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Preface

This guide includes administration information for Kofax RPA including:

• Runtime
• Tomcat Management Console

Related Documentation

The documentation set for Kofax RPA is available here:¹

https://docshield.kofax.com/Portal/Products/RPA/10.6.0_p2wddr4n2j/RPA.htm

In addition to this guide, the documentation set includes the following items:

Kofax RPA Release Notes
Contains late-breaking details and other information that is not available in your other Kofax RPA documentation.

Kofax RPA Installation Guide
Contains instructions on installing Kofax RPA and its components in a development environment.

Help for Kofax RPA
Describes how to use Kofax RPA. The Help is also available in PDF format and known as Kofax RPA User’s Guide.

Kofax RPA Getting Started with Desktop Automation Guide
Provides a tutorial that walks you through the process of using Kofax RPA Desktop Automation to build a robot.

Kofax RPA Getting Started with Document Transformation Guide
Provides a tutorial that explains how to use Document Transformation functionality in a Kofax RPA environment, including OCR, extraction, field formatting, and validation.

Kofax RPA Desktop Automation Service Configuration Guide
Describes how to configure the Desktop Automation Service required to use Desktop Automation on a remote computer.

¹ You must be connected to the Internet to access the full documentation set online. For access without an Internet connection, see the Installation Guide.
**Kofax RPA Developer's Guide**
Contains information on the API that is used to execute robots on RoboServer.

**Kofax RPA Integration API documentation**
Contains information about the Kofax RPA Java API and the Kofax RPA .NET API, which provide programmatic access to the Kofax RPA product. The Java API documentation is available from both the online and offline Kofax RPA documentation, while the .NET API documentation is available only offline.

*Note* The Kofax RPA APIs include extensive references to RoboSuite, the original product name. The RoboSuite name is preserved in the APIs to ensure backward compatibility. In the context of the API documentation, the term RoboSuite has the same meaning as Kofax RPA.

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

### Getting help with Kofax products
The Kofax Knowledge Base repository contains articles that are updated on a regular basis to keep you informed about Kofax products. We encourage you to use the Knowledge Base to obtain answers to your product questions.

To access the Kofax Knowledge Base, go to the Kofax [website](http://www.kofax.com) and select **Support** on the home page.

*Note* The Kofax Knowledge Base is optimized for use with Google Chrome, Mozilla Firefox or Microsoft Edge.

The Kofax Knowledge Base provides:
- Powerful search capabilities to help you quickly locate the information you need.
  - Type your search terms or phrase into the **Search** box, and then click the search icon.
- Product information, configuration details and documentation, including release news.
  - Scroll through the Kofax Knowledge Base home page to locate a product family. Then click a product family name to view a list of related articles. Please note that some product families require a valid Kofax Portal login to view related articles.
- Access to the Kofax Customer Portal (for eligible customers).
  - Click the **Customer Support** link at the top of the page, and then click **Log in to the Customer Portal**.
- Access to the Kofax Partner Portal (for eligible partners).
  - Click the **Partner Support** link at the top of the page, and then click **Log in to the Partner Portal**.
- Access to Kofax support commitments, lifecycle policies, electronic fulfillment details, and self-service tools.
  - Scroll to the **General Support** section, click **Support Details**, and then select the appropriate tab.
Chapter 1

Introduction

This guide is intended for system administrators who deploy Kofax RPA 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 the 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

For details on how to restore a backup, see "Back Up Management Console" in the Kofax RPA online Help. Note that starting from Kofax RPA version 10.3, any admin user can restore a backup created by any other admin user.
Chapter 2

Runtime

Kofax RPA 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 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 Kofax RPA installation folder and type:

```plaintext
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:

```plaintext
```

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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| `-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:** `-service socket:50000`  
**Example:** `-service jmx:50100` |
| `-mcUrl <arg>` | **Required parameter.** Specify which Management Console to register to in the following format:  
http[s]:// <username>:<password>@<hostname>:<port number>  
**Example:** `-mcUrl http://admin:password@localhost:8080/ManagementConsole` |
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-cl</td>
<td>Required parameter. This parameter automatically registers the roboserver with the specified cluster on the Management Console. In the following example the roboserver registers itself with the Production cluster.</td>
</tr>
</tbody>
</table>
| -cluster <Cluster Name> | Example: -cl Production  
|                 | Example: -mcUrl http://admin:password@localhost:8080/ManagementConsole -cl Production                                                                                                                     |
| -eh             | Explicitly specifies the name or IP address of the RoboServer's host. Specified name or IP address and a port number for the RoboServer host is not valid when working in JMS mode. |
| -externalHost <name> | 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             | Explicitly specifies the port number of the RoboServer's host. Specified name or IP address and a port number for the RoboServer host is not valid when working in JMS mode. |
| -externalPort <port number> | 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              | This optional parameter causes RoboServer to output status and runtime events.                                                                                                                                 |
| -verbose        |                                                                                                                                                                                                             |
| -b              | The URL of the message broker (when running a JMS service).                                                                                                                                                   |
| -brokerUrl <url> |                                                                                                                                                                                                             |
| -jmsNamespace <name> | Namespace for JMS destinations. Default is Kapow.                                                                                                                                                          |
| -p              | This is shorthand for calling -s socket:<port-number>                                                                                                                                                       |
| -port <port-number> | Example: -port 50000                                                                                                                                       |
| -sslPort <port number> | This is a shorthand for writing -s ssl:<port number>                                                                                                                                                       |
|                 | Available services                                                                                                                                                                                             |
| -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                                                                 |
To set passwords, either use the RoboServer Settings utility or the ConfigureRS tool. For more information, see RoboServer Configuration and RoboServer Configuration - Headless Mode.

### Important

Kofax RPA 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 RPA 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- ```
wrapper.ntservice.account
The account of the user that has to run RoboServer. Kofax RPA 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.
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.

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 gedit.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. In the examples MC
means Management Console and RS means RoboServer.
• The following script install services that start RoboServers with default parameters. The name of
the service can be changed as needed.
ServiceInstaller.exe -i RoboServer.conf wrapper.ntservice.account=\YOUR_USERNAME> wrapper.ntservice.password.prompt=true
wrapper.ntservice.name="RoboServer10.X_MC"
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=.<YOUR_USERNAME>
wrapper.ntservice.password.prompt=true
wrapper.ntservice.starttype=AUTO_START wrapper.syslog.loglevel=INFO
wrapper.app.parameter.1="-MC"
```

- 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=.<YOUR_USERNAME>
wrapper.ntservice.password.prompt=true
wrapper.ntservice.name="RoboServer10.6.0_50000"
wrapper.ntservice.starttype=AUTO_START wrapper.syslog.loglevel=INFO
wrapper.app.parameter.1="-service" wrapper.app.parameter.2="socket:50000"
wrapper.app.parameter.3="-mcUrl" wrapper.app.parameter.4="URL OF MC"
wrapper.app.parameter.5="-cl" wrapper.app.parameter.6="NAME OF CLUSTER"
```

Remove Windows Services

To uninstall a service you can run the following command:

```
ServiceInstaller.exe -r RoboServer.conf wrapper.ntservice.name=Service-name
```
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/Kofax RPA_10.6.0/bin/RoboServer -p 50000
```
or

```
@reboot $HOME/Kofax RPA_10.6.0/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 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
CPU (core)% = 1 - 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.
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 Kofax RPA 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.

Kofax RPA 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.

Enter License in Embedded Management Console

Before you can enter license information into Management Console, you need to start it. If you use an embedded Management Console, start it as follows. See Tomcat Deployment for information about Tomcat Management Console.

Windows
Use the Start Management Console item in the Start menu.
To start the Management Console from the command line, run the following command in the bin subfolder of the installation folder.

RoboServer -p 50000 -MC

Linux
Start Management Console from the command line. It is part of the RoboServer program, which is found in the bin directory under the installation directory.

$ ./RoboServer -p 50000 -MC

Auto-start
As an alternative, if you later set up auto-start of the Management Console as described in Start RoboServer, you may select to do that now instead of starting Management Console manually.

Once the Management Console is started, you must open its GUI in a browser. On Windows, you can do that with the aid of the Management Console item in the Start menu. On all platforms, you can open a browser and go to http://localhost:50080/. Accept the license terms and enter your license information, including your license keys.
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

Allow File System and Command Line Access
Enables RoboServer to create and edit files on the computer.

**Important** When using embedded Derby database, robots can create and edit files on computers when this option is not selected. We recommend using MySQL or another enterprise-class database in your network environment.

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 on a remote device. This option applies only to automating terminals and browsing websites in Desktop Automation Workflow.

A command is an instruction sent to Automation Device, such as click mouse button, open application, add a location found guard, and so forth. If a command cannot be completed in a specified time, the service sends a notification and execution of the robot stops.

Note that in case of a Location Found guard, this setting applies to invoking the guard in the workflow, but waiting for the guard to be satisfied is not bound to this timeout and can wait forever. Similar situation occurs when using the Move Mouse and Extract steps. The commands must be invoked on the device within the timeout specified in this field, but the robot waits for up to 240 seconds for the commands to complete.

RoboServer TLS Configuration
Kofax RPA 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 Kofax RPA 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 Kofax RPA 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.
**Note** 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` on Linux and `lib` directory on Windows 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 Kofax RPA installation, 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 RoboServer 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**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Username</td>
<td>This is the username used by the user when accessing the RoboServer.</td>
</tr>
<tr>
<td>Password</td>
<td>This is the password used by the user when accessing the RoboServer.</td>
</tr>
<tr>
<td>Comments</td>
<td>Here you can write a comment about the user.</td>
</tr>
<tr>
<td>Start Robot</td>
<td>This enables the user to start robots on the RoboServer.</td>
</tr>
<tr>
<td>Stop Robot</td>
<td>This enables the user to stop robots on the RoboServer.</td>
</tr>
<tr>
<td>Shutdown RoboServer</td>
<td>This enables the user to shutdown the RoboServer from the Management Console.</td>
</tr>
</tbody>
</table>

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 13:51:22  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_6501b4b3093bbbedb61d2e.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 websites 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 website 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 Kofax RPA 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 Kofax RPA 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.

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 Kofax RPA installation.

**Note**
The HTTPS client certificates must be configured into all Kofax RPA 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 Kofax RPA 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:

```java
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:

```java
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:

   ```java
   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

Kofax RPA ships with several utilities to configure your RoboServer from a command line. The utilities are located in the `bin` subfolder of the Kofax RPA 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 Kofax RPA 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:

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

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

```bash
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
<?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**

```plaintext
# 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\\Kofax RPA\\...
defaultProject = /home/TestUser/Kofax RPA/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 will 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 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 Kofax RPA to use JMS.

**Note** Starting from Kofax RPA 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 Kofax RPA 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 Kofax RPA Control Protocol) clients can be created in any major programming language (see Kofax RPA Control Protocol in the Kofax RPA 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`.

For example, to change the message time to live, in the `JMSConfiguration` bean, add the `customTimeToLive` property with an entry for each JMS message type to alter the message time to live. The key is the message type and the value is the time to live in milliseconds as in the following example.

```xml
<property name="customTimeToLive">
  <map>
    <entry key="Execute" value="1200000"/>
    <entry key="Cancel" value="1300000"/>
  </map>
</property>
```
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.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-service jms:&lt;id&gt;</td>
<td>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.</td>
</tr>
<tr>
<td>-brokerUrl</td>
<td>Specifies the URL of the broker. For example, failover://(tcp://localhost:61616)?startupMaxReconnectAttempts=3&amp;timeout=15000 Refer to the broker documentation for the format of this parameter.</td>
</tr>
<tr>
<td>-jmsNamespace</td>
<td>Specifies the name space the RoboServer uses on the broker. It must match the name space used by the Management Console. Default is &quot;Kapow&quot;.</td>
</tr>
</tbody>
</table>

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 Kofax RPA are named `<namespace>.<protocol>.<cluster>.<destination>` where namespace is defined in Configuration.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 Kofax RPA Control Protocol based on protobuf.
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.

### 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, 127.0.0.1:11. 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 stored in a database for creating more advanced reports using Kofax RPA Analytics.

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 Kofax RPA 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 Kofax RPA. Also, the .conf file can be edited only by the user who installed Kofax RPA, 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 Kofax RPA 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.

**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**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Embedded</th>
<th>Standalone J2SE Web Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Console data store</td>
<td>Embedded Derby database</td>
<td>Container managed Data Source (supported platforms)</td>
</tr>
</tbody>
</table>

**Note** The derby JDBC driver is not distributed with the Enterprise Management Console. See [Apache Derby](https://www.apache.org/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 Kofax RPA online help. To start an embedded Management Console, see Starting the Management Console under the Management Console topic.

**Docker Tools for Kofax RPA Deployment**

Kofax supplies Docker tools for fast and easy deployment of Kofax RPA in your Linux environment. Docker tools for Kofax RPA help you build Docker images for the RoboServer and the Management Console. This chapter provides details on Docker tools, configuration variables, and usage examples. For more information about Docker, see [https://www.docker.com](https://www.docker.com). For more information about manual deployment of Kofax RPA on a stand-alone server, see [Tomcat Deployment](https://www.docker.com).
Deploy Kofax RPA using docker-compose files

This topic provides basic steps for deploying Kofax RPA on a standalone server under Linux-based system.

To deploy Kofax RPA using one of the docker-compose files, perform the following:

1. Install Kofax RPA on your computer.
2. Download Docker from https://www.docker.com and install it on your computer.
3. Add user to docker group. For example, to add "Kofax" user, replace docker:x:<n> with docker:x:<n>:Kofax in the /etc/group file. Logout and login or reboot to update permissions.
4. Change to the root of the extracted Kofax RPA distribution and copy the docker-compose file supplied by Kofax RPA, such as docker-compose-basic.yml, renaming it to docker-compose.yml as follows:
   cp docker-compose-examples/docker-compose-basic.yml docker-compose.yml
5. Edit the file as applicable to your environment, for example, you can add license information to the docker-compose.yml in the CONFIG_LICENSE_ variables, and then start the services. The following command builds an image and starts the service.
   docker-compose -p kapow up -d --build
   You can use separate commands to build an image and to start the service as follows.
   • To build an image: docker build -f docker/managementconsole/Dockerfile -t managementconsole:10.6.0.0 .
     Note the space and period at the end of line. The period refers to the current directory.
   • To start a service: docker-compose -p kapow up -d

The first time you build the image, it may take some time to prepare them.

As soon as docker-compose starts the containers, you should be able to open the following address: http://localhost:8080 and see that a Management Console is running with a RoboServer in a separate container.

Note Once the Management Console is running, you cannot change the license. To change the license settings, stop the composition and update the license variables in the docker-compose file.

The following sections provide detailed information about Docker-compose examples, configuration settings, and variables.

Docker-compose examples

Kofax RPA includes several docker-compose files with a few simple configurations in the docker-compose-examples folder.

All of the following examples rely on MySQL as the configuration database for Management Console. Although Management Console can run on other databases, MySQL is recommended for Management Console configuration data. Documentation for the MySQL docker images is available at https://hub.docker.com/_/mysql/.
For logging and robot data storage, any of the supported databases can be used. See "Supported Platforms" in the Kofax RPA Installation Guide.

The following docker-compose files are provided.

**docker-compose-basic.yml**

This configuration starts a Management Console, a RoboServer, a MySQL database, and connects them. Before you start this configuration, you might want to enter your license information into the compose configuration to avoid having to type it upon Management Console startup. To scale the amount of RoboServers (in the "Production" cluster), use the following command.

```
docker-compose -p kapow up -d --scale roboserver-service=2
```

**docker-compose-ha.yml**

This configuration starts a Management Console, a RoboServer, a MySQL, and a load balancer based on the lightweight Traefik image.

Management Console is configured to run with High Availability enabled using multicast discovery (requires enterprise license).

*Note* Multicast discovery requires a network overlay that supports UDP multicast.

For this configuration to work optimally, enter your license information into the docker-compose file before bringing up the services. Also, edit the following line to fit the network assigned to your containers:

```
- CONFIG_CLUSTER_INTERFACE=172.20.0.*
```

Execute the following steps to find out which network is used.

1. Start the composition.
   ```
   docker-compose -p name up -d
   ```
2. List the started containers.
   ```
   docker container ls
   ```
3. Use the following command to get the host name.
   ```
   docker exec kapow_managementconsole-service_1 hostname -i
   ```
4. Stop the composition, before editing the docker-compose file.
   ```
   docker-compose -p kapow down
   ```

Wildcards can be used, so the IP address may be similar to 172.\*.\*.*. Note that hazelcast does not accept all wildcards, and therefore \*.*.*.* is not allowed.

When starting the composition, you can scale the number of running Management Console instances using the following command.

```
docker-compose -p kapow up -d --scale managementconsole-service=2
```

Running more than two instances of Management Console is possible, but doing so increases the database load. The load balancer is set up to use sticky sessions.
**docker-compose-ldap.yml**

This is an example configuration that uses LDAP. It starts the OpenLDAP command in a container, which is normally not needed, but it is included as an example.

We have also included the `ldap_ad_content.ldif` file. Test this composition by running the following command.

```
docker-compose -p kapow up -d docker cp docker/compose-examples/ldapadcontent.ldif kapowldap-service1. docker exec kapowldap-service1 ldapadd -x -D "cn=admin,dc=example,dc=org" -w admin -f /ldapadcontent.ldif
```

**docker-compose-jms.yml**

This is an example configuration that starts a Management Console, a RoboServer, and a MySQL database that communicate through an ActiveMQ broker.

### Use Docker secrets feature for storing passwords

To avoid specifying connection passwords directly in the docker-compose file, you can use the Docker secrets feature to store your passwords in a safe location.

You can use the secrets feature for variables listed when you run the following command:

```
java -jar managementConsoleConfigurator.jar --help
```

In the following example, we will specify a password to connect to the MySQL database.

1. Create a text file with a password in it. One file must contain one password. For this example we created a `mysqlpassword.txt` file that includes a password to the MySQL database.

2. In the `docker-compose.yml` file that you want to use, create a section called `secrets` on the first level (no indent), specify a variable name on the second level, and specify a path to the file with a password on the third level of indent as follows.

   ```yaml
   secrets:
   mysqlpassword:
     file: /kapow/linux64dist/mysqlpassword.txt
   
   3. In the `services > mysql-service > environment` section of the `.yml` file, substitute the `MYSQL_PASSWORD` variable with the `MYSQL_PASSWORD_FILE` variable and specify the variable set in the `secrets` section as follows:

   ```yaml
   services:
   mysql-service:
     image: mysql:5
   environment:
     - MYSQL_ROOT_PASSWORD=mysqlrootpassword
     - MYSQL_DATABASE=mysqldatabase
     - MYSQL_USER=mysqluser
     - MYSQL_PASSWORD_FILE=/run/secrets/mysqlpassword
   networks:
     - net
   
   4. On the same level as the `environment` section under `services > mysqlservice`, create a `secrets` section and specify the `secrets` variable again.

   ```yaml
   secrets:
     - mysqlpassword
   ```
Using this procedure as an example, you can set up the secrets feature for other passwords in the docker-compose file.

### Set up database

For Kofax RPA, we recommend to store your Management Console configuration and repository data in a containerized MySQL database, and add external databases for data storage and (audit-) logs.

However, you might want to store the Management Console internal configuration data in an external or corporate database. To change the Management Console database, correct the environment variables for the database context and add the proper JDBC driver to the image/container.

In the Dockerfile for Management Console (located at `docker/managementconsole/Dockerfile`), the following line adds the current MySQL JDBC driver to the Management Console image in the `/usr/local/tomcat/lib/jdbc/` folder.

```
```

Change this line or add more lines to the Dockerfile to add the correct JDBC driver. Substitute `<version>` with the correct version of the MySQL connector for your Java. Use the latest available version of the driver. For example:

```
```

After editing the Dockerfile, you must rebuild the image by running the following command:

```
docker build -f docker/managementconsole/Dockerfile -t managementconsole:@productVersion@
```

Or run the simple version:

```
docker-compose -p kapow up -d --build
```

### Set up SSL connection to the database

Use the information in this section to establish an SSL connection between the Management Console and the MySQL database. Docker-compose examples supplied by Kofax include two services: `mysql` and `managementconsole`. MySQL service are composed based on the mysql docker image. The `managementconsole` service is composed based on the tomcat docker image. The following procedure explains how to set up an SSL connection between the two services.

When you start a docker-compose file with an insecure connection to the database, some versions of Tomcat produce a warning if SSL is not set up and explicitly disabled. If you do not want to set up the SSL
connection to the database, you can disable the warning by specifying the `useSSL=false` parameter in the `CONTEXT_RESOURCE_URL` variable in the docker-compose file, as shown here:

```
CONTEXT_RESOURCE_URL=jdbc:mysql://mysql-service:3306/scheduler?
useUnicode=yes&characterEncoding=UTF-8&rewriteBatchedStatements=true&useSSL=false
```

To set up an SSL connection between the Management Console and MySQL database, perform the following steps:

1. **Configure SSL in MySQL** to create certificates (including `ca.pem`) and keys in `/var/lib/mysql` of the corresponding mysql image. This step is necessary if you do not have your own signed certificate.

   MySQL supplies the `mysql_ssl_rsa_setup` utility that helps you generate all necessary keys and certificates. The mysql image for the docker-compose files supplied by Kofax is configured to create necessary self-signed certificates and keys. When you start a docker-compose file that starts a MySQL service, the `ca.pem` file is created in the `/var/lib/mysql` of the image.

2. **Add `ca.pem` to the truststore.**
   
   You can use the Java `keytool` utility to add the certificate to the truststore using the following command.
   
   ```
   keytool -importcert -alias MySQLCACert -file /<path to the certificate>/ca.pem -keystore /<path to the truststore>/truststore -storepass <password> -noprompt
   ```

3. **Make the truststore accessible from the Management Console.**
   
   The truststore must be accessible from the Management Console as a local file. For example, you can modify the `Dokerfile.managementconsole` file and include a `COPY` command as follows:
   
   ```
   COPY truststore /usr/local/tomcat/
   ```
   
   Another way is to mount a directory with the `ca.pem` file in the mysql image as a volume to the managementconsole image. Then, run the `keytool` utility from `docker/managementconsole/managementconsole.sh`.

4. **Specify the path to and the password of the truststore in the `CONTEXT_RESOURCE_URL` variable in the docker-compose file.** For example:
   
   ```
   CONTEXT_RESOURCE_URL=jdbc:mysql://mysql-service:3306/scheduler?
   useSSL=true&useUnicode=yes&characterEncoding=UTF-8&rewriteBatchedStatements=true&trustCertificateKeyStorePassword=password&trustCertificateKeyStoreUrl=file:/usr/local/tomcat/truststore
   ```

**Backup and restore**

The Management Console image contains two scripts for backing up and restoring repository and configuration information.
backup.sh
To create a backup to be saved in `/kapow/backup`, run the following Docker command:
docker exec kapow_managementconsole-service_1 backup.sh [options]
The following script usage options are available:
backup.sh [options]

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-u, --username</td>
<td>The username to use when calling the Management Console.</td>
</tr>
<tr>
<td>-p, --password</td>
<td>The password to use when calling the Management Console.</td>
</tr>
<tr>
<td>-h, --host</td>
<td>The hostname for the Management Console (default: localhost).</td>
</tr>
<tr>
<td>-i, --project &lt;Id&gt;</td>
<td>Project ID to use for backing up only a specific project.</td>
</tr>
<tr>
<td>-c, --configurationOnly &lt;Id&gt;</td>
<td>An ID to back up only the configuration and no project data.</td>
</tr>
<tr>
<td>-n, --postfix</td>
<td>Sets the postfix for the created backup file (default is &lt;datetime&gt;).</td>
</tr>
</tbody>
</table>

restore.sh
To restore a backup saved in `/kapow/backup`, run the following docker command:
docker exec kapow_managementconsole-service_1 restore.sh [options]
The following script usage options are available:
restore.sh [options]

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>-u, --username</td>
<td>The username to use when calling the Management Console.</td>
</tr>
<tr>
<td>-p, --password</td>
<td>The password to use when calling the Management Console.</td>
</tr>
<tr>
<td>-h, --host</td>
<td>The host name for the Management Console (default: localhost).</td>
</tr>
<tr>
<td>-f, --filename</td>
<td>The name of the backup file to restore.</td>
</tr>
<tr>
<td>-a, --path</td>
<td>The path to the backup file to restore (default: /kapow/backup/).</td>
</tr>
</tbody>
</table>
The pre-start checks

When starting a container, the ManagementConsole image, by default, runs the following checks.

1. Checks that the database configuration works by connecting to the database using the provided JDBC URI. It also tries to run the validation query once.

2. Checks that the LDAP configuration works. If LDAP is configured, each of the LDAP directories is checked by trying to connect and bind, and running a query to retrieve all groups. You can expand this test for debugging or validation purposes by adding a test username to use for more lookups.

If a check fails, the image retries for a configurable amount of time. If one of the checks does not succeed within the configured timeout, the container exits and you can review your configuration parameters.

You can bypass a check by setting the timeout for the check to zero (0). See the Environment variables section for more information.

Data folders

Logs, database data, and configuration from the containers are stored in folders listed below. To avoid having your container grow, these folders should be mounted to a volume or to the local file system. Refer to the Docker documentation on volumes.

Note Logs, database and other data stored on these volumes cannot be reused when upgrading the version of Kofax RPA.

RoboServer
Data, logs and configuration from the RoboServer container resides in the following folder:
/kapow/data

ManagementConsole
Tomcat logs reside in the following folder:
/usr/local/tomcat/logs
Backups, by default, are saved and restored to the following folder:
/kapow/backup

Environment variables

The following tables list environment variables for different Docker containers relative to docker-compose files supplied by Kofax RPA. The containers are located in the corresponding folders under the docker folder in the Kofax RPA installation folder. For example, the ManagementConsole container is located at docker/managementconsole/managementConsoleConfigurator.jar. To get a list of variables, run one of the following commands:

java -jar docker/managementconsole/managementConsoleConfigurator.jar --help
java -jar docker/roboserver/roboServerConfigurator.jar --help
### Environment variables for the RoboServer container

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRAPPER_MAX_MEMORY (default: )</td>
<td>The java heap size (in MB).</td>
</tr>
<tr>
<td>WRAPPER_JAVA_ADDITIONAL_1 (default: )</td>
<td>Additional Java parameter 1.</td>
</tr>
<tr>
<td>WRAPPER_JAVA_ADDITIONAL_2 (default: )</td>
<td>Additional java parameter 2.</td>
</tr>
<tr>
<td>WRAPPER_JAVA_ADDITIONAL_3 (default: )</td>
<td>Additional java parameter 3.</td>
</tr>
<tr>
<td>ROBOSERVER_SEC_ALLOW_FILE_SYSTEM_ACCESS (default: false)</td>
<td>Allow file system access.</td>
</tr>
<tr>
<td>ROBOSERVER_SEC_ACCEPT_JDBC_DRIVERS (default: false)</td>
<td>Access JDBC drivers sent as part of requests.</td>
</tr>
<tr>
<td>ROBOSERVER_SEC_LOG_HTTP_TRAFFIC (default: false)</td>
<td>Activate an (audit) log for all HTTP traffic.</td>
</tr>
<tr>
<td>ROBOSERVER_ENABLE_SOCKET_SERVICE (default: false)</td>
<td>Enable the socket service.</td>
</tr>
<tr>
<td>ROBOSERVER_SOCKET_SERVICE_PORT (default: 50000)</td>
<td>Port for the socket service.</td>
</tr>
<tr>
<td>ROBOSERVER_ENABLE_SSL_SOCKET_SERVICE (default: false)</td>
<td>Enable the SSL socket service.</td>
</tr>
<tr>
<td>ROBOSERVER_SOCKET_SSL_SERVICE_PORT (default: 50001)</td>
<td>Port for the SSL socket service.</td>
</tr>
<tr>
<td>ROBOSERVER_ENABLE_MC_REGISTRATION (default: false)</td>
<td>Register with a Management Console.</td>
</tr>
<tr>
<td>ROBOSERVER_MC_URL (default: )</td>
<td>The URL for the Management Console to register with.</td>
</tr>
<tr>
<td>ROBOSERVER_MC_CLUSTER (default: )</td>
<td>The cluster to join when registering with the Management Console.</td>
</tr>
<tr>
<td>ROBOSERVER_MC_USERNAME (default: )</td>
<td>Username to use when registering with the Management Console.</td>
</tr>
<tr>
<td>ROBOSERVER_MC_PASSWORD (default: )</td>
<td>Password to use when registering with the Management Console.</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>ROBOSERVER_MC_PASSWORD_FILE (default: )</td>
<td>Specify this variable to use the secrets feature for secure password storage. See Use Docker secrets feature for storing passwords for details.</td>
</tr>
<tr>
<td>ROBOSERVER_EXTERNAL_HOST (default: )</td>
<td>The external host name at which the Management Console can reach this server.</td>
</tr>
<tr>
<td>ROBOSERVER_EXTERNAL_PORT (default: 0)</td>
<td>The external port at which the Management Console can reach this server.</td>
</tr>
<tr>
<td>ROBOSERVER_ENABLE_JMS (default: false)</td>
<td>Enable JMS for communication with the Management Console.</td>
</tr>
<tr>
<td>ROBOSERVER_JMS_BROKERURL (default: false)</td>
<td>The JMS broker URL.</td>
</tr>
<tr>
<td>LOG4J_ROOTLOGGER (default: ERROR, file)</td>
<td>Root logging level.</td>
</tr>
<tr>
<td>LOG4J_LOGGER_WEBKIT (default: INFO)</td>
<td>Log level for messages related to WebKit.</td>
</tr>
<tr>
<td>LOG4J_LOGGER_KAPOW_SERVERMESSAGELOG (default: INFO)</td>
<td>Log level for log messages not related to a robot.</td>
</tr>
<tr>
<td>LOG4J_LOGGER_KAPOW_ROBOTRUNLOG (default: INFO)</td>
<td>Log level for log messages related to robot runs.</td>
</tr>
<tr>
<td>LOG4J_LOGGER_KAPOW_ROBOTMESSAGELOG (default: INFO)</td>
<td>Log level for log messages logged by a robot.</td>
</tr>
<tr>
<td>LOG4J_LOGGER_KAPOW_AUDITLOG (default: OFF)</td>
<td>Log level for messages with each http/ftp request.</td>
</tr>
<tr>
<td>LOG4J_LOGGER_KAPOW_KCUMANAGER_KCUINFO (default: OFF)</td>
<td>Log level for KCU information. See &quot;Kofax RPA Compute Units&quot; in the Installation Guide for information on KCUs.</td>
</tr>
<tr>
<td>LOG4J_LOGGER_HUB (default: WARN, file)</td>
<td>Log level related to the desktop automation process.</td>
</tr>
<tr>
<td>LOG4J_APPENDER_FILE_MAXFILESIZE (default: 10MB)</td>
<td>Max log file size for the log before it rotates.</td>
</tr>
<tr>
<td>LOG4J_APPENDER_FILE (default: /Kapow/data/Logs/${logFileName})</td>
<td>Path and log file name.</td>
</tr>
<tr>
<td>LOG4J_APPENDER_FILE_MAXBACKUPINDEX (default: 3)</td>
<td>Max number of rotated logs.</td>
</tr>
</tbody>
</table>
## Environment variables for the ManagementConsole container

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTEXT RESOURCE MAXTOTAL</td>
<td>Maximum number of database connections in pool. Make sure you configure your database to handle all of your connections.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE MAXIDLE</td>
<td>Maximum number of idle database connections to retain in pool. Set to -1 for no limit. See also the DBCP documentation.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE MAXWAITMILLIS</td>
<td>Maximum time to wait for a database connection to become available in ms. An exception is thrown if this timeout is exceeded. Set to -1 to wait indefinitely.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE VALIDATIONQUERY</td>
<td>Validation query to use when using a connection from the pool.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE TESTONBORROW</td>
<td>Set to true to validate connections when taking them out of the pool.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE USERNAME</td>
<td>The username for the database.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE PASSWORD</td>
<td>The password for the database.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE PASSWORD_FILE</td>
<td>Specify this variable to use the secrets feature for secure password storage. See Use Docker secrets feature for storing passwords for details.</td>
</tr>
<tr>
<td>CONTEXT RESOURCE DRIVERCLASSNAME</td>
<td>The JDBC driver class name (must be a javax.sql.DataSource).</td>
</tr>
<tr>
<td>CONTEXT RESOURCE URL</td>
<td>The database JDBC URL and connection parameters.</td>
</tr>
<tr>
<td>CONTEXT CHECK_DATABASE_TIMEOUT</td>
<td>Database connection pre-start check timeout. Set to 0 if the pre-start check should not run.</td>
</tr>
<tr>
<td>CONFIG LICENSE NAME</td>
<td>The name associated with your license.</td>
</tr>
<tr>
<td>CONFIG LICENSE_EMAIL</td>
<td>The email associated with your license.</td>
</tr>
<tr>
<td>CONFIG LICENSE COMPANY</td>
<td>The company name matching your license.</td>
</tr>
<tr>
<td>CONFIG LICENSE PRODUCTIONKEY</td>
<td>Your license production key.</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>CONFIG_LICENSE_NONPRODUCTIONKEY (default: )</td>
<td>Your license non-production key.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_PORT (default: 5701)</td>
<td>The TCP port to listen for connections when running in clustered mode.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_INTERFACE (default: 127.0.0.1)</td>
<td>Interface to bind to for listening to cluster connections. Using local interface cannot work for docker containers. You can use wildcards here. See Docker-compose examples in this chapter.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_JOINCONFIG (default: noCluster)</td>
<td>Set to either &quot;tcpCluster&quot; or &quot;multicastCluster&quot; for node discovery. Both require settings. &quot;multicastCluster&quot; is by far the most flexible, but requires a network overlay that can handle UDP/multicast.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_TCP_NODE_COUNT (default: 0)</td>
<td>The number of nodes in the TCP cluster.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_TCP_NODE_HOST_&lt;N&gt; (default: )</td>
<td>The host-name or IP address of a node in the TCP cluster.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_TCP_NODE_PORT_&lt;N&gt; (default: 5701)</td>
<td>The port for the specified host name.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_MULTICAST_GROUP (default: 224.2.2.3)</td>
<td>The multicast group to use for multicast discovery of nodes.</td>
</tr>
<tr>
<td>CONFIG_CLUSTER_MULTICAST_PORT (default: 54327)</td>
<td>The port to send the multicast messages to.</td>
</tr>
<tr>
<td>CONFIG_KEYSTORE_LOCATION (default: /WEB-INF/mc.p12)</td>
<td>The path to the location of the keystore file, relative to webapps folder.</td>
</tr>
<tr>
<td>CONFIG_KEYSTORE_PASSWORD (default: changeit)</td>
<td>Passphrase for the key store.</td>
</tr>
<tr>
<td>CONFIG_KEYSTORE_ALIAS (default: mc)</td>
<td>Alias for the key store.</td>
</tr>
<tr>
<td>CONFIG_SECURITY.AllowScriptExecution (default: false)</td>
<td>Allow script execution.</td>
</tr>
<tr>
<td>CONFIG_SECURITY_JDBC_DRIVERUPLOAD (default: LOCALHOST)</td>
<td>Allow JDBC driver uploads to the Management Console. Can be set to NONE, LOCALHOST, ANY_HOST.</td>
</tr>
<tr>
<td>CONFIG_JMS_ENABLED (default: false)</td>
<td>Enable JMS mode.</td>
</tr>
<tr>
<td>CONFIG_JMS_BROKERURI (default: failover://(tcp://127.0.0.1:61616)?startupMaxReconnectAttempts=3)</td>
<td>The JMS broker URI and connection attempts.</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>LOGIN_USE_LDAP (default: false)</td>
<td>Use LDAP for authentication. To enable this option, there must be at least one LDAP directory configured.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_COUNT (default: 0)</td>
<td>The number of LDAP directories to add into the configuration.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_ADMINGROUP_COUNT_&lt;N&gt; (default: 1)</td>
<td>The number of groups in the list of administrator groups.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_ADMINGROUP_VALUE_&lt;N&gt;_&lt;N&gt; (default: ADMINISTRATOR)</td>
<td>The name of an administrator group.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_SERVERURL_&lt;N&gt; (default: )</td>
<td>The URL for the LDAP directory.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_USERDN_&lt;N&gt; (default: )</td>
<td>The bind user DN.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_PASSWORD_&lt;N&gt; (default: )</td>
<td>The bind password.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_USERSEARCHBASE_&lt;N&gt; (default: )</td>
<td>The base to search for users.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_USERSEARCHFILTER_&lt;N&gt; (default: )</td>
<td>The filter to apply, combined with the login to apply while searching.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_USERSEARCHSUBTREE_&lt;N&gt; (default: true)</td>
<td>Search the subtree from the base to look for the user.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_GROUPSEARCHBASE_&lt;N&gt; (default: )</td>
<td>The base to use when searching for groups.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_GROUPSEARCHFILTER_&lt;N&gt; (default: (member=0))</td>
<td>The filter to apply, combined with the user DN to search for group memberships.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_GROUPROLEATTRIBUTE_&lt;N&gt; (default: cn)</td>
<td>The group role attribute.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_GROUPSEARCHSUBTREE_&lt;N&gt; (default: true)</td>
<td>Search the subtree when looking for groups.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_ALLGROUPSFILTER_&lt;N&gt; (default: (cn=*))</td>
<td>Filter to apply when listing all groups.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_FULLNAMEATTRIBUTE_&lt;N&gt; (default: displayName)</td>
<td>The full-name attribute to use for users.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_EMAILATTRIBUTE_&lt;N&gt; (default: userPrincipalName)</td>
<td>The attribute to use to retrieve a user's email.</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_REFERRAL_&lt;N&gt; (default: follow)</td>
<td>Follow referrals sometimes useful when forests use several ADs for subdomains.</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>LOGIN_LDAP_DIRECTORY_CONVERTTOUPPERCASE_&lt;N&gt; (default: true)</td>
<td>Convert group names to upper-case.</td>
</tr>
<tr>
<td>LOGIN_LDAP_CHECK_TIMEOUT_&lt;N&gt; (default: 120)</td>
<td>LDAP pre-start check timeout. Set to 0 to disable this check.</td>
</tr>
<tr>
<td>LOGIN_LDAP_CHECK_TESTUSER_&lt;N&gt; (default: )</td>
<td>A user name that can be found in the LDAP directory to search for and while running the pre-start check.</td>
</tr>
<tr>
<td>TOMCAT_SERVER_SESSION_REPLICATION (default: false)</td>
<td>Enable session replication between tomcat instances. This option should only be needed if the load balancer does not support sticky sessions and only work if the network overlay supports multicast.</td>
</tr>
<tr>
<td>TOMCAT_SERVER_SSL_CONNECTOR (default: false)</td>
<td>Set to true to enable SSL.</td>
</tr>
<tr>
<td>TOMCAT_SERVER_SSL_CONNECTOR_PORT (default: 8443)</td>
<td>The https port.</td>
</tr>
<tr>
<td>TOMCAT_SERVER_SSL_CONNECTOR_MAXTHREADS (default: 150)</td>
<td>Max threads for this connector. Do not alter the default value unless absolutely sure.</td>
</tr>
<tr>
<td>TOMCAT_SERVER_SSL_CONNECTOR_CERTIFICATEKEYFILE (default: )</td>
<td>Path to the certificate key file.</td>
</tr>
<tr>
<td>TOMCAT_SERVER_SSL_CONNECTOR_CERTIFICATEFILE (default: )</td>
<td>Path to the certificate file.</td>
</tr>
<tr>
<td>TOMCAT_SERVER_SSL_CONNECTOR_CERTIFICATECHAINFILE (default: )</td>
<td>Path to the certificate chain file.</td>
</tr>
<tr>
<td>PERSISTENCE_PU1_LOG_LEVEL (default: SEVERE)</td>
<td>For debugging of the (eclipse) persistence layer, you can change this value to FINE for detailed log information.</td>
</tr>
</tbody>
</table>

Run on Docker Swarm with Management Console in High Availability

**Note** The following procedure and setup are intended only as an example and should not be considered a recommendation.

The example in this section demonstrates how to set up Kofax RPA on a Docker swarm with more than one instance of Management Console (with High Availability mode enabled).

This section contains an example of setting up a Docker swarm that consists of two nodes, manager and worker, which provide a higher level of fault tolerance than using only one node. The example uses a single instance of MySQL with a throw-away volume.

The Management Console can run as several instances in a cluster, sharing configuration, log and repository data through a database, and sharing the cluster volatile state through the Hazelcast platform.
This platform requires each instance of the Management Console to be able to discover and connect to the other instances in the cluster. The two discovery methods that are currently implemented are multicast and TCP. In this example procedure, we use the multicast (UDP) discovery method. The TCP discovery method was also successfully tested.

To make multicast UDP work in a Docker swarm, the Weave Net plugin 2.5.1 is used in this procedure.

Set up a minimal UDP work with Management Console

Before proceeding, ensure that you have two Docker hosts running on Windows or with Linux kernel 3.8 or higher. In this procedure, the hosts are referred to as host1 and host2.

1. Set up the hosts in a Docker swarm cluster as follows.
   ```bash
   host1$ docker swarm init --advertise-addr="$(hostname -i)"
   host2$ docker swarm join --token
   ```
   On the second command line, replace the colon with the token retrieved from the first command.

2. Install the Weave Net plugin on the hosts as follows.
   ```bash
   host1$ docker plugin install --grant-all-permissions store/weaveworks/net-plugin:2.5.1
   host2$ docker plugin install --grant-all-permissions store/weaveworks/net-plugin:2.5.1
   ```

3. On the manager node, create a Docker network using the Weave Net plugin as the driver as follows.
   ```bash
   host1$ docker network create --driver=store/weaveworks/net-plugin:2.5.1 weavenet
   ```

4. Build the Management Console and RoboServer Docker images on all of the nodes in your Docker swarm. With a Docker repository, you can push the images to it. For information on building the Docker images, see Docker Tools for Kofax RPA Deployment.

5. Create a file called docker-compose.yml, adapting the following lines to your environment.

```yaml
version: '3.2'
networks:
  net:
    external:
      name: weavenet
services:
  loadbalancer:
    image: traefik
    command: --docker --docker.swarmmode --docker.watch --web --loglevel=DEBUG
    ports:
      - 80:80
    volumes:
      - /var/run/docker.sock:/var/run/docker.sock
    networks:
      - net
  deploy:
    mode: global
    placement:
      constraints: [node.role == manager]
  mysql-service:
    image: mysql:5
    environment:
      - MYSQL_ROOT_PASSWORD=mysqlrootpassword
      - MYSQL_DATABASE=scheduler
      - MYSQL_USER=scheduler
```

- MYSQL_PASSWORD=schedulerpassword

networks:
- net

managementconsole-service:
  image: managementconsole:@productVersion@
  depends_on:
  - mysql-service
  environment:
  - CONTEXT_RESOURCE_VALIDATIONQUERY=SELECT 1
  - CONTEXT_RESOURCE_USERNAME=scheduler
  - CONTEXT_RESOURCE_PASSWORD=schedulerpassword
  - CONTEXT_RESOURCE_DRIVERCLASSNAME=com.mysql.jdbc.Driver
  - CONTEXT_RESOURCE_URL=jdbc:mysql://mysql-service:3306/scheduler?
    useUnicode=yes&characterEncoding=UTF-8&rewriteBatchedStatements=true
  # enter your license here, or type it through the GUI in first login
  - CONFIG_LICENSE_NAME=
  - CONFIG_LICENSE_EMAIL=
  - CONFIG_LICENSE_COMPANY=@licenseCompany@
  - CONFIG_LICENSE_PRODUCTIONKEY=@licenseProduction@
  - CONFIG_LICENSE_NONPRODUCTIONKEY=@licenseNonProduction@
  - CONFIG_CLUSTER_JOINCONFIG=multicastCluster
  # change to fit your network
  - CONFIG_CLUSTER_INTERFACE=10.*.*.*
  - CONFIG_CLUSTER_MULTICAST_GROUP=224.2.2.3
  - CONFIG_CLUSTER_MULTICAST_PORT=54327
  - LOG4J_LOGGER_COM_HAZELCAST=ERROR, A

deploy:
  replicas: 2
  labels:
    traefik.docker.network: weavenet
  traefik.port: 8080
  traefik.backend.loadbalancer.sticky: "true"
  traefik.frontend.rule: PathPrefix:/

networks:
- net

roboserver-service:
  image: roboserver:@productVersion@
  depends_on:
  - mysql-service
  environment:
  - ROBOSERVER_ENABLE_MC_REGISTRATION=true
  - ROBOSERVER_MC_URL=http://loadbalancer/
  - ROBOSERVER_MC_CLUSTER=Production
  - ROBOSERVER_MC_USERNAME=admin
  - ROBOSERVER_MC_PASSWORD=admin
  - ROBOSERVER_ENABLE_SOCKET_SERVICE=true
Note:

- Replace @productVersion@, @licenseCompany, @licenseProduction@, and @licenseNonProduction@ with your appropriate values.

- **CONFIG_CLUSTER_INTERFACE** must fit the Weave Net subnet in your Docker swarm. You can find the subnet using the following command on your manager node:

  ```bash
  host1$ docker network inspect weavenet
  ```

- The common network **net** refers to the external network **weavenet** that you created before.

- **Traefik** is used as the load balancer with sticky sessions.

- This setup runs a single instance of MySQL on a temporary volume. In a real production setup, the database also needs to be run clustered and with a permanent data volume.

- To run multiple instances of the RoboServer, you can add deployment constraints to `roboserver-service`.

6. Deploy the service stack on the manager node as follows.

   ```bash
   host1$ docker stack deploy -c docker-compose.yml rpa
   ```

   **Tip** Starting **managementconsole-service** with two replicas on an empty database may lead to a race condition. If you experience this situation, change the line **replicas: 2** to **replicas: 1** and run the preceding command. Wait until the services are started, change the line back, and then run the preceding command again.

   To stop the services, use the following command.

   ```bash
   host1$ docker stack down rpa
   ```

7. After deploying the stack, the Management Console can be accessed at the following URL.

   ```http://host1/```

## Tomcat Deployment

This chapter provides details on how to manually install the Management Console on a stand alone J2SE web container. For this guide we have chosen Tomcat. 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 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 Tomcat and set user password.
Installation

1. Download full Kofax RPA 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 Kofax RPA installation to the webapps directory on the Tomcat server and configure the .war file.


   - To upload applications, edit the following.
     ```
     <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>
     ```
   - If your policies require compulsory use of HTTPS protocols on your network, enable the HTTP Strict Transport Security Header (HSTS Header) on the Tomcat server by using the org.apache.catalina.filters.HttpHeaderSecurityFilter class in web.xml. See the Apache Tomcat documentation for details.
   - Management Console implements Content Security Policy as an added layer of defense that helps to detect and mitigate certain classes of attacks. A SecurityHeadersFilter filter that is mapped to all URLs is declared and configured in web.xml. To configure the header's value, set the contentSecurityPolicy variable. This is the configuration example of header filtering in the web.xml file:
     ```
     <filter>
     <filter-name>SecurityHeadersFilter</filter-name>
     <filter-class>com.kapowtech.scheduler.server.servlet.SecurityHeadersFilter</filter-class>
     <init-param>
     <param-name>contentSecurityPolicy</param-name>
     <param-value>default-src 'self' data: blob: 'unsafe-inline' 'unsafe-eval'</param-value>
     </init-param>
     </filter>
     <filter-mapping>
     <filter-name>SecurityHeadersFilter</filter-name>
     <url-pattern>/</url-pattern>
     </filter-mapping>
     ```

   If you do not require header filtering, either disable or remove the filter code and the corresponding filter mapping. For more information about possible options and header filtering, search the web for Content Security Policy.

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 Kofax RPA installation folder.

The version of ManagementConsole.war that ships with Kofax RPA 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

<table>
<thead>
<tr>
<th>File</th>
<th>Configures</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEB-INF/Configuration.xml</td>
<td>Clustering, password encryption, REST-Plugin</td>
<td>If you copy the version of the file from 8.1, it will automatically be upgraded once you start the Management Console</td>
</tr>
<tr>
<td>WEB-INF/login.xml</td>
<td>Administrators and users, this is where you integrate with LDAP</td>
<td></td>
</tr>
<tr>
<td>WEB-INF/classes/log4j.properties</td>
<td>Application logging</td>
<td></td>
</tr>
<tr>
<td>WEB-INF/spring/authentication.xml</td>
<td>User authentication</td>
<td></td>
</tr>
<tr>
<td>WEB-INF/roles.xml</td>
<td>Built-in roles in Management Console.</td>
<td></td>
</tr>
</tbody>
</table>

### Spring Configuration Files

Configuration.xml, login.xml, roles.xml, and authentication.xml are all Spring configuration files (www.springsource.org) and share the same general syntax outlined 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:

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

<table>
<thead>
<tr>
<th>File</th>
<th>Configures</th>
</tr>
</thead>
<tbody>
<tr>
<td>id=&quot;id&quot;</td>
<td>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.</td>
</tr>
<tr>
<td>class=&quot;SomeClass&quot;</td>
<td>The class identifies the code component which the bean configures.</td>
</tr>
</tbody>
</table>
In Kofax RPA 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 Kofax RPA, user management is enabled by default. See the Users Tab topic for more details. User population from previous installations can be performed using the Kofax RPA 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.

Important Please create and maintain the Kofax RPA product databases according to the recommendations in the product documentation. If you are considering database modifications or customizations, do not proceed without consulting Kofax; otherwise, the results are unpredictable and the software may become inoperable.

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

<table>
<thead>
<tr>
<th>Database</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM DB2</td>
<td>Create the database using CODESET UTF-8</td>
</tr>
<tr>
<td>MySQL 5.x</td>
<td>Create the database with utf8_bin collation:</td>
</tr>
<tr>
<td></td>
<td>CREATE DATABASE KAPOW_MC COLLATE utf8_bin</td>
</tr>
</tbody>
</table>
Database          | Recommendations |
------------------|-----------------|
Oracle            | We use NVARCHAR2, NCLOB types for Unicode. For case-sensitive comparison ensure that NLS_COMP is set to BINARY |
Microsoft SQL Server | 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:  
CREATE DATABASE KAPOWER_MC COLLATE SQL_Latin1_General_CP1_CS_AS  
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 Kofax RPA in the documentation\sql directory. See SQL Scripts for Kofax RPA 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 Kofax RPA 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.

```xml
<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"
</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, the relevant three lines above should instead be:

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

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

<table>
<thead>
<tr>
<th>Database</th>
<th>Query</th>
</tr>
</thead>
<tbody>
<tr>
<td>MySQL</td>
<td>/* ping */</td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>SELECT 1</td>
</tr>
<tr>
<td>Sybase Adaptive Server Enterprise</td>
<td>SELECT 1</td>
</tr>
<tr>
<td>IBM DB2</td>
<td>VALUES(1)</td>
</tr>
<tr>
<td>Oracle</td>
<td>SELECT 1 FROM DUAL</td>
</tr>
</tbody>
</table>

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.

**Configure Microsoft SQL Server in Windows Integrated Security**

If you use Microsoft SQL Server and Windows Integrated Security, computers running Design Studio and RoboServer must comply with the following:

- Run on Windows
- Run under a user account that has been granted access to the database
- The JDBC driver must be installed manually as described later in this part

To configure Microsoft SQL Server in Windows Integrated Security, do the following:

- Install JDBC drivers to the Tomcat folders: copy JAR file to the `lib` folder, copy DLL file to the `bin` folder.
- Do not upload the jar-file to Management Console, because it is not possible for the Management Console to distribute the JDBC driver.
- Do not forget to add `;integratedSecurity=true` to the connection URL, both in your ManagementConsole.xml (or context.xml) and in the Database Type definition in Management Console as well as any local definitions in Design Studio. See Add Database Type in Kofax RPA help at Management Console > Management Console Configuration and User Interface.

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 the 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 login screen.

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

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

License Updated

Predefined User Roles

Management Console provides roles that users can have. Roles are mapped to a user of a security group. User permissions are calculated based on the roles that are mapped to security groups the user is a member of. You can modify built-in roles or add additional roles. The built-in roles are defined in the `roles.xml` file. See **Project Permissions** and **Prohibit Kapplet users from creating schedules** for details.

The following is a list of built-in roles.

- **Administrator**: An administrator is a global role in all projects and has all rights (excluding special admin rights) including creation of new administrators and users in any project.
• **Project Administrator**: Users with Project Administrator role have a right to create new users in their own projects but cannot promote users to Administrators. They have a view right to view RoboServer and Cluster settings without changing them. Project Administrator is not a member of the Administrator group.

• **Developer**: Developers have a right to upload, download, and view all resource types in the repository. A user with this role can create, edit, and delete schedules, run robots, view run logs and clusters.

• **Viewer**: Viewers have similar view rights as developers without access to Kapplets and the rights to change or run anything.

• **API** (This user logs in only as a service authenticating via the API): A user with this role can use the repository API to read from and write to the repository.

• **DAS client user** (This user logs in only as a service authenticating via the API): This is a user that is created for remote Desktop Automation Service (DAS) clients, and can only access the DAS API. The DAS client user has a right to announce a DAS to the Management Console, and retrieve DAS configuration.

• **Password store user**: A user with this add-on role can access the password store. The role is provided on top of other roles, such as the Developer role. This role only provides access to the password store tab.

• **VCS Service user** (This user logs in only as a service authenticating via the API): The Version control service user is granted a special set of rights for the Synchronizer. This role has a right to add, modify, and delete resources. This is the only role that can deploy on behalf of another user to use the "deployer" feature in the VCS.

• **RoboServer** (This user logs in only as a service authenticating via the API): A restricted user that can only read from the repository. This role is used by RoboServers when accessing a cluster, retrieving repository items, and requesting passwords from the password store.

• **Kapplet Administrator**: A user who can create, view, run, and edit Kapplets.

• **Kapplet User**: A user who can view and run Kapplets. A user with this role cannot access the Management Console if this user has no other rights.

**admin user**

*admin* is not a member of the Administrator group, but it is a user that always has access to everything.

In an LDAP integration setup, the *admin* group is defined as part of the LDAP configuration. *admin* can then log in and define which LDAP groups should be mapped to the Developer, Administrator, RoboServer, and other roles.

In an internal user setup, the *admin* user is created at first start and can then login and create Administrators, Developers, and other users.

**admin special rights**

Besides being the initial user, *admin* also has special rights, such as:

• On the RoboServers tab, *admin* can click a RoboServer node and request a stack trace from the corresponding RoboServer.

• Only *admin* can create and import backups.

• In the password store, *admin* can move passwords to another project.
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:

![Login Screen](image)

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

User Not Mapped

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

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.

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Download and install a supported version of Apache Tomcat Server</td>
<td>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.</td>
</tr>
<tr>
<td>Download and install Java (JDK 1.8.0_40 or later)</td>
<td>Management Console will not initialize correctly if Apache Tomcat is started using any version of Java other than Java 8.</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ensure that the JAVA_HOME variable is pointed to the Java installation.</td>
<td>You can use the catalina run command from the \bin directory to start the server.</td>
</tr>
<tr>
<td>Start up the Apache Tomcat and confirm that the Apache Tomcat server will come online before attempting to deploy the Management Console application.</td>
<td>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 .war file so that we can easily gain access to the files we will need to edit to complete the installation and configuration process.</td>
</tr>
<tr>
<td>From a Kofax RPA installation, locate the ManagementConsole.war file that will be deployed under the Apache Tomcat \webapps directory</td>
<td>Select one of the support platforms.</td>
</tr>
<tr>
<td>Turn the Apache Tomcat server off.</td>
<td>Validation query to be specified is database specific. The online help has all accepted values for all supported databases.</td>
</tr>
<tr>
<td>Create a new database to be used by the Enterprise Management Console to hold its configuration.</td>
<td>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.</td>
</tr>
<tr>
<td>Create the DB user account to be used by the application to connect to the database via JDBC.</td>
<td>Deploying to &lt;APACHE_TOMCAT_INSTALL_DIR&gt;\lib makes it available to ALL apps running under Tomcat.</td>
</tr>
<tr>
<td>Create the Tomcat Context file: ManagementConsole.xml</td>
<td>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.</td>
</tr>
<tr>
<td>Restart the Apache Tomcat Server</td>
<td>Confirm the Tomcat main home page loads: <a href="http://localhost:8080">http://localhost:8080</a></td>
</tr>
</tbody>
</table>
**Advanced Configuration**

**LDAP and CA Single Sign-On Integration**

The installation guide shows you how to authenticate users using the internal user management. This topic describes how to use LDAP and CA Single Sign-On 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:

```xml
<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:

```xml
<bean id="ldapDirectories" class="com.kapowtech.mc.config.LdapDirectories" lazy-init="true">
  <property name="directories">
    <list>
      <!-- List of security groups which will be application administrators. Users in these groups will have all permissions. Only users in these groups can access the backup tab and create and restore backups -->
      <bean class="com.kapowtech.mc.config.LdapDirectory">
        <property name="adminGroups">
          <list>
            <value>KAPOWADMIN</value>
          </list>
        </property>
        <property name="ldapServerURL" value="ldap://ldap.kapowdemo.com:389"/>
        <property name="userDn" value="CN=LDAPtest,CN=Users,DC=kapowdemo,DC=local"/>
        <property name="password" value="change-me"/>
        <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"/>
      </bean>
    </list>
  </property>
</bean>
```
This defines a list of `ldapDirectory` beans named `ldap` and represents a list of connections to LDAP servers. Kofax RPA supports multi-forest LDAP integration, so you can specify several connections to LDAP directories. 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.

Important Group names must be unique across all ldap servers in the list.

Kofax RPA 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

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ldapServerURL</td>
<td>The URL to the LDAP server. This uses either the ldap:// or ldaps:// protocol.</td>
</tr>
<tr>
<td>userDn</td>
<td>The DN (distinguished name) used to log in to LDAP to authenticate other users.</td>
</tr>
<tr>
<td>password</td>
<td>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.</td>
</tr>
<tr>
<td>userSearchBase</td>
<td>Subdirectory in the LDAP tree where users can be found.</td>
</tr>
<tr>
<td>userSearchFilter</td>
<td>Filter that is applied to find the username.</td>
</tr>
<tr>
<td>userSearchSubtree</td>
<td>Set to true if users may be located in the subdirectory of the userSearchBase.</td>
</tr>
<tr>
<td>groupSearchBase</td>
<td>Subdirectory in the LDAP tree where groups can be found.</td>
</tr>
<tr>
<td>groupSearchFilter</td>
<td>Filter that is applied to identify the users in this group.</td>
</tr>
<tr>
<td>groupRoleAttribute</td>
<td>Attribute that holds the group name.</td>
</tr>
<tr>
<td>groupSearchSubtree</td>
<td>Set to true if groups may be located in the subdirectory of the groupSearchBase.</td>
</tr>
<tr>
<td>convertToUpperCase</td>
<td>Should the group names be converted to upper case, true by default.</td>
</tr>
<tr>
<td>allGroupsFilter</td>
<td>Optional. Controls which groups are displayed when creating project permissions, see below.</td>
</tr>
<tr>
<td>fullNameAttribute</td>
<td>Attribute to fetch the full name of the user.</td>
</tr>
<tr>
<td>emailAttribute</td>
<td>Attribute to fetch the email of the user.</td>
</tr>
<tr>
<td>referral</td>
<td>Set to “follow” to allow redirection to sub nodes in the LDAP tree.</td>
</tr>
</tbody>
</table>
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.

CA Single Sign-On Integration

The Management Console supports pre-authentication using CA Single Sign-On. With CA Single Sign-On the identity of the user is established before accessing the Management Console, and the user's identity is communicated through an 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.

CA Single Sign-On integration is disabled by default. You can enable it by setting the useSiteMinder property to true in the login.xml file as follows:

```xml
<bean class="com.kapowtech.scheduler.server.spring.security.AuthenticationConfiguration" id="authenticationConfiguration">
  <property name="useLdap" value="false"/>
  <property name="useSiteMinder" value="true"/>
</bean>
```
After you enable the CA Single Sign-On integration, specify the name of the HTTP header that contains the user's distinguished name. The accountAttribute property identifies 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, which must be a regular expression (with a single set of parentheses identifying the account name), and the (.*) value in the accountAttributePattern property means everything in the attribute. To extract the account name from the user's email address in 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 CA Single Sign-On 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 log out of the system, since the presence of the CA Single Sign-On header means that you are always authenticated. To log out, close your browser.

**Limitations**

CA Single Sign-On integration only works when the Management Console is accessed through the browser. However, if the Management Console is accessed by applications that are not browsers, the CA Single Sign-On authentication mechanism is not used and such services require a set of credentials (username and password) set in the Management Console. These clients include, but are not limited to, 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 the Management Console. This
requires access to the following URLs (relative to the context path where Management Console is deployed).
• /License/*/  
• /secure/*/  
• /IDESettings/*/  
• /rest/*/  
• /ws/*

Access to the URLs above is protected by basic authentication with passwords set in the Management Console.

**REST services**
REST services are 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.

**RoboServer**
RoboServer is protected by basic authentication for registering to a cluster and for resource requests.

**Desktop Automation service**
Desktop Automation service is protected by basic authentication for registering and status updates.

**Any application based on Kofax RPA Java or .Net API**
Any application based on Kofax RPA Java or .Net API is protected by basic authentication when accessing the Management Console.

**Example: Usage example**
- **Jane** is the designated Management Console administrator. Because she is added to the **kapowadmins** group in the AD, this group is mentioned in **login.xml** and once she authenticates her browser with CA Single Sign-On, she is immediately logged to Management Console.

- **John** is a robot developer who is a member of the group **users** in the AD and currently he is declined when trying to log to the Management Console.

Jane must grant some privileges to the **users** group in the Management Console for the selected project before John can log in as in the following figure.
Now John can log in to the Management Console using CA Single Sign-On.

When John starts Design Studio, he is still required to enter his credentials to acquire a license. To get credentials, the administrator must log to the Management Console and (re-)set the password for John as follows: navigate to **Admin > Users**, select **John** and choose **Reset Password**.

After that Jane must hand this password to John and he can now use it in Design Studio.

Jane can also create local service users that are never allowed to log to the Management Console, such as for the RoboServer service or Desktop Automation Service. Note the following:

- The groups you select for service users must originate only from Active Directory.
• The group must have the appropriate privileges set in the Management Console.

Example: Example login.xml file

```xml
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
    <!-- 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"/>
        <property name="accountAttribute" value="sAMAccountName"/>
        <property name="accountAttributePattern" value="(.*)"/>
    </bean>

    <!-- ldap directories -->
    <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://localhost:389"/>
                    <property name="userDn" value="CN=User,OU=TheEnterprise,DC=kapowdemo,DC=local"/>
                    <property name="password" value="change-to-password"/>
                    <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})"/>
                </bean>
            </list>
        </property>
    </bean>

    <bean id="ldap" class="com.kapowtech.mc.config.LdapDirectory">
        <property name="adminGroups">
            <list>
                <value>KAPOWADMIN</value>
            </list>
        </property>
        <property name="ldapServerURL" value="ldap://localhost:389"/>
        <property name="userDn" value="CN=User,OU=TheEnterprise,DC=kapowdemo,DC=local"/>
        <property name="password" value="change-to-password"/>
        <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})"/>
    </bean>
</beans>
```
SAML Single Sign-On Integration

The Management Console supports user pre-authentication using SAML Single Sign-On.

The following procedure is written with the assumption that you have already created and configured a SAML application in your identity provider.

Integration of the Management Console with SAML Single Sign-On is disabled by default. To enable it, in the login.xml file, locate and set the useSaml property to true.

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

After you enable the integration in login.xml, you need to configure the identity provider and the service provider settings. In the saml.xml file located in the folder \WEB-INF\spring, modify the following properties to match your setup.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>forceAuthN</td>
<td>When set to true, the identity provider re-authenticates users and does not rely on previous authentication events. Default is false.</td>
</tr>
<tr>
<td>groupsAttributes</td>
<td>Group attribute. User access to the Management Console is managed by means of groups that a particular user belongs to. Names of groups defined in the saml.xml file must match those defined in your SAML application.</td>
</tr>
<tr>
<td>email</td>
<td>Email address of the Management Console user.</td>
</tr>
<tr>
<td>firstname</td>
<td>First part of full name of the Management Console user.</td>
</tr>
<tr>
<td>lastname</td>
<td>Second part of full name of the Management Console user.</td>
</tr>
<tr>
<td>idpName</td>
<td>Name of the identity provider. Possible values are OKTA or ONELOGIN. Otherwise, set to DEFAULT.</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>idpGroupNameSeparator</td>
<td>Delimiter to use to separate identity provider group names. Takes effect only if the identity provider specified with idpName is OneLogin. Otherwise, this property is ignored.</td>
</tr>
<tr>
<td>entityId</td>
<td>URL of the Management Console, plus saml/login. You can get this URL from your SAML application. For example: <a href="http://localhost:8080/ManagementConsole/saml/login">http://localhost:8080/ManagementConsole/saml/login</a></td>
</tr>
<tr>
<td>entityBaseURL</td>
<td>Base URL of the Management Console. For example: <a href="http://localhost:8080/ManagementConsole">http://localhost:8080/ManagementConsole</a></td>
</tr>
<tr>
<td>maxAuthenticationAge</td>
<td>Validity of single sign-on in seconds. Time window allowed for users to sign in after they are initially authenticated with the identity provider. By default, it is 86400 seconds, which is 24 hours. Use this property to change the default.</td>
</tr>
<tr>
<td>responseSkew</td>
<td>Inaccuracy tolerance in seconds for comparing clocks between the identity provider server and the computer where the Management Console is deployed. As the clock synchronization may not be fully accurate, a tolerance of 60 seconds is applied by default. Use this property to change the default.</td>
</tr>
<tr>
<td>maxAssertionTime</td>
<td>Validity of assertions processed during the single sign-on. If the assertion time reaches the configured limit, the authentication becomes invalid. By default, it is limited to 6000 seconds, which is 100 hours. Use this property to change the default.</td>
</tr>
</tbody>
</table>

The following snippets from the example saml.xml file contain the properties you need to configure.

```xml
<bean id="samlEntryPoint" class="org.springframework.security.saml.SAMLEntryPoint" lazy-init="true">
    <property name="defaultProfileOptions">
        <bean class="org.springframework.security.saml.websso.WebSSOProfileOptions">
            <property name="includeScoping" value="false"/>
            <property name="forceAuthN" value="false"/>
            <property name="passive" value="false"/>
        </bean>
    </property>
    <property name="filterProcessesUrl" value="/saml/entry"/>
</bean>
```
<bean id="samlAuthenticationProvider" class="com.kapowtech.scheduler.server.spring.security.GroupProvidingSAMLAuthenticationProvider" lazy-init="true">  <constructor-arg ref="platformEMF"/>  <property name="internalAuthenticationProvider" ref="internalAuthenticationProvider"/>  <property name="customerNameMapper" value="false"/>  <property name="customerNameMapperIdentifier" value=""/>  <property name="groupsAttributes">  <list>    <value>FirstUserGroup</value>    <value>SecondUserGroup</value>    <value>groups</value>  </list>  </property>  <property name="adminGroups">  <list>    <value>KapowAdmins</value>  </list>  </property>  <property name="createUsers" value="true"/>  <property name="assignGroups" value="true"/>  <property name="consumer" ref="webSSOprofileConsumer"/>  <property name="email" value="email"/>  <property name="firstname" value="firstname"/>  <property name="lastname" value="lastname"/>  <property name="idpName" value="ONELOGIN"/>  <property name="idpGroupNameSeparator" value=";"/>  <property name="idpUserNameRegex" value="^[a-zA-Z0-9]*$"/>  <property name="idpEmailRegex" value="^[A-Z0-9._%+-]+@[A-Z0-9.-]+\.[A-Z]{2,6}$"/></bean>

<bean id="metadataGeneratorFilter" class="org.springframework.security.saml.metadata.MetadataGeneratorFilter">  <constructor-arg>    <bean class="org.springframework.security.saml.metadata.MetadataGenerator">      <property name="entityId" value="http://localhost:8080/ManagementConsole/saml/login"/>      <property name="requestSigned" value="false"/>      <property name="entityBaseURL" value="http://localhost:8080/ManagementConsole"/>      <property name="extendedMetadata">        <bean class="org.springframework.security.saml.metadata.ExtendedMetadata">          <property name="idpDiscoveryEnabled" value="false"/>          <property name="signMetadata" value="false"/>        </bean>      </property>    </bean>  </constructor-arg></bean>

<bean id="webSSOprofileConsumer" class="org.springframework.security.saml.websso.WebSSOProfileConsumerImpl">  <property name="maxAuthenticationAge" value="86400"/>  <property name="responseSkew" value="600"/>  <property name="maxAssertionTime" value="6000"/></bean>

<bean id="metadata" class="org.springframework.security.saml.security.saml.metadata.CachingMetadataManager">  <constructor-arg>    <list>      <bean class="org.opensaml.saml2.metadata.provider.HTTPMetadataProvider">      </bean>    </list>  </constructor-arg></bean>
Configure JMS Mode

To enable JMS mode in Kofax RPA, 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](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.

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

   **Important** If you want to configure access for Kofax RPA 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 Kofax RPA 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"/>`.

---

**<constructor-arg>**
- `<value type="java.lang.String">http://example.okta.com/saml/metadata/222670a0-2b96-48ef-975a-b7267446d09e</value>`
- `<constructor-arg>`
  - `<value type="int">10000</value>`
- `<property name="parserPool" ref="parserPool"/>
- `<bean`

**<bean class="org.opensaml.saml2.metadata.provider.FilesystemMetadataProvider">**
- `<constructor-arg>`
  - `<value type="java.io.File">classpath:security/idp.xml</value>`
- `<property name="parserPool" ref="parserPool"/>
- `<bean>
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 Kofax RPA 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-<version>-bin.jar) to the `lib` subdirectory of the ActiveMQ installation directory. Substitute `<version>` with the correct version of the MySQL connector for your Java, such as mysql-connectorjava-8.0.16.jar. Use the latest available version of the driver. For more information, see https://repo1.maven.org/maven2/mysql/mysql-connector-java/.

3. Create an ActiveMQ schema in your MySQL database.
Beans code example.

```xml
<beans ...>
  ...
</beans>

<!-- 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.

```xml
<!-- 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-dbcp-1.4.jar` (see https://commons.apache.org/proper/commons-dbcp/ 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.
   ```xml
   <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.
   ```bash
   -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

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load balancer</td>
<td>An HTTP load balancer is required to distribute requests between multiple Tomcat servers.</td>
</tr>
<tr>
<td>Clustered platform database</td>
<td>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.</td>
</tr>
<tr>
<td>Tomcat session replication</td>
<td>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.</td>
</tr>
<tr>
<td>Apache Tomcat Connector</td>
<td>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.</td>
</tr>
<tr>
<td>Hazelcast</td>
<td>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 an 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.</td>
</tr>
</tbody>
</table>
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 website: https://tomcat.apache.org
3. Install Tomcat on both hosts and set user password. See Tomcat Deployment for more information.
4. Install Management Console on Tomcat on both hosts.
5. 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.
   • 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.properties 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.

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

<Engine name="Catalina" defaultHost="localhost" jvmRoute="jvm1">
  <Cluster className="org.apache.catalina.ha.tcp.SimpleTcpCluster"/>
</Engine>

For more information, see Tomcat Session Replication.

10. 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"/>
  </property>
  <!-- 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-->
      </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-->
      </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 on Tomcat 5.5.

```xml
<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"/>
```
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 uncommenting 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 uncommenting 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:

<table>
<thead>
<tr>
<th>Node Id</th>
<th>Interface</th>
<th>Status</th>
<th>Connected to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node-1</td>
<td>/127.0.0.1:5701</td>
<td>Running</td>
<td>false</td>
</tr>
<tr>
<td>Node-1</td>
<td>/127.0.0.1:5702</td>
<td>Running</td>
<td>true</td>
</tr>
</tbody>
</table>

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:

```xml
<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 have to configure Management Console to perform a password conversion.

**Important** Upgrading the keystore is available only for the Management Console keystore that stores passwords in schedule input objects. It cannot be used to upgrade passwords stored in the password store or any other encrypted passwords.

To upgrade the keystore, copy the current keystore file into a new location, such as your users home folder, then modify `Configuration.xml` to create a password converter with a reference to the old keystore:

```xml
<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 you 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 you 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:

```xml
<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 it 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:

```xml
<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 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
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.

Simultaneous Sessions for a User Account

By default, the system allows a single user account to be authenticated simultaneously from multiple locations. To restrict the possibility of concurrent sessions for a single user account, adjust the settings in the authentication.xml file that resides in WEB-INF/spring.

In authentication.xml, locate the following section and remove the comment tags (marked in bold here):

```
<!--
<bean class="com.kapowtech.scheduler.server.spring.security.KapowConcurrentSessionControlAuthenticationStrategy" lazy-init="true"> <constructor-arg ref="sessionRegistry"/> <constructor-arg ref="platformEMF"/> <property name="maximumSessions" value="1"/> <property name="exceptionIfMaximumExceeded" value="true"/> </bean>
-->
```

Also, to define the timeout to automatically end the session if the user does not perform any actions, configure the session-timeout property in the web.xml file that resides in WEB-INF. By default, the timeout is 30 minutes.

Prohibit Kapplet users from creating schedules

By default, Kapplet users and Kapplet administrators can create schedules for Kapplets. Follow the procedure below to prohibit Kapplet users and Kapplet administrators from creating schedules for Kapplets.

   A WAR file is compressed using a zip algorithm.
2. Locate the Kapplet User role and the kappletSchedulesCreator property in that role.

```
<bean class="com.kapowtech.scheduler.client.auth.Role">
```

---

certificate. Note that localhost and 127.0.0.1 is not considered the same host when it comes to hostname checks.
3. Change `kappletSchedulesCreator` value to `false`.
4. Repeat steps 3 and 4 for the Kapplet administrator by locating the Kapplet Administrator role.
5. Re-zip and deploy `ManagementConsole.war` to your Tomcat server.

See Tomcat Deployment and Configure ManagementConsole.war for details.

### Set up Robot File System server

Robot File System (RFS) server provides shared storage for RoboServers, Design Studio instances, and Desktop Automation agents. To set up an RFS server on a Tomcat server, perform the following steps.

1. Locate the `rfs.war` file in the `WebApps` folder in your Kofax RPA installation folder, for example on a Windows system, `C:\Program Files (x86)\Kofax RPA 10.6.0.0 110 x32\WebApps`.
2. Copy `rfs.war` to the `webapps` folder in your Apache Tomcat installation folder, for example on a Windows system, `C:\apache-tomcat-9.0.20\webapps`.
3. Restart the Tomcat server.
   Once you restart the Tomcat server, the `webapps` folder in the Tomcat installation folder should contain the `rfs` subfolder.
4. In a text editor, open the `web.xml` file located at the `webaps\rfs\WEB-INF` folder in the Tomcat installation folder.
5. Locate the `mc-path` parameter and specify the Management Console URL in `param-value`. For example, `http://localhost:50080`.
6. Specify a user name and a password if necessary to access the Management Console in `mc-username` and `mc-password` respectively.
7. Locate and set the `allow-absolute-paths` parameter to either `true` or `false`. If `allow-absolute-paths` is set to `true`, you can create RFS shares with paths like `c:\files`, `z:\data`, and other paths that the RFS service user can access. If `allow-absolute-paths` is set to `false` and `data-path` is set to a specific folder, such as `/data` on Linux, the service only allows access to shares with a path within the specified folder, such as `/data`.
8. Specify a folder to store temporary robot run data in `data-path`. For example, `C:\RFSData`. Note that you can specify the absolute path if `allow-absolute-paths` is set to `true`. Temporary shares are created and deleted as subfolders of the specified folder.
9. Leave other settings as they are and restart the Tomcat server.
10. Open the Management Console and go to `Admin > Settings > Robot File System Server`. Select `Use RFS Server` and specify the URL of the Tomcat server where you set up the RFS server, for example, `http://myserver.mydomain:8080/rfs`. Leave the `User` and `Password` fields as they are.

Now you can use file systems configured to share and store data used and/or produced by robots. See "Robot File System" in help for details.
Chapter 4

WebSphere 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 on a WebSphere server.

The following procedure helps you set up Management Console and your WebSphere software to work together.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>com.ibm.crypto.provider.DoRSATypeChecking</td>
<td>false</td>
</tr>
<tr>
<td>com.ibm.websphere.persistence.ApplicationsExcludedFromJpaProcessing</td>
<td>*</td>
</tr>
</tbody>
</table>

1. Download full Kofax RPA installer and proceed with the installation. Select the Management Console WAR option during the installation.

2. Open and log in to the WebSphere Administrative Console.

3. Set the following Java Virtual Machine Custom properties. To set the properties, in the left pane of the WebSphere Administrative Console navigate to Servers > Server Types > WebSphere Application Servers and click the application server that you will use to run Kofax RPA Management Console. After that go to Process definition > Java Virtual Machine > Custom properties.

   a. Extract the login.xml file located at WEB-INF/login.xml in the ManagementConsoleWebsphere.war file.

   b. Define the administrator role for Management Console by adding the following bean to the login.xml file. See LDAP Integration for more information.

   ```xml
   <bean id="webSphereConfiguration" class="com.Kapowtech.mc.config.WebSphereConfiguration" lazy-init="true">
     <property name="adminGroups">
       <list>
         <value>KapowAdmin</value>
       </list>
     </property>
   </bean>
   ```


   The Management Console application comes in the form of a Web Application Archive (WAR file) named ManagementConsoleWebsphere.war, which is located in the /WebApps folder in the Kofax RPA installation folder. Before you can deploy it as a standalone application on WebSphere, 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 ManagementConsoleWebsphere.war to your WebSphere server. See Configure ManagementConsole.war for more information.
c. Re-zip the ManagementConsoleWebsphere.war file adding the edited login.xml.

5. Add the LDAP repository to the realm for Kofax RPA under Security > Global security > Federated repositories. For example:
   Repository KapowDemo, DC=Kapowdemo, DC=local.

6. Specify a datasource under Resources > JDBC > Data sources. We strongly recommend that you create a new database for the tables used by the Management Console. You can use a derby database embedded into the WebSphere, but we recommend using MySQL or other enterprise-class database. See Create a New Database for details.

7. Deploy the ManagementConsoleWebsphere.war file as follows:
   a. Navigate to Applications > New Application and follow the procedure to install a new enterprise application from a local file system.
   b. Using the Fast Path in the application installation, change the following:
      - Application name, such as ManagementConsole.
      - Target Resource JNDI Name to the designated JNDI name of your configured data source binding the resource reference jdbc/Kapow/platform to the default data source.
      - The Context Root to /mc.

8. For the ManagementConsole application set Class loader order to Classes loaded with local class loader first under Enterprise Applications > ManagementConsole > Class loader.


10. Map security role to users and groups under Enterprise Applications > ManagementConsole > Security role to user/group mapping.

Once the setup procedure is complete, restart the WebSphere server and try to login to the Enterprise Management Console as user: admin, password: admin.
Configure Robot Lifecycle Management

With the Robot Lifecycle Management, you can control work objects of various types in a version control system. Using this functionality, you can compare and synchronize the state of objects between the Management Console and your repository. The synchronization is done using Kofax RPA Synchronizer included in your installation. The following objects can be synchronized: robots, types, snippets, resources, schedules, and OAuth.

Currently, only the Git version control system is supported for use. This procedure is written with the assumption that you have required knowledge to use Git.

**Note** If the synchronizer operates on a file system that has specific non-standard limitations on characters and, therefore, may apply some restrictions on object names, it may cause issues during the synchronization of those objects, even if the file system itself is supported. To ensure successful synchronization, check that your file system allows characters used in the synchronized object names.

**Create a new empty repository**

1. The repository can be local or remote.
   - For a local repository, place it a local folder on your computer. If you do not create a local repository manually, it is automatically created when you run the Synchronizer.
   - For a remote repository, a clone of the repository is created on your computer.

2. Create a new branch. For example, `branch-one`.

**Specify the repository to use in the Management Console**

1. Start the Management Console.

2. In the upper group of tabs, select **Admin > Projects**, select the project to synchronize with the repository and click the Edit button.
3. In the new dialog, select the **Repository** tab.
   a. In the **URL** property, type the local path or URL to the repository directory.
      **Example**
      - Local: C:\Repository\parent
      - Remote: git@github.com:UserName/MyRep.git for SSH connection or https://github.com/UserName/MyRep.git for HTTP connection
   b. In the **Branch** property, specify the branch to use. For example, **branch-one**.
   c. To make the repository the only source for object changes, select **read-only**.
      When this option is enabled, you cannot upload or change objects belonging to the synchronized project in the Management Console or upload objects from the Design Studio.
   d. To enable the configuration specified above, select **enabled**.
   e. Under **Objects to synchronize**, select the objects to include in the synchronization and save the changes.
      The dialog box is closed.

All objects that are currently maintained by the Management Console will be synchronized with the repository. Before starting the synchronization, you can check these objects and make modifications on the respective tabs in the Management Console.

**Start the synchronization**

To connect the Management Console and your repository, run the **Synchronizer** shortcut from the start menu. By default, the synchronization runs with an interval of 10 seconds. The Management Console user and password are not used.

To configure custom settings, in the command prompt, specify the **-c** property for the **synchronizer.exe** file. With this property, you can use properties from the command line and ignore the synchronizer.settings file and environment. You can specify the following properties:

* **-c,--command-line** Uses settings specified in the command-line and ignores the settings file.
* **-e,--environment** Uses settings from the environment and ignores the settings file.
* **-g,--generate-ssh-keys <argument>** Generates a key-pair for SSH authentication and saves it to the specified folder. For example, -g C:\Work\MyKeys
* --mc_url <argument> **Required.** URL to connect to the Management Console, containing the protocol and a port number. Only used when **-c** is specified.
* --username <argument> **Required.** Management Console user. Only used when **-c** is specified.
* --password <argument> **Required.** Password for the Management Console user. Only used when **-c** is specified.
* --interval <argument> **Required.** Interval in seconds between synchronization runs. If set to a value equal to or less than 0 or not a numeric value, the Synchronizer runs once and exits. Only used when **-c** is specified.
* --no-host-key <argument> **Optional.** Disables strict SSH host-key checking. Default is **false**. Only used when **-c** is specified.
* --private-key <argument> **Required.** Path to a file containing the private SSH key to connect to a remote repository. When connecting to a local repository, this attribute is ignored, but any value must be specified. Only used when **-c** is specified.
• -r, --reset-hard Resets the version information and removes all local cache.
• -s, --save Saves the configuration settings in the synchronizer.settings file and exits.
• -v, --version Prints version information and exits.
• -h, --help Prints the description of properties and exits.

Example

```
Synchronizer.exe -c --mc-url http://localhost:8080/ManagementConsole --username admin
--password pass --interval 1 --no-host-key false --private-key $USER_HOME\.ssh\id_rsa
-s
```

Check the synchronization result

To check the synchronization result, see the respective log file **log4j_synchronizer.properties**. On a Windows system, the log file is located at: `User home\AppData\Local\Kofax RPA\version \Configuration`.

If synchronization is successful, the log contains the name of the synchronized project and a commit ID of the synchronization. The synchronization is run at the specified interval, and object changes are automatically synchronized between the Management Console and the repository once the changes appear.

If there are conflicting changes, the repository object version has a priority over changes in the Management Console. In this case, the conflicting Management Console changes are ignored.

**Note** Currently, it is not supported to rename and change location of synchronized files from the repository. In this case, references to these files in the Management Console become incorrect.

A successful synchronization includes:

• commit ID. Denotes a commit of the repository object changes synchronized with the Management Console.

• timestamp. All objects modified in the Management Console before this point in time are synchronized with the repository.

In the Management Console, to see the author of a newly added object, commit message, object revision, and date of the last modification, ensure that the following columns are added to the respective view: **Modified By, Commit Message, Revision Number**, and **Last Modified**, respectively.
Chapter 6

Kofax RPA Process Discovery

Kofax RPA Process Discovery helps you gather the data necessary to monitor user activity and process bottlenecks, and to make informed decisions about using Kofax RPA in your production environment.

**Note** Process Discovery relies on Windows UI Automation API. Do not run any UI Automation API clients on the same computer simultaneously with Process Discovery Agent.

Your product includes the files you need to successfully install the Kofax RPA Process Discovery components. See the following table.

<table>
<thead>
<tr>
<th>Components</th>
<th>Required Installation File</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux</td>
<td>Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_&lt;buildnumber&gt;.zip</td>
</tr>
<tr>
<td>• Docker Tools for installing and running Analyzer</td>
<td></td>
</tr>
<tr>
<td>• .deb and .rpm packages</td>
<td>Process Discovery Analyzer is designed to process the recorded raw data and to generate refined data for the Kofax Analytics for RPA dashboard views.</td>
</tr>
<tr>
<td>Windows</td>
<td>Kofax_RPA_ProcessDiscoveryAgent_10.6.0.0_&lt;buildnumber&gt;_x32.msi</td>
</tr>
<tr>
<td>Process Discovery Analyzer .msi installer</td>
<td>Process Discovery Agents are installed on computers to gather user activity information in specified applications and store the data in a database.</td>
</tr>
<tr>
<td>Kofax Analytics for RPA</td>
<td>• Kofax Insight installation file, such as:</td>
</tr>
<tr>
<td></td>
<td>KofaxInsightSetup_6.1.0.0.&lt;buildnumber&gt;_x64.msi</td>
</tr>
<tr>
<td></td>
<td>• Kofax Analytics for RPA project zip file, such as:</td>
</tr>
<tr>
<td></td>
<td>Kofax_RPA_KAFRPA_2.0.&lt;version&gt;_.zip</td>
</tr>
</tbody>
</table>

To use Process Discovery, perform the following installation and configuration steps.

1. Depending on your environment, perform one of following:
   - Deploy Analyzer using Docker on Linux
   - Deploy Process Discovery Analyzer on Windows
   - Deploy Process Discovery Analyzer on Linux

2. **Deploy Process Discovery Agents.**

3. **Use Kofax Analytics for RPA to analyze Process Discovery data.**
Kofax RPA Administrator's Guide

Important Kofax RPA Process Discovery is designed to use a MySQL database. For supported versions of MySQL, see the Kofax RPA Technical Specifications document on the Kofax support portal. We recommend using a dedicated server for your MySQL database and run no more than twenty agents simultaneously for one Process Discovery group.

Deploy Analyzer using Docker on Linux

This procedure provides basic steps for deploying Process Discovery Analyzer on a standalone server on a Linux-based system using Docker Compose files.

1. Start Management Console.
2. Download Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.zip and extract the archive to a folder on your computer.
3. Download Docker and Docker Compose from https://www.docker.com and install them on your computer.
4. You can add the current user to the Docker group to avoid being asked to type sudo with every Docker command. For example, to add a "kofax" user, replace docker:x:<n> with docker:x:<n>:kofax in the /etc/group file. Log out and log in or reboot to update permissions.
5. Navigate to the folder with extracted files. In the compose-examples folder, open docker-compose.yml in a text editor and specify the following environment variables in the environment sections inside the file. The variables provide information to connect to the Management Console and schedule Analyzer runs:

   analyzer-service section
   • MC_URL: Management Console URL
   • MC_USER: Username
   • MC_PASSWORD: Password
   • LOG: Sets logging level. Possible values are CRITICAL, ERROR, WARNING, INFO, DEBUG.

   mysql-server-service section
   MYSQL_ROOT_PASSWORD: Specify a password for the root user to access the database.

Analyzer default settings

MC_URL=localhost:50080
LOG=INFO

For the list of Analyzer options and default settings, see the "Process Discovery Analyzer options" topic in the Kofax RPA help.
6. In the terminal, execute the following command:

```
docker-compose -p process_discovery -f compose-examples/docker-compose.yml up --build
```

The first time you build images, it may take some time to prepare them. You do not need to build the images again. The next time you want to run the containers, omit the `--build` option as follows:

```
docker-compose -p process_discovery -f compose-examples/docker-compose.yml up
```

As soon as Docker Compose starts the containers, you can view the messages from executing the Analyzer in a console window.

Once started, Analyzer works until you stop it.

To update or reinstall the image, clear the cache by running the following command before building the Analyzer image.

```
docker-compose -p process_discovery -f compose-examples/docker-compose.yml rm -v
```

**Docker Compose example**

The `compose-examples` folder contains one docker-compose file. It provides an example of how a container can be configured and run.

```yaml
docker-compose.yml
```

This configuration starts a MySQL server and Analyzer.

7. Open Management Console and specify Process Discovery Analyzer parameters. Use the default settings where they are available in the following fields.

a. In the Management Console, select **Admin > Settings**.

b. Expand **Process Discovery Analyzer** and click **Settings** in the left pane.

c. Specify Process Discovery Analyzer database connection settings, runtime parameters, and supply the database root password that you specified in the `MYSQL_ROOT_PASSWORD` option in `docker-compose.yml`.

d. Perform database provisioning by clicking **Create schema** and **Grant user access** in the **Database Provisioning** section. For details, see the "Process Discovery Analyzer" topic in the Kofax RPA help.

---

**Deploy Process Discovery Analyzer on Windows**

Use the following information to run Process Discovery Analyzer under Windows without using Docker.

---

2 This is an IP address or a domain name of the computer running the Docker container with MySQL server. Note that you cannot specify `localhost` or `127.0.0.1` as the address.
To deploy Process Discovery Analyzer on Windows without Docker, you must have a running MySQL server.

1. Start and open Management Console and specify Process Discovery Analyzer parameters.
   a. In the Management Console, select Admin > Settings.
   b. Expand Process Discovery Analyzer and click Settings in the left pane.
   c. Specify Process Discovery Analyzer database connection settings, runtime parameters, and supply credentials to perform database provisioning. For more details, see the "Process Discovery Analyzer" topic in the Kofax RPA help.
   d. Perform database provisioning by clicking Create schema and Grant user access in the Database Provisioning section.

2. Download Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.zip and extract the archive to a folder on your computer.

3. Navigate to the extracted files and run Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.msi.

By default, the Process Discovery Analyzer is installed in C:\Program Files (x86)\Kofax RPA Process Discovery Analyzer 10.6.0.0.<buildnumber> x32. You can change the installation path if necessary.

Note Any previous version of the Process Discovery Analyzer is removed when you install a new version of the Analyzer.

4. Navigate to KofaxRPAProcessDiscoveryAnalyzer.exe and run it. To specify options other than default, run Analyzer in the Command Prompt window with specified options. See "Process Discovery Analyzer options" in help for details.

Analyzer default settings

<table>
<thead>
<tr>
<th>MC_URL==localhost:50080</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG=INFO</td>
</tr>
</tbody>
</table>

For the list of Analyzer options and default settings, see the "Process Discovery Analyzer options" topic in Kofax RPA help.

Deploy Process Discovery Analyzer on Linux

Use the following information to run Process Discovery Analyzer under Linux without using Docker.

1. Start and open Management Console and specify Process Discovery Analyzer parameters.
   a. In the Management Console, select Admin > Settings.
   b. Expand Process Discovery Analyzer and click Settings in the left pane.
   c. Specify Process Discovery Analyzer database connection settings, runtime parameters, and supply credentials to perform database provisioning. For more information, see the "Process Discovery Analyzer" topic in the Kofax RPA help.
   d. Perform database provisioning by clicking Create schema and Grant user access in the Database Provisioning section.
2. Download Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.zip and extract it to a folder on your disk. The extracted folder contains two installation packages:
   • Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.deb for Debian-based systems
   • Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.rpm for Red Hat-based systems
3. To install the Analyzer on your system, run the appropriate command.
   a. For a Debian-based system, use the following command to install or upgrade the Analyzer:
      ```
      sudo dpkg -i Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.deb
      ```
      To uninstall the Analyzer, run:
      ```
      sudo dpkg -r kofax-rpa-processdiscoveryanalyzer
      ```
   b. For a Red Hat-based system, use the following command to install the Analyzer:
      ```
      sudo rpm -i Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.rpm
      ```
      To upgrade the Analyzer, run:
      ```
      rpm -Uvh Kofax_RPA_ProcessDiscoveryAnalyzer_10.6.0.0_<buildnumber>.rpm
      ```
      To uninstall the Analyzer, run:
      ```
      sudo rpm -e kofax-rpa-processdiscoveryanalyzer
      ```
   By default, the Analyzer is installed at /opt/KofaxRPA/ProcessDiscoveryAnalyzer. Now you can run it using the command in the following step.
4. To run the Analyzer, navigate to /opt/KofaxRPA/ProcessDiscoveryAnalyzer and run the following command.
   ```
   ./KofaxRPAProcessDiscoveryAnalyzer
   ```
   
   **Analyzer default settings**
   
   ```
   MC_URL=localhost:50080
   LOG=INFO
   ```
   
   For the list of Analyzer options and default settings, see the "Process Discovery Analyzer options" topic in the Kofax RPA help.

---

### Deploy Process Discovery Agents

Process Discovery Agents are installed on computers to gather user activity information in specified applications and store the data in a database.

Start and open Management Console and create at least one group to logically combine computers and assign agents to, such as financial_dept, hr_dept, sales_dept, or others. When you deploy Process Discovery Agents, specify a name of the group created in the Management Console.

1. In the Management Console, select Admin > Settings.
2. Click Process Discovery Groups in the left pane.
   This action creates a new group.
4. Specify necessary values for the created group. For details, see the "Process Discovery Groups" topic in the Kofax RPA help.

5. Perform database provisioning by clicking Create schema and Grant user access in the Database Provisioning section.

To manually install an agent, run Kofax_RPA_ProcessDiscoveryAgent_10.6.0.0_<buildnumber>_x32.msi and follow the wizard steps.

**Note** Any previous version of the Process Discovery Agent is removed when you install a new version of the Agent.

The first time you run the agent after installation, the Process Discovery Agent configuration window is opened. Fill in parameters, such as Management Console URL, Process Discovery group name, and credentials to log in to the Management Console if necessary. Click Start Recording.

You can also perform a silent installation of agents for automating the installation process using a script file.

**Configure Process Discovery Agents**

To edit the agent settings, right-click the Process Discovery Agent icon in the notification area and select Configure. To open the help topic, right-click the Process Discovery Agent icon in the notification area and click Help.

**Silent installation of Process Discovery Agents**

You can perform a silent installation of agents for automating the installation process using a script file. To perform a silent installation of Kofax RPA Process Discovery Agent to the default location, run the following command with administrative rights:

```
msiexec /qn /I Kofax_RPA_ProcessDiscoveryAgent_10.6.0.0_<buildnumber>_x32.msi MCURL="mc_url" MCUSER="username" MCPW="password" GROUP="group"
```

Where "mc_url", "username", and "password" are a URL, a user name, and a password to connect to the Management Console, and "group" is the group name Created in the Management Console in the Process Discovery Groups section under Admin > Settings.

To specify a location to install the agent, run the following command:

```
msiexec /i Kofax_RPA_ProcessDiscoveryAgent_10.6.0.0_<buildnumber>_x32.msi MCURL="mc_url" MCUSER="username" MCPW="password" GROUP="group" INSTALLDIR="dir"
```

Where "dir" is the path where you want to install the agent.

To log the installation process, specify a log file:

```
msiexec /qn /i Kofax_RPA_ProcessDiscoveryAgent_10.6.0.0_<buildnumber>_x32.msi /l RAPamsilolog.txt
```

To start the agent after installation, specify the following command:
"start /d <installdir> KofaxRPAProcessDiscoveryAgent.exe"

Where <installdir> is the directory where the program is installed. If the INSTALLDIR option was specified during the installation, use its value for <installdir>.

Note To edit the agent settings, right-click the Process Discovery Agent icon in the notification area and select Configure. To open the help topic, right-click the Process Discovery Agent icon in the notification area and click Help

Use Kofax Analytics for RPA to analyze Process Discovery data

The Process Discovery views in the Kofax Analytics for RPA dashboard provides reports with information based on data collected by the Process Discovery Agents. The view includes a variety of visual and analytical representations of data using charts and tables. System administrators, business process managers, and other stakeholders use this interface to gain visibility into analytical information.

Important For correct display of data in the Insight dashboard, make sure Java correctly sets the time according to your time zone on RoboServers and computers running Management Consoles. See the Timezone Data Versions in the JRE Software on the Oracle website for the latest updates in time zones. If necessary, use the Oracle Timezone Updater Tool to update the time zone information.
Kofax Analytics for RPA

Kofax Analytics for RPA is an extension of Kofax RPA that produces a graphical business intelligence dashboard based on data collected while Kofax RPA robots and Process Discovery agents are working.

Kofax Analytics for RPA views are based on values from predefined Kofax records and metrics. When using the Dashboard Designer within Insight Studio to add custom views, do not modify the predefined views, records, or metrics that come with the product. You can make a copy of existing views and then customize the settings. For details, see the Kofax Analytics Project Customizations Application Note on the Kofax website.

Time zone settings

For correct display of data in the Kofax Analytics for RPA dashboard, make sure Java correctly sets the time according to your time zone on RoboServers and computers running Management Consoles. See the Timezone Data Versions in the JRE Software on the Oracle web site for the latest updates in time zones. If necessary, use the Oracle Timezone Updater Tool to update the time zone information.

Install and Configure Kofax Analytics for RPA

Follow the instructions in this section to perform a new Kofax Analytics for RPA 2.0 installation.

If you are upgrading from Kofax Analytics for Kapow 1.0, see Upgrade from the previous version.

Your Kofax Analytics for RPA product includes Kofax_RPA_KAFRPA_2.0.<version>_.zip, the project bundle file required to successfully import RPA components and built-in views.

SSL

If you initially perform the Kofax Analytics for RPA installation without SSL, you can switch to SSL later. You can switch to SSL by reinstalling Kofax Insight with the "Use Existing Database" option.
Installation and Configuration Checklist

The following checklist provides an overview of steps necessary to set up Kofax Analytics for RPA.

1. Check settings and set up if necessary the following parameters in Kofax RPA. The settings are located on the Admin > Settings tab in Kofax RPA Management Console.

   **For robot-run analytics**
   - RoboServer log database: Select Log to Database and specify database parameters.
   - Analytics database: Select Log the statistics to Analytics Database and specify database parameters.
   - Kofax Insight dashboards: Select Allow Dashboards and specify the URL of the Insight server as follows http://<insighthost>/Insight/View
   - Single sign-on: Select Use Single Sign-On and specify database parameters if you plan to use HTTP request authentication.

   **For Process Discovery analytics**
   Deploy Process Discovery. See Kofax RPA Process Discovery for details.

2. Create and configure Insight databases: admin, metadata, data, and SSO. See the "Databases" topic below.

3. Install Kofax Insight.

4. Import and configure your project.

5. Set up Kofax RPA Kapplets to connect to dashboard.

**Databases**

Use a new or existing database management system instance to create the following databases for use with Kofax Analytics for RPA:

- **Metadata**: Stores configuration information such as metric definitions and calculation logic. Assign a name such as rpa_analytics_meta.
- **Data**: Stores the processed records and metrics. You can assign any name, such as rpa_analytics_data.
- **Admin**: Stores Insight administrative data related to users, roles, filtering, alerts, logs, and more. Assign a name such as rpa_analytics_admin.
- **SSO**: Stores information required for using the HTTP Request Authentication. Assign a name such as rpa_analytics_sso.

We recommend that you use a consistent naming convention for each database, such as rpa_analytics_admin, rpa_analytics_meta, and rpa_analytics_data.

**Important** Please create and maintain all the Kofax RPA product databases according to the recommendations in the product documentation. If you are considering database modifications or customizations, do not proceed without consulting Kofax; otherwise, the results are unpredictable and the software may become inoperable.
For the Oracle database, all database schemas must already be in place before you proceed with the product installation.

**Note** If you use an Oracle database for collecting analytics data in Kofax RPA and specify the same database while upgrading to a new version of Kofax RPA, you must manually drop and create tables in the database. See the "RoboServer Log Database" and "Scripts for Creating Database Tables" topics in Kofax RPA help for information on creating database tables.

### Install Kofax Insight

Kofax Insight produces a graphical business intelligence dashboard based on robot-run data and data collected by Kofax RPA Process Discovery Agents.

For more detailed installation instructions, see the *Kofax Insight Installation Guide*.

**Important** Before starting the Insight installation process, install MySQL Connector/NET on the computer running Kofax Insight. You can download MySQL Connector/NET from the MySQL website.

1. Run the Kofax Insight installation file, such as `KofaxInsightSetup_6.1.0.0.0.1838_x64.msi`. The Insight build number is listed in the "Version information" section of the *Kofax Insight Release Notes*. Install Kofax Insight using the default options.

   When the installation wizard is complete, the **Completed the Kofax Insight Setup Wizard** window appears.

2. Click **Finish**. The Insight Installation Manager is started. If you clear the **Launch Insight Installation Manager** option before clicking **Finish**, you can start the Installation Manager later from the Start menu. Go to **Start > Insight 6.1.0 > Administration > Installation Manager**.

   The Installation Manager continues the installation process and helps you set up and configure Kofax Insight, such as the Insight admin database and other parameters. See the *Kofax Insight Installation Guide* for details.

Once the Insight installation is complete, the final screen of the Insight Installation Manager provides several options:

**Installation Completed**

The installation is finished successfully.

- **Manage Settings**
- **Admin Console**
- **Setup Kofax Analytics Project**
- **Exit**
To set up the dashboard project, click **Admin Console** and continue to the next section.

**Import and configure your project**

Use this procedure to set up your Kofax RPA dashboard project.

Note that by default Insight sets up the **User’s logins and passwords are defined within Insight platform. Users are explicitly linked to roles.** option for your project. You can change the type of authentication later.

1. Start Insight Admin Console.
   - If you have not closed the Insight Installation Manager, on the Installation Completed window, click **Admin Console**.
   - If you closed the Insight Installation Manager, navigate to **Start > All Programs > Insight 6.1.0 > Admin Console**.
2. Enter the login credentials for the Administrator that you specified during the Insight installation.
   If this is the first time you start the Admin Console, you are prompted to enter license information on the **License** tab.
3. In the navigation panel, click **Projects**, and then right-click and select **New Project**.
   The **New Project** window appears.
4. Type **Kofax_RPA** as the project name and click **OK**.
   The **Create New Project [Kofax_RPA]** window appears.
5. Click the **Import from file** tab, and then click **Select file**. Select **File is located on the client computer and will be copied to the server for processing**.
   The **File Upload** window appears.
6. Navigate to **Kofax_RPA_KAFRPA_2.0.<version>_.zip**, and click **Open**.
   Wait until the file is imported.
7. Set the database connection information for the Meta and Data databases.
   The database name field is automatically pre-filled with the project name and a database ending, such as **Kofax_RPA_meta**. Edit the name to suit your requirements. Note that the database name must not contain spaces.
   
     **Tip** If the server details are nearly the same for the Meta and Data databases, select **Same server as the meta database** to copy the entries from the **Meta** section into the **Data** section. After the entries are copied, be sure to update the database name in the **Data** section.
   
     Do not click **Connect** during this step, because the databases do not exist yet.
8. Click **OK** to import the project.
9. When prompted to confirm database creation, click **Yes** even if databases already exist. Insight creates the necessary tables in the database.
   An indicator appears on the screen while the project import is in progress.
   The built-in views, records, and metrics for Kofax RPA are added to your installation.
10. Expand the newly created project and verify that you have the following databases under Data Sources:
   - Data DB: Insight data warehouse
   - Analytics: Reporting database that you have configured in Kofax RPA
   - Logs: Log database that you have configured in Kofax RPA
   - erd_dean: Process Discovery database

To expand the project, click the arrow to the right of the project name.

11. Set parameters to connect to each of the databases by specifying the Server name, Database name, User and password. Click Connect to test the connection. The circular indicator turns green if the connection is successful.

   **Note** The analyzer database is set in the Kofax RPA Management Console on the Admin > Settings tab. Click Process Discovery Analyzer on the left of the Settings tab to see the database settings.

12. Click Save to save your configuration.

13. Expand Users and set passwords for the built-in users that can access Kofax RPA Viewer directly to view the reports. Click Save to save passwords. The following users are available:
   - KAFK: This user can access both Process Discovery and RPA dashboards.
   - RPA: This user can access only the RPA dashboard.
   - PD: This user can only access the Process Discovery dashboard.
   - KAFK_admin: This user is preserved for backward compatibility with version 1.0 and has similar rights as the Administrator.

14. Open Insight Studio by clicking Studio from the Insight Admin Console, or open a web browser and enter the following URL:
    
    http://<server>/Insight/Studio/

15. Expand Execution Plans and click Minute Plan for the imported Kofax RPA project.

    This plan is scheduled to load data every five minutes.

16. Click Data Load and do the following on the Date range tab:
    a. Select today's date and tomorrow's date to load and show data gathered today.
    b. Click Load Data.
       
       To load data collected during previous days, load data day by day instead of loading the entire time period. Loading data for more than one day increases the load and may prevent the program from loading data.

Once configuration is complete, you can start using the dashboard.

**Set up Kofax RPA Kapplets to connect to dashboard**

After you import and configure your project, open your Kofax RPA Kapplets, where the Main Navigation menu should contain the NEW DASHBOARD item. To create a new Kapplet with a connection to the Kofax RPA dashboard, click NEW DASHBOARD and specify necessary parameters. See the "Connecting to Kofax Analytics for RPA Dashboards" topic in the Kofax RPA Help for more details.
Upgrade from the previous version

Kofax Analytics for RPA is designed to use Kofax Insight 6.1 or later.

This is the recommended way of upgrading your Kofax Analytics version 1.0. Kofax Analytics for RPA 2.0 contains the same robot-run reports as version 1.0 and the built-in users are preserved for accessibility reasons.

1. Download a new version of Kofax Insight and upgrade your copy of Kofax Insight.
2. Import and configure the Kofax Analytics for RPA 2.0 project.
   After you complete the import procedure, you can view the Kofax Analytics for RPA 2.0 reports the same way as in version 1.0.

   Note To load data collected during previous time, load data day by day instead of loading the entire time period. Loading data for more than one day increases the load and may prevent the program from loading data.

For more information, see the "Upgrade Insight" chapter in the Kofax Insight Installation Guide. You can also consult Kofax support before performing an upgrade.

Windows Authentication

If you are using Windows user authentication, access to all Kofax Analytics for RPA databases must be given to the following:

1. User account used to perform the Kofax Analytics for RPA installation
2. Account/identity for the IIS application pool
3. Account/identity for the Insight Scheduler service

Configure Insight for Windows Authentication

Use the procedure in this section to configure Kofax Insight for Windows Authentication.

Before configuring Insight, select Windows authentication in IIS for the web application (default website).
1. Navigate to Start > All Programs > Insight 6.1.0 > Administration > Admin Console.

2. In the navigation panel, click Authentication.

3. Click the Authentication Method tab and select the following:
   a. User properties are obtained from the environment: Windows
   b. And then user roles and access rights are determined by comparing these values to: Fixed values

4. User identifier: Specify a way to get the user’s ID. The ID should be constant for a specific user’s login. Usually, it is a session property (Identity) that looks to the Active Directory domain and user name.
   a. In the navigation panel, click User mapping.
   b. On the User Mapping tab for User Identifier (UID), set the "Session property" to Identity.

5. Set session properties for User Name and Email.
   a. On the User Mapping tab for User Name, set the "Session property" to FullName. User Name is the display name of a user account. Usually, it is one of the Active Directory properties, such as Identity, name, FullName, displayName or another convenient property. Your Domain Admin can provide all available Active Directory properties.
   b. On the User Mapping tab for Email, set the "Session property" to EmailAddress. Email is the email address of the user account. It is used for self-subscriptions only. Usually, it is the Active Directory property mail or EmailAddress. Your Domain Admin can provide you with all available Active Directory properties.

Mapping Roles

Roles define a set of predefined Admin settings such as the theme, date format, etc. Also, roles define specific access rights to projects and dashboard views. It's necessary to describe mapping rules for each role. Usually, the Active Directory property memberOf is used. In the sample illustration, users with the Active Directory property memberOf, including the admin, are assigned to the KAFK admin role. Your Domain Admin can provide you with all available Active Directory properties.

Each row in the mapping grid uses the AND operand. If multiple roles on the Roles list match conditions for a user account, the access rights are merged from all matching roles, while other settings (such as the theme or date format) are assigned by the top matching role on the list.
Set Up HTTP Request Authentication

Perform the following steps to authenticate Kofax Analytics for RPA users as Insight users.

1. Open the Kofax RPA Management Console.
   a. Navigate to Admin > Settings.
   b. Select Kofax Insight Dashboards in the left pane, click Allow Dashboards and specify the Insight server URL in the form host:port/Insight/View.
   c. Select Single Sign-On, click Use Single Sign-On and specify a Single Sign-On database to be used by Kofax Insight.
   d. Navigate to Kapplets > KappZone and click the KappZone URL.
   e. In the KappZone, on the Main Navigation Menu, click New Dashboard.
   f. Specify the dashboard name and click Create Dashboard.
   g. Click the Publish switch.
   h. Navigate to KappZone again and click Install for the created dashboard.

Once you set up the HTTP Request authentication in Insight, you can open the Insight View by opening the dashboard that you created.

Note that password-protected login must be enabled in the Management Console and you must be logged on to the Management Console to be able to use SSO.

2. Navigate to Start > All Programs > Insight 6.1.0 > Administration > Admin Console.
   The Insight Admin Console page appears.

3. Enter login information and click OK.
   
   Note The default user name is Administrator, which uses the password you specified during the Insight installation.

4. On the navigation panel, click Authentication.
   a. Select View in the Application list.
   b. Click HTTP Request and External database.
5. On the navigation panel, click and expand **Connections**. Verify that **SSOConnection** is selected.

6. In the **Connection Option** group, complete the entries as applicable to your SSO database that you set up in the Kofax RPA Management Console.

7. Click **Save**.

Kafka view role is automatically assigned to all users that log in using Single Sign On. If you want to switch back to the default authentication, select **User's logins and passwords are defined within Insight platform. Users are explicitly linked to roles.** in the **Authentication** settings.

---

### Use Kofax Analytics for RPA

With Kofax Analytics for RPA, you can view the data retrieved from your Log and Analytics databases in an interactive dashboard through the **Viewer**.

The Kofax Analytics for RPA dashboard consists of several built-in views. Each view has graphical elements and other components to analyze data in your Kofax RPA database.

**Viewer**

Use the Viewer to display the dashboard views included in your Kofax Analytics for RPA project. These views include a variety of visual and analytical representations of data using charts and tables. System administrators, business process managers, and other stakeholders use this interface to gain visibility into analytical information.

Note that Viewer data is updated every five minutes.

**Open the Viewer**

Depending on the authentication method, the procedure for opening the Viewer may vary. Follow the procedure in this section, depending on the authentication type.

**Note** The recommended monitor resolution is 1280x1024.
Insight Users Authentication
Do one of the following to open the Viewer:

- Navigate to Start > All Programs > Insight 6.1.0 > Viewer.
- Open a web browser and enter the following URL:
  
  http://<server>/Insight/View/

  where <server> is the name of your server.

  A login window appears. Enter one of the user names (KAFK, RPA, or PD) and a password set for this user in the Insight Admin Console. Click Login. Note that only one of the above-mentioned users can access the Viewer directly. See Import and configure your project for user configuration details.

**Note** Be sure to verify that the website's binding host name is set to blank or localhost in your IIS settings. Otherwise, a login error may occur.

To ensure proper viewing, verify the proper Authentication Method setting in Insight Admin Console. The "No authentication" setting is not supported and may produce errors or unexpected results in the browser window. For details, see Import and configure your project.

Also, if Main is not selected as the default view for the role associated with the user who is logging in, the following error may appear:

You can specify view name parameter in Admin Tool

Resolve the issue by setting Main as the default view.

Windows Users Authentication
Do one of the following to open the Viewer:

- Navigate to Start > All Programs > Insight > Viewer.
- Open a web browser and enter the following URL:
  
  http://<server>/Insight/View/

  where <server> is the name of your server

  Be sure to verify that the website's binding host name is set to blank or localhost in your IIS settings. Otherwise, a login error may occur.

HTTP Request Authentication (SSO)
After you set up the HTTP request authentication and create a Kapplet with a connection to the Kofax Analytics for RPA, open your Kapplets and click Open in the Kapplet that connects to Kofax RPA dashboards.

See the Kofax RPA help for details.

Viewer screen layout and navigation

**Toolbar Menu**
Use the menu to access different views, such as RPA and Process Discovery as well as different reports in the selected view. Use additional user-level items to bookmark frequently used views and log out.

**Context Menus and Chart Options**
Right-click a chart or grid to access more options such as Reset, Pivot, Zoom in, View, and Metric grid format. The options vary, based on the chart type or area where you right-click.
RPA views

**RPA view filters**
You can filter the reports by the time in the **Time Period** list and by RoboServers where robots run in the **RoboServer** list.
Process Discovery views

Process Discovery filter input
Filter the results by the Process Discovery group name and date.
Select a group name in the Process Discovery Group list. If you select No filter, information for all groups is displayed in the view.

Use the Viewer
While working with the Viewer, you can do the following:
• Click any Project, Robot, or Schedule name in the list to drill down to activity details.
• Manipulate and interact with any component on the dashboard.
• Hover over a point in a graph to view details.
• Double-click any graph name to expand it to the full browser window.
• Click and drag to the side any graph name to switch to the list view and back.
• Select the period for the statistics in the Time Period list.
• To restore default values in filters, click Reset Filters.
Export to Excel

On any grid with Export to Excel functionality, you can set preferences for exporting the content of the grid to Microsoft Excel.

1. On a grid with Export to Excel enabled, click Export to Excel. The Export to Excel window appears.

2. Select an Export content option:
   • Current page and top drill down
   • All pages of a grid. top drill down level. Could take some time.
   • All pages of a grid, all drill down levels. Could take much longer.

3. Select an Export format option:
   • Unformatted XML file, readable by Excel
   • Formatted Excel file
   • Unformatted CSV file
   • Unformatted TSV file

4. Optionally select Enabled to use a flat export, which retains granular details for drill down or expandable data.

5. Click OK and when prompted, save or open the .xml file.

Kofax Analytics for RPA views

This section gives you information about each view provided in your Kofax Analytics for RPA project. You can interact with and manipulate different objects on the view to get detailed information. Kofax Analytics for RPA provides RPA views and Process Discovery views.

RPA views

RPA views provide Kofax RPA analytics information.

• Overview
• Clusters
• Projects
• Schedules
• Heatmaps

Overview

The Overview provides a graphical representation of Kofax RPA system performance parameters, so that you can quickly see capacity bottlenecks or system utilization issues. You can filter the data by selecting a period in the Time period list and selecting a Roboserver in the Roboserver list. The percentage on tiles shows a difference between the selected period and the same period preceding the selected one. For example, if you select "Last hour" as the time period, the percentage shows the difference between the
last hour and an hour preceding it. Note the triangle next to the value points down if the value decreased and points up if the value increased.

- For API Calls, Scheduled runs, Extracted records, HTTP requests, and Mb loaded: The percentage is green if the value is more than zero, indicating the value has increased.
- For KCU, KCU wait time, Robot runs with errors, and Missed schedules: The percentage is green if the value is less than zero, indicating the value has decreased.
- The CRE graph shows the total number of executed robots and the number of robots that were executed concurrently on a Kofax RPA RoboServer.

Click a tile with this symbol to view network details.

**KCU Health**

KCU (Kofax RPA Compute Units) Health is calculated based on two metrics: one for API calls and one for Schedules. For details about KCU, see “Kofax RPA Compute Units” in the *Kofax RPA Installation Guide*.

The KCU health for API calls is calculated based on KCU wait time from robot runs.

- The KCU health becomes Yellow if the maximum KCU wait time for a robot run is more than one second.
- The KCU health becomes Red if the average KCU wait time for a robot run is more than one second.

The KCU health for schedules is drawn from the statistics as follows: zero base is 2 seconds per minute, and the peak limit is 10 seconds per minute.

- The KCU health becomes Yellow if 10% of the data points have a KCU wait that exceeds the peak limit, or if 50% of the data points have a KCU wait that exceeds the zero base.
- The KCU health becomes Red if 50% of data points have KCU wait that exceeds the peak limit, or if 90% of data points have a KCU wait that exceeds the zero base.

**Clusters**

This view provides a graphical representation of Kofax RPA system performance parameters on a cluster level. The CPU and Memory graphs show average usage for all RoboServers in a cluster.

RoboServer names change color depending on the last activity as follows.

- Green: If the value is greater than 60 seconds.
- Orange: If the value is greater than or equal to 60 seconds, and less than 5 minutes.
- Red: If the value is greater than or equal to 5 minutes, and less than 1 day.
- Gray: If the value is greater than or equal to 1 day.

You can filter the results by selecting a RoboServer in the list. When you select a RoboServer, the CPU and Memory graphs show minimum, maximum and average usage.

**Projects**

This view provides an overview of robot health in your projects by displaying a graphical presentation of key robot-run metrics. You can identify and fix robots that are not performing as expected.
**Robot Health and Color**

Robot health is calculated based on three values: errors count, execution time, and extracted records. For each robot run for a selected period, a mean and deviation is calculated. If all values fall into mean plus/minus deviation, the robot run is Green. Otherwise, the robot run becomes Red.

If all robot runs of a robot are Green, the robot health is Green. If one or more, but not all robot runs are Red, the robot health is Yellow. If all robot runs are Red, the robot health is shown as Red.

**Schedules**

This view provides a graphical presentation of the number of concurrent schedule runs, which offers an overview of the load distribution on your system.

To see the details of a Schedule run, select a schedule and click **Details** in the **Schedules** pane. You should see the Schedules details window.

**Schedule Health and Color**

Schedule health is calculated based on three values: error count, execution time, and extracted records. For each schedule run for a selected period, a mean and deviation are calculated. If all values fall into mean plus/minus the deviation, the schedule run is Green. Otherwise the schedule run becomes Red.

If all schedule runs of a schedule are Green, the schedule health is Green. If one or more, but not all schedule runs are Red, the schedule health is Yellow. If all schedule runs are Red, the schedule health is shown as Red.

**Heatmaps**

The RPA dashboard provides color-coded heatmaps for robot runs and schedule runs. The threshold value for a heatmap is specified in the **Enter critical status threshold** option above the report. When you hover your mouse over the report, the number of runs appears in cells. The following colors are available.

<table>
<thead>
<tr>
<th>Color</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Above the specified threshold</td>
</tr>
<tr>
<td>Orange</td>
<td>Above three-quarters and up to the specified threshold</td>
</tr>
<tr>
<td>Yellow</td>
<td>Above half and up to three-quarters of the specified threshold</td>
</tr>
<tr>
<td>Green</td>
<td>Up to the half of the specified threshold</td>
</tr>
</tbody>
</table>

**Process Discovery views**

Process Discovery views are reports with information based on data collected by the Process Discovery agents.

The following reports are available in the Process Discovery views.

<table>
<thead>
<tr>
<th>View</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>Provides a summary of all data gathered by agents to the specified database.</td>
</tr>
<tr>
<td>View</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Grouped sessions</td>
<td>Shows duration of sessions in hours drilled down by applications present in each session. A session represents a user activity period. A session starts when an agent starts receiving user actions. If an agent does not receive any actions during the specified time, the session is marked as complete. A new session is opened the next time the agent records a user action. An interval between the end of one session and the beginning of a new one is specified for each group in Analytics advanced settings on the Admin &gt; Settings tab in the Kofax RPA Management Console.</td>
</tr>
<tr>
<td>Sessions grouped by application</td>
<td>Shows duration of sessions (in hours) containing the selected application.</td>
</tr>
</tbody>
</table>
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\Kofax RPA\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.RollingFileAppender

#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 Kofax RPA installation folder (where the Kapowtech-common.jar and platform.jar are located). For example, mysql-connector-java-8.0.16.jar. Use the latest available version of the driver for your Java. For more information, see https://repo1.maven.org/maven2/mysql/mysql-connector-java/.

2. Create a database table where you want to log the data to. The following is a MySQL script for creating tables:

```sql
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:

```properties
#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.

Important The timestamp format used in the example above is not universal. The correct processing of the query depends on the database type and the time format used in the database. Make sure timestamp format meets the database requirements.

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-8.0.16.jar. Use the latest available version of the driver for your Java. For more information, see https://repo1.maven.org/maven2/mysql/mysql-connector-java/.

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, there is a login event 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

Kapplets 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

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 = -1-9-67f2087bbebb 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 = -1-1-67f2087bbebb task id = 1 has requested to start
2015-11-27 16:34:24        INFO      admin run Robot f1/f2/f3/Wait60 robot 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 = -1-2-67f2087bbebb task id = 2 has requested to start
2015-11-27 16:35:56        INFO      admin run Robot Wait60 with id = 17 task id = 2 from REST
```

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 9

SQL Scripts for Kofax RPA Tables

The SQL scripts for creating and dropping tables in your database are located in the documentation\sql directory in your Kofax RPA installation directory. For example, C:\Program Files (x86)\Kofax RPA 10.6.0 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 Kofax RPA 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.

```sql
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_CALENDARS;
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 QRTZJOBDETAILS;
```