HOME</code> variable is pointed to the Java 8 installation.	
Start up the Apache Tomcat and confirm that the Apache Tomcat server will come online before attempting to deploy the Management Console application.	<ul style="list-style-type: none"> <li>▪ You can use the <code>catalina run</code> command from the <code>\bin</code> directory to start the server.</li> <li>▪ Going to <code>http://localhost:8080</code> in the browser should display the default Apache Tomcat start up page.</li> </ul>
From a Kapow installation, locate the <code>ManagementConsole.war</code> file that will be deployed under the Apache Tomcat <code>\webapps</code> directory	Expect errors on the initial start up of the application at this point, because the server has not been configured yet. We are simply unpacking the <code>.war</code> file so that we can easily gain access to the files we will need to edit to complete the installation and configuration process.



Item	Description
Turn the Apache Tomcat server off.	
Create a new database to be used by the Enterprise Management Console to hold its configuration.	<ul style="list-style-type: none"> <li>Select one of the support platforms.</li> <li>The Kapow installation contains the CREATE and DROP SQL scripts needed to create all the required database tables. See <a href="#">SQL Scripts for Kapow Tables</a> for details. Note that these scripts only need to be used if the user account that the application will use to connect to the database does not have the CREATE privileges on the schema.</li> </ul>
Create the DB user account to be used by the application to connect to the database via JDBC.	
Create the Tomcat Context file: ManagementConsole.xml	<ul style="list-style-type: none"> <li>Validation query to be specified is database specific. The online help has all accepted values for all supported databases.</li> <li>Do not forget to update the Username, Password, and DatabaseName parameters in the JDBC URL string with the correct values for your database.</li> </ul>
Prior to starting up the application, notice that the Management Console database (as specified in the ManagementConsole.xml) does not have any tables related to the Management Console process at this time.	<ul style="list-style-type: none"> <li>When the application is started, the needed database tables are automatically created if they are not present assuming that the DBUser account has the CREATE privileges.</li> <li>If the user does not have the CREATE privileges, the CREATE SQL scripts can be found in the <code>documentation\sql</code> directory in your Kapow installation directory. See <a href="#">SQL Scripts for Kapow Tables</a> for details.</li> </ul>
Do not forget to deploy the necessary JDBC .jar file under the Apache Tomcat installation directory.	<ul style="list-style-type: none"> <li>Deploying to <code>&lt;APACHE_TOMCAT_INSTALL_DIR&gt;\lib</code> makes it available to ALL apps running under Tomcat.</li> <li>Deploying to <code>&lt;APACHE_TOMCAT_INSTALL_DIR&gt;\webapps\ManagementConsole\WEB-INF\lib</code> makes the JDBC .jar file only accessible to the Management Console application itself.</li> </ul>
Restart the Apache Tomcat Server	Confirm the Tomcat main home page loads: <code>http://localhost:8080</code>
Try to login to the Enterprise Management Console as user - admin, password - admin	<code>http://localhost:8080/ManagementConsole</code>
Enter the Kapow Software License Keys	

## Advanced Configuration

### LDAP and SiteMinder Integration

The installation guide shows you how to authenticate users against a list of hard-coded credentials. This topic describes how to use LDAP and SiteMinder authentication.

## LDAP Integration

To use LDAP for authentication, enable the LDAP authentication and edit the `ldap` definition in the `login.xml` file.

To enable the LDAP authentication, set the `useLdap` property to `true` as follows:

```
<bean id="authenticationConfiguration"
  class="com.kapowtech.scheduler.server.spring.security.AuthenticationConfiguration">
  <property name="useLdap" value="true"/>
  <property name="useSiteMinder" value="false"/>
</bean>
```

In `login.xml`, you can find the following definition:

```
<bean id="ldapDirectories" class="com.kapowtech.mc.config.LdapDirectories" lazy-init="true">
  <property name="directories">
    <list>
      <bean id="ldap" class="com.kapowtech.mc.config.LdapDirectory">
        <property name="adminGroups">
          <list>
            <value>KAPOWADMIN</value>
          </list>
        </property>
        <property name="ldapServerURL" value="ldap://<hostname>:389"/>
        <property name="userDn" value="CN=LDAP test,CN=Users,DC=kapowdemo,DC=local"/>
        <property name="password" value="change-to-passowrd"/>
        <property name="userSearchBase" value="OU=Users,OU=TheEnterprise,DC=kapowdemo,DC=local"/>
      >
      <property name="userSearchFilter" value="(userPrincipalName={0}@kapowdemo.local)"/>
      <property name="userSearchSubtree" value="true"/>
      <property name="groupSearchBase" value="OU=Security
Groups,OU=TheEnterprise,DC=kapowdemo,DC=local"/>
      <property name="groupSearchFilter" value="(member={0})"/>
      <property name="groupRoleAttribute" value="cn"/>
      <property name="groupSearchSubtree" value="true"/>
      <property name="convertToUpperCase" value="true"/>
      <property name="allGroupsFilter" value="cn=E*"/>
      <property name="fullNameAttribute" value="displayName"/>
      <property name="emailAttribute" value="userPrincipalName"/>
      <property name="referral" value="follow"/>
    </bean>
  </list>
</property>
</bean>
```

This defines a list of `ldapDirectory` beans named `ldap` and represents a list of connections to LDAP servers. Each bean defines a number of properties that controls the LDAP integration. If you are familiar with the way Tomcat integrates to LDAP, this should be quite familiar as well.

Kapow supports LDAPS (LDAP over SSL) with Management Console. To use LDAPS, the `ldapServerURL` property must be set as follows:

```
<property name="ldapServerURL" value="ldaps://<hostname>:<port>"/>
```

By default the LDAPS port is 636.

### Deployment Checklist

Property	Description
<code>ldapServerURL</code>	The URL to the LDAP server. This uses the <code>ldap://</code> protocol.
<code>userDn</code>	The DN (distinguished name) used to log in to LDAP to authenticate other users.

Property	Description
password	The password for the userDN account. As the password will be stored in clear text in this file you should use an account that only has 'read' access.
userSearchBase	Subdirectory in the LDAP tree where users can be found.
userSearchFilter	Filter that is applied to find the username.
userSearchSubtree	Set to true if users may be located in the subdirectory of the userSearchBase.
groupSearchBase	Subdirectory in the LDAP tree where groups can be found.
groupSearchFilter	Filter that is applied to identify the users in this group.
groupRoleAttribute	Attribute that holds the group name.
groupSearchSubtree	Set to true if groups may be located in the subdirectory of the groupSearchBase.
convertToUpperCase	Should the group names be converted to upper case, true by default.
allGroupsFilter	Optional. Controls which groups are displayed when creating project permissions, see below.
fullNameAttribute	Attribute to fetch the full name of the user.
emailAttribute	Attribute to fetch the email of the user.
referral	Set to "follow" to allow redirection to sub nodes in the LDAP tree.

To use an LDAP account to administer the Management Console, you must add one of the groups that you are a member of to the `adminGroups` bean in `login.xml`, as described in [Project Permissions](#). Note that anyone who is a member of a group listed in `adminGroups` is a Management Console administrator, so you may want to create a new LDAP group for this purpose. Use the upper case group name if `convertToUpperCase` is true.

When you select a project permission in the Management Console, you can see that all the group names are pulled from LDAP to populate the list. The groups are located by using the `groupRoleAttribute` to construct a filter to fetch all groups. Sometimes you do not want all LDAP groups displayed here, in which case override this behavior by providing your own filter. This is done by adding an additional property to the `LdapLogin`.

```
<property name="allGroupsFilter" value="(cn=*)" />
```

Finds all group names, if the group name is in the `cn` attribute (this is the default).

If you only want to find groups starting with the letter 'e' you can use the following code

```
<property name="allGroupsFilter" value="(cn=E*)" />
```

The filter uses basic LDAP queries. See LDAP documentation for more complex queries.

### Checklist for solving SSL connection errors when using LDAPS

If you experience errors connecting using LDAPS, check the following:

- LDAPS requires that the certificate presented by the LDAP server is trusted by the java running the tomcat. Import the public certificate to the Java keystore that your application uses.
- Make sure certificates are imported into the correct truststore, such as if you have multiple instances of JRE or JDK.
- Make sure the correct truststore is in use. If `-Djavax.net.ssl.trustStore` is configured, it overrides the location of the default truststore.
- If connecting to a mail server, such as Exchange, ensure that authentication allows plain text.

- Verify that the target server is configured to serve SSL correctly. This can be done with the SSL Server Test tool.
- Check if your anti virus tool has "SSL Scanning" that blocks SSL and TLS. Disable this feature or set exceptions for the target addresses.

## SiteMinder Integration

The Management Console supports pre-authentication using SiteMinder SSO. With SiteMinder the identity of the user is established before accessing the Management Console, and the user's identity is communicated through a HTTP header. The identity of the user must be in the form of an LDAP distinguished name, for the Management Console to resolve the user's LDAP group memberships.

SiteMinder integration is disabled by default. You can enable it by setting the `useSiteMinder` property to `true` in the `login.xml` file as follows:

```
<bean class="com.kapowtech.scheduler.server.spring.security.AuthenticationConfiguration"
id="authenticationConfiguration">
  <property name="useLdap" value="false"/>
  <property name="useSiteMinder" value="true"/>
</bean>

<bean class="com.kapowtech.mc.config.SiteMinderConfiguration" id="siteMinderConfiguration">
  <property name="headerName" value="sm_userdn"/>
  <property name="accountAttribute" value="sAMAccountName"/>
  <property name="accountAttributePattern" value="(.*)/>
</bean>
```

After you enable the SiteMinder integration, specify the name of the HTTP header which contains the user's distinguished name. The `accountAttribute` property identify which of the user's LDAP attributes is used as an account name (The default uses the `sAMAccountName`, which is the user's Windows login name). The `accountAttributePattern` property specifies how the account name is parsed from the attribute value. `accountAttributePattern` must be a regular expression (with a single group of parentheses identifying the account name), the `(.*)` value in the `accountAttributePattern` property means everything in the attribute. If you wanted to extract the account name form the users email address the configuration, you can specify the following:

```
<bean class="com.kapowtech.mc.config.SiteMinderConfiguration" id="siteMinderConfiguration">
  <property name="headerName" value="sm_userdn"/>
  <property name="accountAttribute" value="userPrincipalName"/>
  <property name="accountAttributePattern" value="([^\@]*)@.*"/>
</bean>
```

`([^\@]*)@.*` will match an email address and extract everything before `@` as the account name.

Since SiteMinder uses part of the LDAP login configuration, you need to add a user group to the `adminGroups` bean, before you can start configuring the Management Console.

It is not possible to logout of the system, since the presence of the SiteMinder header means that you are always authenticated. To logout, close your browser.

### Limitations

SiteMinder integration only works when the Management Console is accessed through the browser. However if Management Console is accessed by applications which are not browsers, you need to bypass the SiteMinder authentication mechanism for some URLs. These clients include the following:

## Design Studio

Robot developers need to access Management Console to obtain a developer seat license, to upload robots, and get database configurations and other settings stored in Management Console. This requires access to the following URLs (relative to the context path where Management Console is deployed).

- /License/\*
- /secure/Repository/\*
- /IDESettings/\*

Access to above URLs is protected by basic authentication.

## REST services

REST service is protected by basic authentication by default, but robots can be exposed without authentication as REST services. Such services are typically invoked by external applications. REST uses /rest/\* URL.

### Example: Complete login.xml file

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<beans xmlns="http://www.springframework.org/schema/beans" xmlns:xsi="http://www.w3.org/2001/
XMLSchema-instance" xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans-3.0.xsd">
  <!-- This file is only used when deployed in standalone mode -->
  <!-- version of the file, used when upgrading from previous versions -->
  <bean class="com.kapowtech.scheduler.server.license.StringBasedVersion" id="loginVersion">
    <property name="fullVersion" value="9.3.0"/>
  </bean>

  <!-- Default is internal User management. To enable LDAP change useLdap property to true -->
  <bean class="com.kapowtech.scheduler.server.spring.security.AuthenticationConfiguration"
id="authenticationConfiguration">
    <property name="useLdap" value="false"/>
    <property name="useSiteMinder" value="false"/>
  </bean>

  <!-- SiteMinder pre authentication integration -->
  <bean class="com.kapowtech.mc.config.SiteMinderConfiguration" id="siteMinderConfiguration">
    <property name="headerName" value="sm_userdn"/>
    <!-- the LDAP attribute that holds the account name, and a pattern to extract the name
for the attribute value. Defaults work with Windows AD -->
    <property name="accountAttribute" value="sAMAccountName"/>
    <property name="accountAttributePattern" value="(.*?)"/>
  </bean>

  <!-- users for demo ldap
test/Kapow4Ever, engineering , CN=Test
Testesen,OU=Users,OU=TheEnterprise,DC=kapowdemo,DC=local
lisa/Kapow4Ever, Finance, CN=Lisa
Fromfinance,OU=Users,OU=TheEnterprise,DC=kapowdemo,DC=local
jim/Kapow4Ever, Marketing CN=Jim
Frommarketing,OU=Users,OU=TheEnterprise,DC=kapowdemo,DC=local
-->
  <bean class="com.kapowtech.mc.config.LdapLogin" id="ldap" lazy-init="true">
    <property name="adminGroups">
      <list>
        <value>ADMINISTRATOR</value>
        <value>ENGINEERING</value>
      </list>
    </property>
    <property name="ldapServerURL" value="ldap://ldap.kapowdemo.com:389"/>
    <property name="userDn" value="CN=LDAP test,CN=Users,DC=kapowdemo,DC=local"/>
    <property name="password" value="1U3akahy"/>
    <property name="userSearchBase" value="OU=Users,OU=TheEnterprise,DC=kapowdemo,DC=local"/>
  </bean>
</beans>
```

```

    <property name="userSearchFilter" value="(userPrincipalName={0}@kapowdemo.local)"/>
    <property name="userSearchSubtree" value="true"/>
    <property name="groupSearchBase" value="OU=Security
Groups,OU=TheEnterprise,DC=kapowdemo,DC=local"/>
    <property name="groupSearchFilter" value="(member={0})"/>
    <property name="groupRoleAttribute" value="cn"/>
    <property name="groupSearchSubtree" value="true"/>
    <property name="allGroupsFilter" value="(cn=*)"/>
    <property name="fullNameAttribute" value="displayName"/>
    <property name="emailAttribute" value="userPrincipalName"/>
  </bean>
</beans>

```

## Configure JMS Mode

To enable JMS mode in Kapow, perform the following steps.

**Note** Running JMS is not supported when running in [High Availability](#) mode nor when running the Management Console in embedded mode.

1. Install a broker, such as Apache ActiveMQ (see <http://activemq.apache.org> for more information). Once the broker is installed, set JAVA\_HOME to use the latest JDK and run `activemq.bat`. Instead of manually setting JAVA\_HOME and starting `activemq.bat`, you can create the bat file in `...\apache-activemq-5.13.3\bin` and run it. The content of the `.bat` file can be as follows.

```

set JAVA_HOME=C:\Program Files\Java\jdk1.8.0_25\
activemq.bat start

```

**Important** If you want to configure access for Kapow clients using the ActiveMQ broker, set up the users as described in the ActiveMQ documentation and ensure that the user has administrator rights to create and use all destinations prefixed with name space used by the clients (the default name space is "Kapow"). Also, the user must have administrator rights to use temporary destinations. The user and password must be configured in the Management Console `configuration.xml` file and either on the RoboServer command line or using the [RoboServer Settings](#) application on the General tab.

The ActiveMQ broker persists all Kapow messages. Ensure that the broker has sufficient resources to store the messages.

2. Install Management Console on Tomcat (see [Tomcat Management Console](#)). Edit `...\webapps\ManagementConsole\WEB-INF>Configuration.xml` and set `<property name="jmsEnabled" value="true"/>`.
3. Change the following lines
  - In `<CATALINA_HOME>/webapps/ManagementConsole/WEB-INF`

```

<property name="brokerUri" value="failover://(tcp://localhost:61616)?
startupMaxReconnectAttempts=3"/>

```
  - In the Roboserver connection line

```

-brokerUrl failover://(tcp://localhost:61616)?startupMaxReconnectAttempts=3

```

See [RoboServer Options in JMS Mode](#) for information on the available parameters.

4. Configure the RoboServers to use JMS services instead of sockets services, such as change "-service socket:50000" to "-service jms:1". For each RoboServer, configure the broker URL using the "-brokerUrl" option and specify the cluster it belongs to. RoboServer configuration can either be done on the command line or using the [RoboServer Settings](#) application.

Start RoboServer. For example, `RoboServer.exe -mcUrl http://admin:admin@localhost:8080/ManagementConsole -cluster Production -service jms:1 -brokerUrl failover://(tcp://localhost:61616)?startupMaxReconnectAttempts=3`

**Note** Starting from Kapow version 10, all RoboServer must auto register to the Management Console. Therefore, the URL and credentials for the Management Console along with the cluster name must be specified when starting the RoboServer (either at the command line as in the previous example or using the [RoboServer Settings](#) application).

5. Start the Management Console and remove any socket-based RoboServers from the cluster configurations on the **Admin > RoboServers** tab.  
Running JMS and socket mode robots at the same time is not supported. In the JMS configuration, all RoboServers, the Management Console and other clients must run in JMS mode.

## Use MySQL in ActiveMQ

By default ActiveMQ uses KahaDB. It is necessary to change settings to use any enterprise-class database. In this topic we use MySQL as an example.

1. Locate the `conf\activemq.xml` file in your ActiveMQ installation folder.
  - Add a MySQL datasource bean.

**Note** Depending on the version of ActiveMQ, the datasource bean can either be in the `dbcp` or `dbcp2` package.

- Comment out the persistence adapter for KahaDB.
  - Add a persistence adapter for MySQL.
2. Add MySQL database driver (`mysql-connector-java-5.1.34-bin.jar`) to the `lib` subdirectory of the ActiveMQ installation directory.
  3. Create an ActiveMQ schema in your MySQL database.

Beans code example.

```
<beans ...>
...
</bean>

<!-- MySql DataSource Sample Setup -->
<bean id="mysql-ds" class="org.apache.commons.dbcp2.BasicDataSource" destroy-method="close">
  <property name="driverClassName" value="com.mysql.jdbc.Driver"/>
  <property name="url" value="jdbc:mysql://localhost:3306/activemq"/>
  <property name="username" value="root"/>
  <property name="password" value="root"/>
  <property name="maxActive" value="200"/>
  <property name="poolPreparedStatements" value="true"/>
</bean>

<broker ...>
...
<!-- Comment out the default storage adapter
```

```

    <persistenceAdapter>
      <kahaDB directory="{activemq.data}/kahadb" />
    </persistenceAdapter>
  -->

  <persistenceAdapter>
    <jdbcPersistenceAdapter dataSource="#mysql-ds" />
  </persistenceAdapter>

  ...
</broker>
  ...
</beans>

```

### MySQL datasource code example.

```

<!-- MySql DataSource Sample Setup -->
<bean id="mysql-ds" class="org.apache.commons.dbcp.BasicDataSource" destroy-method="close">
  <property name="driverClassName" value="com.mysql.jdbc.Driver"/>
  <property name="url" value="jdbc:mysql://localhost:3306/activemq"/>
  <property name="username" value="root"/>
  <property name="password" value="root"/>
  <property name="maxActive" value="200"/>
  <property name="poolPreparedStatements" value="true"/>
</bean>

```

## Multi-Broker Setup

You can set up several brokers in JMS mode to increase stability and enable failover.

**Note** JMS mode is not supported in [high availability](#) mode.

Perform the following steps to configure multi-broker usage. In this example we use MySQL as a database.

1. Install ActiveMQ on two computers. In this example they are host1 and host2.
2. Add the following files to the `lib` subdirectory of each ActiveMQ installation directory.
  - `commons-dbc-1.4.jar` (see <https://commons.apache.org/proper/commons-dbc/> for details)
  - `commons-pool-1.6.jar` (see <https://commons.apache.org/proper/commons-pool/> for details)
3. Change `activemq.xml` file on each ActiveMQ computer to use MySQL database as described in [Use MySQL in ActiveMQ](#).

4. Change the `brokerUri` property in `<CATALINA_HOME>/webapps/ManagementConsole/WEB-INF/Configuration.xml` to use both ActiveMQ hosts as follows.

```

<property name="brokerUri" value="failover://(tcp://host1:61616,tcp://
host2:61616)?startupMaxReconnectAttempts=3"/>

```

5. Start both ActiveMQ hosts before starting RoboServers.
6. Specify both ActiveMQ hosts in the RoboServer connection string as follows.

```

-brokerUrl failover://(tcp://host1:61616,tcp://host2:61616)?
startupMaxReconnectAttempts=3

```

## High Availability

If high availability (failover) is required you can configure multiple Management Console instances to work together as a cluster. The following components must be clustered to achieve full failover.



## Cluster Components

Component	Description
Load balancer	An HTTP load balancer is required to distribute requests between multiple Tomcat servers.
Clustered platform database	The Management Console stores schedules, robots etc. in the platform database. In a failover scenario the platform database should run on a clustered DBMS to avoid a single point of failure.
Tomcat session replication	Although the Management Console doesn't store any data directly in the user's session (except during Import/Export), the session holds the user's authentication information. If session replication is not enabled, the user will have to login again if the Tomcat he is currently connected to crashes.
Apache Tomcat Connector	mod_jk is an Apache module used to connect the Tomcat servlet container with web servers such as Apache, iPlanet, Sun ONE (formerly Netscape) and even IIS using the Apache JServ Protocol.
Hazelcast	Hazelcast ( <a href="http://www.hazelcast.com">www.hazelcast.com</a> ) is used to cluster data structures over multiple JVMs. Inside the Management Console this is used to provide clustering of vital data structures, and to provide intercommunication between application instances. Here is a example: When you run a robot on RoboServer, a thread is required to process the status messages returned by RoboServer. This thread will be running inside a concrete Tomcat instance. In a clustered environment, a user trying to stop the robot may in fact be generating the stop request on another Tomcat instance than the instance running the robot. In that case the stop request is broadcast through Hazelcast to all instances and the instance running the robot will receive it and act to stop the robot.

## Multiple Management Console Instances

You should have two or more identical Tomcat installations, and deploy the same version of ManagementConsole.war on them all. Make sure the web.xml, Configuration.xml, login.xml, and roles.xml files are the same across all the instances.

## Install and Configure Components

This topic describes how to install and configure necessary components for high availability configuration using multicast clustering. In this configuration we will set up two host computers: one host (host1) contains Tomcat server and a database, another host (host2) contains Tomcat server and Apache server as a load balancer.

### Step-by-Step Procedure

The following procedure helps you to install components for high availability configuration.

1. Set up a database on "host1" computer.
2. Download Tomcat from the Apache web site: <https://tomcat.apache.org/download-70.cgi>, install Tomcat on both hosts, and set user password. See [Tomcat Deployment](#) for more information.
3. [Install Management Console](#) on Tomcat on both hosts.

4. Start Tomcat application on both computers and make sure they go online. You should have two identical Tomcat installations, and deploy the same version of ManagementConsole.war on them all. Make sure the web.xml, Configuration.xml, login.xml, and roles.xml files are the same on both installations.
5. Shut down Tomcat servers.
6. Download Apache server from the Apache web site: <http://httpd.apache.org/download.cgi#apache24>. Install the Apache server on "host2" and start the Apache service. See Apache doc for details: <http://httpd.apache.org/docs/>
7. Download Apache mod\_jk connector from the Apache web site: <https://tomcat.apache.org/download-connectors.cgi>.

- Unzip the files to a directory on your disk.
- Copy mod\_jk.so file to the <host2>\module directory.
- Edit <host2>\conf\httpd.conf as follows:

```
LoadModule jk_module modules/mod_jk.so
<IfModule mod_jk.c>
  JkWorkersFile " <apache>\conf\workers.properties"
  JkLogFile " <apache>\logs\mod_jk.log"
  JkLogLevel error
  JkLogStampFormat "[%a %b @d %H:%M:%S %Y] "
  JkRequestLogFormat "%w %V %T"
</IfModule>
JkMount /ManagementConsole/* loadbalancer
JkMount /ManagementConsole loadbalancer
```

- Create a <host2>\conf\workers.conf file with the following content:

```
worker.list=host1, host2, loadbalancer

worker.host1.host=<ip address>
worker.host1.port=8009
worker.host1.type=ajp13
worker.host1.lbfactor=1
worker.host2.host=<ip address>
worker.host2.port=8009
worker.host2.type=ajp13
worker.host2.lbfactor=1
worker.loadbalancer.type=lb
worker.loadbalancer.balance_workers=host1, host2
```

Where <ip address> is the address of the host computers running Tomcat.

8. For both Tomcat servers enter the following lines to the conf\server.xml file.

```
<Engine name="Catalina" defaultHost="localhost" jvmRoute="jvml">
<Cluster className="org.apache.catalina.ha.tcp.SimpleTcpCluster"/>
```

For more information, see [Tomcat Session Replication](#).

9. On each Tomcat server, edit webapps\ManagementConsole\WEB-INF\Configuration.xml file as follows. Note that you must specify valid IP addresses of the host computers on your network.

```
<!-- Cluster configuration -->
<bean id="cluster" class="com.kapowtech.mc.config.ClusterConfig" >
  <property name="port" value="5701"/>
  <property name="interface" value="10.10.*.*"/>
<!-- Uncomment the line below to enable clustering via multicast. Your license must support
High Availability for this to work -->
  <property name="joinConfig" ref="multicastCluster"/>
<!-- or uncomment this line to enable clustering via TCP-IP. Your license must support High
Availability for this to work-->
  <!--property name="joinConfig" ref="tcpCluster"/-->
</bean>
<!-- definition for a TCP cluster. You need to add peers to this list, so each
client can locate at least one other functioning cluster member -->
```

```

<bean id="tcpCluster" class="com.kapowtech.mc.config.TcpJoinConfig" lazy-init="true">
<property name="peers">
<list>
<bean class="com.kapowtech.mc.config.TcpPeer">
<property name="host" value="10.10.0.47"/>
<!-- port is only needed if the other machine is not using the same port as this instance--
>
<!--property name="port" value="5701"/-->
</bean>
<bean class="com.kapowtech.mc.config.TcpPeer">
<property name="host" value="10.10.0.57"/>
<!-- port is only needed if the other machine is not using the same port as this instance--
>
<!--property name="port" value="5701"/-->
</bean>
</list>
</property>
</bean>

```

For more information, see [Hazelcast Replication](#).

Now you can log in to the Management Console on the load balancer by navigating to `<host2>:80/ManagementConsole`, where "host2" is the name of the computer running Apache server. Once you log in, go to **Admin > Projects** tab. Under Application Nodes you should see two nodes with correct IP addresses.

## Load Balancer Startup

This section describes how to determine if the application started correctly.

If the `ManagementConsole.xml` (context configuration) or `web.xml` files are invalid, the application cannot be deployed on Tomcat, and requests normally return 404 (since you will hit the Tomcat's ROOT application which does not have anything deployed on `/ManagementConsole/`).

Any other errors encountered during application startup are shown to the user when the application loads. This way you do not always have to check the log to figure out why the application did not load correctly. This is, however, a bit impractical as the application returns 200 OK even if there are errors during startup. Also, if authentication is enabled, you have to login before you can see the error messages.

To make it easier for load balancers to see if the application started correctly, you can make a request to the URL `/ManagementConsole/Ping`. This either returns HTTP status code 200 if the application loaded correctly, or 500 with a stack trace of the error.

## Tomcat Session Replication

Session replication is configured in `/conf/server.xml`. Here is an example that uses multicast for instance discovery (Tomcat 5.5).

```

<Cluster className="org.apache.catalina.cluster.tcp.SimpleTcpCluster"
managerClassName="org.apache.catalina.cluster.session.DeltaManager"
expireSessionsOnShutdown="false"
useDirtyFlag="true"
notifyListenersOnReplication="true"
printToScreen="true">

<Membership
className="org.apache.catalina.cluster.mcast.McastService"
mcastAddr="228.0.0.4"
mcastPort="45564"

```

```

        mcastFrequency="500"
        mcastDropTime="3000" />

    <Receiver
        className="org.apache.catalina.cluster.tcp.ReplicationListener"
        tcpListenAddress="auto"
        tcpListenPort="4002"
        tcpSelectorTimeout="100"
        tcpThreadCount="6" />

    <Sender
        className="org.apache.catalina.cluster.tcp.ReplicationTransmitter"
        replicationMode="pooled"
        ackTimeout="150000"
        waitForAck="true" />

    <Valve className="org.apache.catalina.cluster.tcp.ReplicationValve"
        filter=".*\.gif;.*\..js;.*\..jpg;.*\..png;.*\..htm;.*\..html;.*\..css;.*\..txt;"/>

    <Deployer className="org.apache.catalina.cluster.deploy.FarmWarDeployer"
        tempDir="/tmp/war-temp/"
        deployDir="/tmp/war-deploy/"
        watchDir="/tmp/war-listen/"
        watchEnabled="false" />

    <ClusterListener className="org.apache.catalina.cluster.session.ClusterSessionListener" /
>
</Cluster>

```

You also have to set the `jvmRoute` attribute on the `<Engine>` element in `server.xml`:

```
<Engine jvmRoute="tomcat2" name="Catalina" defaultHost="MyHost" >
```

**Note** If you are using `mod_jk` as a poor man's load balancer, the value of the `jvmRoute` has to match the name listed in the `workers.properties` file references by the `mod_jk` configuration.

See your Tomcat documentation for details.

## Hazelcast Replication

The most basic Hazelcast settings can be edited in `Configuration.xml`, while more advanced settings such as SSL encryption must be configured in `/WEB-INF/Hazelcast.xml`

When Management Console starts, it creates a Hazelcast node on port 5701 (or the next available port that is available). By default this Hazelcast node will bind to IP address 127.0.0.1. You will have to change the bind address to a public IP/host name before it can participate in a cluster. This is done by modifying the interface property of the cluster bean in `Configuration.xml`. It might look like this:

```

<bean id="cluster" class="com.kapowtech.mc.config.ClusterConfig" >
    <property name="port" value="26000" />
    <property name="interface" value="10.0.0.*" />
    .....
</bean>

```

The `*` is used as a wildcard, in this case the application will try bind to the 'first' interface that has an IP address starting with 10.0.0. It is possible, but not recommended to use `*.*.*` as you may end up binding to 127.0.0.1, or another virtual interface.

When you start additional instances of Management Console, their Hazelcast instances will try to find any existing Hazelcast node and join the cluster. This discovery can be done through multicast or through TCP/IP.

To use multicast discovery you must modify the cluster bean in Configuration.xml. This is done by un-commenting the following line:

```
<property name="joinConfig" ref="multicastCluster"/>
```

multicastCluster is a reference to the multicastCluster bean, which defines the multicast group and port. You may change it to fit your network topology.

If your network doesn't allow multicast you will have to use the tcpCluster. That is done by un-commenting this line instead:

```
<property name="joinConfig" ref="tcpCluster"/>
```


The tcpCluster bean contains a list of TcpPeer, one for each other Hazelcast node. If you use the same TCP port for all Hazelcast nodes you don't need to specify a port number (each node will assume that its peers are running on the same port as itself). If you have two nodes configured in a TCP cluster it could look like this:

```
<bean id="tcpCluster" class="com.kapowtech.mc.config.TcpJoinConfig">
  <property name="peers">
    <list>
      <bean class="com.kapowtech.mc.config.TcpPeer">
        <property name="host" value="10.0.0.25"/>
      </bean>
      <bean class="com.kapowtech.mc.config.TcpPeer">
        <property name="host" value="10.0.0.26"/>
      </bean>
    </list>
  </property>
</bean>
```

Notice that both nodes are in the list. This means that regardless which node starts first it will be able to find its peer. It also allows you to use identical Configuration.xml files in both applications. Also, TCP ports numbers are not defined, so each peer will try to connect to the other one on the same port as it is listening on itself.

## Application Nodes

You can verify that the application is properly clustered by going to the Projects tab, and look at the Application Nodes section in the bottom of the page. Here you should see something like this:

Application Nodes <span style="float: right;">?</span>			
 Refresh			
Node Id	Interface	Status	Connected to
Node-1	/127.0.0.1:5702	Running	false
Node-2	/127.0.0.1:5703	Running	true

This means that the cluster currently consists of two nodes. The interface column will list the IP/host and port that Hazelcast is using for inter-cluster communication. The Connected to column informs you

which of the two nodes you are connected to at the moment. If you shut down the server you are currently connected to, you will automatically be re-routed to another live instance by the load balancer.

If you right click on an application node a context menu will appear, here you can request a thread dump from any node, this may be useful for debugging purposes.

## URI Encoding

If you plan to upload robots with names that contain non-ASCII characters, like Danish ÆØÅ or German ß to the repository, you have to configure the URI Encoding on your web container to UTF-8.

On Tomcat this is done on the <connector> definition found in server.xml file inside the /conf folder. Here you add the attribute URIEncoding="UTF-8" like this:

```
<Connector port="8080" URIEncoding="UTF-8" . . . . . />
```

## Password Encryption

As of version 8.2 the Management Console uses certificate based (public-, private-key) encryption when storing passwords. When you import from a previous version password will automatically be re-encrypted using the new certificate based algorithm.

The certificate and the matching private key is stored in a Java keystore, Management Console ships with a keystore that contains a default certificate and private key. Since all customers get the same keystore we recommend that you create your own keystore, otherwise anyone will be able to load your exports and potentially get your passwords.

### Create Your Own Keystore

If you have already started the Management Console you will need to upgrade the certificate. The keystore must be in pkcs12 format, and can be created using the keytool application that comes with the Java SDK (which can be downloaded from Oracle.com, currently available here). The following command creates a new pkcs12 keystore with a certificate that is valid for 365 days.

```
keytool -genkey -alias mc -keyalg RSA -validity 3650 -keystore mc.p12 -storetype pkcs12
```

You will be prompted for password, and the information that will be stored in the X.509 private key. The command will create a file mc.p12 (the value from the -keystore argument) in the current directory. - validity 3650 means the certificate will be valid for 10 years.

**Note** We don't recommend that you use a certificate issued by a certificate authority (CA) since pkcs12 holds both the private key and the public certificate, and the password to the private key will be written in clear text as part of the application configuration.

To instruct Management Console to use the new certificate, change the Configuration.xml file. The file is located inside the ManagementConsole.war web archive, which must be unpacked, see Deploying into Tomcat for details. Inside Configuration.xml you will find the following entry:

```
<bean id="keyStore" class="com.kapowtech.mc.config.KeyStoreConfig" >
```

```

    <property name="location" value="/WEB-INF/mc.p12"/>
    <property name="password" value="changeit"/>
    <property name="alias" value="mc"/>
  </bean>

```

Here you must specify the location, password and alias of the keystore. If you copy the keystore into ManagementConsole.war the location must be relative to the root of the application. If you want to refer to a keystore stored in the file system, the location must start with file://, and must be an absolute reference to the keystore location.

## Upgrading the Keystore

The first time Management Console starts, it creates a checksum using the private key from the keystore, this allows it to detect when the keystore has been replaced, and verify that passwords can in fact be decrypted with the provided certificate. If you have already started Management Console before installing your own keystore, you will have to configure Management Console to perform a password conversion.

First copy the current keystore file into a new location, like your users home folder, then modify Configuration.xml to create a password converter with reference to the old keystore:

```

    <bean id="oldKeyStore" class="com.kapowtech.mc.config.KeyStoreConfig" >
      <property name="location" value="file:///home/roboserver/mc.p12"/>
      <property name="password" value="changeit"/>
      <property name="alias" value="mc"/>
    </bean>

    <bean id="passwordConverter"
    class="com.kapowtech.scheduler.server.service.PasswordConverter">
      <constructor-arg ref="oldKeyStore"/>
    </bean>

```

This configures a password converter to use the previous certificate to decrypt any existing passwords and checksum (you will have to provide correct location, alias and password for the old keystore), and use the new private key (as configured above) to re-encrypt passwords and create a new checksum. The conversion will occur the next time the Management Console is started, the conversion occurs while the application is starting and may take some time if there are many schedules. You don't have to remove the oldKeyStore and passwordConverter beans from Configuration.xml, as the password conversion is only triggered when the checksum and keystore is out-of-sync, and after the conversion the checksum will match the new keystore).

## SSL Endpoint Verification

When you create a new Cluster you can select that you want the communication with the RoboServers to be SSL encrypted, this prevents anyone from "listening" to the network and extracting critical information exchanged between the two parties.

In addition to encryption, SSL also offer endpoint validation. This is to ensure that you don't exchange critical information with a third party, either due to misconfiguration, or because your DNS has been hacked. For this to work you need to configure RoboServer to trust your Management Console and configure Management Console to trust your RoboServers.

This requires you to edit files inside ManagementConsole.war, so make sure your Tomcat server is not running when you perform this modification.

## Certificates

You will need to create two certificates, one for Management Console and one for RoboServer, each certificate contains a private and a public key. Creating a certificate and exporting the public key is described here, in general it is a good idea to read the entire section of the help the discusses certificates, especially the section on API Client/Server certificates.

Endpoint verification can be separated into two parts, making RoboServer trust Management Console and making Management Console trust RoboServer, each of these are configured individually, and you don't have to configure both.

## Make RoboServer Trust Management Console

You now have to tell Management Console to use the private key when creating the SSL connection to RoboServer. This is done by modifying `/WEB-INF/certs.xml` found inside the WAR file. Here you will need to provide the location, and the password for the certificate, which could look like this:

```
<bean id="sslCertificationConfiguration"
  class="com.kapowtech.mc.config.SSLVerificationConfiguration">
  ...
  <property name="privateCertificateLocation" value="file:///home/roboserver/client.p12"/>
  <property name="privateCertPassword" value="changeit"/>
</bean>
```

Management Console is now using its private key when establishing SSL connections, once Management Console's public key is deployed in RoboServer's `/TrustedClients` folder it will allow the RoboServer to verify that it is connected to the right Management Console. You can read about the `/TrustedClients` here. Remember to enable `Verify API Client Certificates` in RoboServer Settings, and deploy the public key on all RoboServers in the cluster.

## Make Management Console Trust RoboServer

RoboServer already comes with a API certificate installed, so you have to create a new certificate and replace the pre-configured. First create the certificate as described above, then start RoboServer Settings and go to the Certificates tab, and click the change button, select the certificate, and enter the password when prompted. RoboServer will now use the new certificate when creating SSL connection with Management Console (and other API clients).

Now you need to configure Management Console to only trust SSL connections from RoboServers with the correct certificate. Like Management Console's client certificate this is (partly) configured in `/WEB-INF/certs.xml`, using the following two options:

```
<bean id="sslCertificationConfiguration"
  class="com.kapowtech.mc.config.SSLVerificationConfiguration">
  <property name="verifyRoboServerCert" value="true"/>
  <property name="checkHostName" value="true"/>
  ...
</bean>
```

The option for verifying RoboServer certificates is a simple boolean flag (`true/false`), this is because you have to import the RoboServers public key into the JRE's default keystore. The JRE's default keystore is a file named `cacerts` located at `/jre/lib/security/`.

To import RoboServer's public key into `cacerts`, you use the following command:



```
keytool -import -alias RoboServer -keystore cacerts -trustcacerts -file server.pub.cer
```

You will be prompted for a password, which is changeit unless you have changed it. The alias will have to be unique, so if you created a separate certificate for each RoboServer, you will have to add a suffix. Also note that the references to cacerts and server.pub.cer are relative in this example.

The checkHostName option ensures that Management Console will only talk to the RoboServer if it presents the correct certificate AND is contacted using the hostname written inside the RoboServer's certificate. Note that localhost and 127.0.0.1 is not considered the same host when it comes to hostname checks.

## Troubleshooting

Troubleshooting can be quite hard as there is virtually no information available if SSL connections can't be established, but it is important to know that:

- Management Console will not start if it can't find the certificate, or if the password is wrong.
- When you change RoboServer's certificate in RoboServer settings, it checks that the password is correct before storing the certificate.

If Management Console can't connect to a RoboServer the following may help you troubleshoot:

- Is RoboServer running. Try to telnet to the socket to be sure.
- Is the RoboServer host name correct (if checkHostName is enabled).
- Is the v public key imported into cacerts. Use `keytool -list -v -keystore cacerts -alias RoboServer` if you give -alias it lists all certificates.
- Has Management Console's public certificate been copied to RoboServers /TrustedClients folder.
- Check expiration date. The public key contains the expiration data of the private key, and can be opened/view in both Windows and Linux.

## Chapter 4

# Audit Log for Management Console

Audit log for Management Console logs all users' operations in the Management Console including API calls. By configuring the `log4j.properties` file, you can log the information to a file or a database. The following are examples for different configurations. On a Windows system, the `log4j.properties` file is located at: `User home\AppData\Local\Kapow\version\Configuration`.

**Note** All variables that are in ***bold and italic*** need to be changed.

### Logging to a File

```
#Log4j log to file configuration example
log4j.appender.auditLog=org.apache.log4j.FileAppender

#Configure the file path and maximum file size before rollover
log4j.appender.auditLog.File=logFilePath/logFileName.log
log4j.appender.auditLog.MaxFileSize=100KB

log4j.appender.auditLog.layout=org.apache.log4j.PatternLayout
log4j.appender.auditLog.layout.ConversionPattern=%d - %m%n

log4j.category.auditLog=DEBUG, auditLog
log4j.additivity.auditLog=false
```

### Logging to Database

**Note** The instructions below use MySQL database as an example but other supported databases can be used for logging by using their specific jdbc drivers and url connections.

To enable audit logging to MySQL database of the Management Console running with the embedded roboserver, perform the following steps:

1. Copy MySQL connector jar file to the `lib` subfolder of the Kapow installation folder (where the `kapowtech-common.jar` and `platform.jar` are located), for example, `mysql-connector-java-5.1.26-bin.jar`.
2. Create a database table where you want to log the data to. The following is a MySQL script for creating tables:

```
CREATE TABLE LOGS
(
  DATED    timestamp      NOT NULL,
  LEVEL    VARCHAR(10)    NOT NULL,
  MESSAGE  VARCHAR(1000)  NOT NULL
);
```

**Important** To prevent loss of information, make sure the message column has a minimum varchar size of 600.

3. Add the following lines to the `log4j.properties` file:

```
#Log4j log to MySQL database configuration example
log4j.appender.auditLog=org.apache.log4j.jdbc.JDBCAppender
```

```

log4j.appender.auditLog.URL=jdbc:mysql://localhost/YourDatabaseSchemaName

# Set Database Driver
log4j.appender.auditLog.driver=com.mysql.jdbc.Driver

# Set database user name and password
log4j.appender.auditLog.user=UserName
log4j.appender.auditLog.password=Password

# Set the SQL statement to be executed
log4j.appender.auditLog.sql=INSERT INTO LOGS VALUES ('%d{yyyy-MM-dd HH:mm:ss}','%p','%m')

# Define the xml layout for file appender
log4j.appender.auditLog.layout=org.apache.log4j.PatternLayout

log4j.category.auditLog=DEBUG, auditLog
log4j.additivity.auditLog=false

```

**Note** Define the database schema name, user name, password and the table name that you created in the database.

To enable audit logging to MySQL database of the Management Console running with the Tomcat, perform the following steps:

1. Copy MySQL connector jar file to the `lib` directory under apache tomcat, for example, `mysql-connector-java-5.1.26-bin.jar`.
2. Steps 2 and 3 are the same as for the Management Console running with the embedded roboserver. The `log4j.properties` file is located under `tomcat directory\webapps\Management Console\WEB-INF\classes`.

## Audit Log Reference

This section provides a list of operations that are logged when they are executed successfully or fail due to access restrictions. Log file examples are also provided for your reference.

### Login Events

RoboServers are using credentials to register to the Management Console, therefore all user logins are logged. When a RoboServer starts, a login event appears in the audit log from the user that was given access to the RoboServer.

### Logged Operations

The logged operations are grouped by tabs in the Management Console.

#### Robots tab

- Upload robot
- Delete robot
- Move robot (Set Folder)
- Run robot
- Generate API code for robot
- Run robot via REST
- Run robot via SOAP

- Download robot

**Types tab**

- Upload type
- Delete type
- Move type (Set Folder)
- Create table for type (Generate and execute SQL)

**Snippets tab**

- Upload snippet
- Delete snippet
- Move snippet (Set Folder)

**Resources tab**

- Upload resource
- Delete resource
- Move resource (Set Folder)

**Databases tab**

- Add new database mapping
- Delete database mapping
- Edit database mapping

**OAuth tab**

- Add new OAuth application
- Edit OAuth application
- Delete OAuth application
- Add OAuth user
- Verify OAuth user
- Edit OAuth user
- Delete OAuth user

**Schedules tab**

- Create schedule
- Activate schedule
- Deactivate schedule
- Run schedule
- Edit schedule
- Delete schedule
- Run schedule

**Kaplets tab**

- Create Kapplet
- Edit Kapplet
- Run Kapplet

- Delete Kapplet
- Create Kapplet schedule
- Update Kapplet flow
- Update Kapplet property
- Delete Kapplet property
- Delete Kapplet icon
- Upload file to Kapplet

#### **Dashboard tab**

View of dashboard windows (those that are shown)

#### **Data tab**

- View tables from the mapping tree
- View data for selected table
- Delete data from table
- Export data as Excel/XML/CSV for selected data rows
- View the exported file list
- Delete the file from exported file list

#### **Logs tab**

Delete logs

#### **Admin main tab**

The following tabs are located in the **Admin** main tab.

##### **Task View tab**

Stop task

##### **Clusters tab**

- Add roboserver
- Delete roboserver
- Add Cluster
- Rename Cluster
- Edit(e.g assign KCU) Cluster
- Delete Cluster
- Change Cluster Mode
- Delete Databases/Proxy Servers
- Update Databases/Proxy Servers
- Update Logging
- Update Profiling
- Update Robot Execution

##### **Projects tab**

- Create project
- Edit project

- Delete project

#### **Managing Users and Groups tab**

- Create user
- Edit user
- Delete user
- Reset password for user
- Create group
- Edit group
- Delete group

If the LDAP is enabled, the following is logged:

- Update LDAP user details (email, full name)
- Create new LDAP user

#### **Settings tab**

Update settings

#### **Backup tab**

- Create backup
- Restore backup
- Export project
- Import Project

#### **License tab**

License update

#### **API calls**

- Get Management Console version and DTD information
- Get project/cluster list
- Delete file
- Upload/download/update/move file
- Get robot signature
- Add/remove roboserver
- Rename robot

If you rename a robot in Design Studio, the system first logs the "delete" operation and then the "upload" operation due to the implementation. When you use API rename method directly, the system only logs the "rename" operation.

#### **Example: Log Examples**

Here are some examples of how the robot execution logs look like in different scenarios. MySQL is used as the logging database and the log message consists of timestamp, logging level and detail message.

**Robot run from REST call**

A robot that is started by REST call, first logs the robot name with id, execution id and task id; and then the user who started the robot with the project name and task id.

```
2015-11-27 16:42:26      INFO      Robot Wait60 with id = 17 execution id = -1-9-67f20877bebb
task id = 9 has requested to start
2015-11-27 16:42:26      INFO      admin run Robot f1/f2/f3/Wait60.robot from Project Default
project with task id = 9 from REST
```

**Robot run from SOAP call**

```
2015-11-27 16:34:24      INFO      Robot Wait60 with id = 17 execution id = -1-1-67f20877bebb
task id = 1 has requested to start
2015-11-27 16:34:24      INFO      admin run Robot f1/f2/f3/Wait60 from Project Default project
with task id = 1 from SOAP
```

**Robot run started from UI**

This robot was started from the Management Console: **Management Console > Repository Main tab > Robot tab > Run now**

```
2015-11-27 16:35:56      INFO      Robot Wait60 with id = 17 execution id = -1-2-67f20877bebb
task id = 2 has requested to start
2015-11-27 16:35:56      INFO      admin run Robot Wait60 with id = 17 task id = 2
```

**Kapplet triggered by time**

```
2015-12-01 09:05:42      INFO      Robot Wait60 with id = 17 execution id = -1-9-189caec518edd
task id = 9 has requested to start - from Kapplet
```

**Kapplet triggered by user**

The log messages can be referenced by Kapplet id and task id. The execution log messages with postfix "- from Kapplet, started by user" also indicates that this robot was triggered by a manual Kapplet run. For example, "MultipleTaskKapplet" schedule contains 3 robots: ExampleRobot1, ExampleRobot2, ExampleRobot3. When a user manually runs the Kapplet, the log messages should look like following:

```
2015-12-02 10:51:52      INFO      admin start Kapplet MultipleTaskKapplet with id =
b368f548-995c-4bc4-8c2a-5c48a0e60e6d
2015-12-02 10:51:52      INFO      Robot ExampleRobot1 with task id = 58 has been queued for
Kapplet MultipleTaskKapplet with id = b368f548-995c-4bc4-8c2a-5c48a0e60e6d
2015-12-02 10:51:52      INFO      Robot ExampleRobot2 with task id = 59 has been queued for
Kapplet MultipleTaskKapplet with id = b368f548-995c-4bc4-8c2a-5c48a0e60e6d
2015-12-02 10:51:52      INFO      Robot ExampleRobot3 with task id = 60 has been queued for
Kapplet MultipleTaskKapplet with id = b368f548-995c-4bc4-8c2a-5c48a0e60e6d
2015-12-02 10:51:52      INFO      Robot ExampleRobot1 with id = 1 execution id =
-1-58-1dc33f3a2a44b task id = 58 has requested to start - from Kapplet, started by user
2015-12-02 10:51:52      INFO      Robot ExampleRobot2 with id = 39 execution id =
-1-59-1dc33f3a2a44b task id = 59 has requested to start - from Kapplet, started by user
2015-12-02 10:51:52      INFO      Robot ExampleRobot3 with id = 20 execution id =
-1-60-1dc33f3a2a44b task id = 60 has requested to start - from Kapplet, started by user
```

**Schedule triggered by time**

No log.

**Schedule triggered by user**

Log messages can be referenced by schedule id and task id. The execution log messages with postfix "- from schedule, started by user" also indicates this robot was triggered by a manual schedule run. For example, "MultipleTaskSchedule" schedule contains 4 robot jobs: ExampleRobot1, ExampleRobot2,

ExampleRobot2, ExampleRobot3. When a user manually runs the schedule, the log messages should look like following:

```
2015-12-02 10:50:22      INFO      admin start Schedule MultipleTaskSchedule with id =
373284858997185
2015-12-02 10:50:22      INFO      Robot ExampleRobot1 with task id = 53 has been queued for
schedule MultipleTaskSchedule with id = 373284858997185
2015-12-02 10:50:22      INFO      Robot ExampleRobot2 with task id = 54 has been queued for
schedule MultipleTaskSchedule with id = 373284858997185
2015-12-02 10:50:22      INFO      Robot ExampleRobot2 with task id = 55 has been queued for
schedule MultipleTaskSchedule with id = 373284858997185
2015-12-02 10:50:22      INFO      Robot ExampleRobot3 with task id = 56 has been queued for
schedule MultipleTaskSchedule with id = 373284858997185
2015-12-02 10:50:22      INFO      Robot ExampleRobot1 with id = 1 execution id =
3816-53-1dc33f3a2a44b task id = 53 has requested to start - from schedule, started by user
2015-12-02 10:50:22      INFO      Robot ExampleRobot2 with id = 39 execution id =
3816-54-1dc33f3a2a44b task id = 54 has requested to start - from schedule, started by user
2015-12-02 10:50:23      INFO      Robot ExampleRobot2 with id = 39 execution id =
3816-55-1dc33f3a2a44b task id = 55 has requested to start - from schedule, started by user
2015-12-02 10:50:23      INFO      Robot ExampleRobot3 with id = 20 execution id =
3816-56-1dc33f3a2a44b task id = 56 has requested to start - from schedule, started by user
```



## Chapter 5

# SQL Scripts for Kapow Tables

The SQL scripts for creating and dropping tables in your database are located in the `documentation\sql` directory in your Kapow installation directory. For example, `C:\Program Files (x86)\Kapow 10.1.0.4 x32\documentation\sql` on the Windows system. The name of the script file includes the name of the database the script is intended for.

**Note** SQL scripts are installed together with Kapow documentation and when you install Design Studio.

### SQL Scripts for Database Tables

The `sql` directory contains four subdirectories with different scripts as follows:

- `altosoftsession`: Scripts for creating and dropping tables for single sign on with Altosoft
- `logdb`: Scripts for creating and dropping logdb tables
- `mc`: Scripts for creating and dropping Management Console tables
- `statistics`: Scripts for creating and dropping Statistics (KAFKA) tables

**Important** The IBM DB2 database must have a table space with a page size of at least 8192 KB to create all tables.

The Management Console uses a 3rd party scheduling component called Quartz. Quartz also requires a number of tables which must reside among the other platform tables. These tables are also created automatically when the Management Console starts, or may be created manually using the scripts.

The following is a Quartz verification script.

```
select count(*) from QRTZ_SIMPLE_TRIGGERS;
select count(*) from QRTZ_BLOB_TRIGGERS;
select count(*) from QRTZ_CRON_TRIGGERS;
select count(*) from QRTZ_TRIGGER_LISTENERS;
select count(*) from QRTZ_CALEDNARS;
select count(*) from QRTZ_FIRED_TRIGGERS;
select count(*) from QRTZ_LOCKS;
select count(*) from QRTZ_PAUSED_TRIGGER_GRPS;
select count(*) from QRTZ_SCHEDULER_STATE;
select count(*) from QRTZ_JOB_LISTENERS;
select count(*) from QRTZ_TRIGGERS;
select count(*) from QRTZ_JOB_DETAILS;
```